THE PHENOMENAL STORM OF JANUARY 25-26, 1978

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1. INTRODUCTION

New record low sea-level pressure, sustained blizzard conditions, and intense cold accompanied and followed a rapidly moving low-pressure center through the southern Appalachians, eastern Ohio Valley, and across Lake Erie into Canada. New records may also have been set for three-hourly pressure falls and rises accompanying an inland extratropical storm. Stations east of the Appalachians reported near-record warmth and even tornadoes. Heavy rains in the east, falling on a deep snow cover, produced widespread localized flooding.

2. SURFACE ANALYSES

Figures 1 and 2 show aviation observations, fronts, and isobars at 0300 and 0900 GMT, respectively, during the period of maximum storm intensification. Symbols are the same as those used on the Daily Weather Maps.* During this period the central pressure of the low dropped 14 millibars (mb). A very cold air mass to the west was rapidly being drawn into the storm's circulation, undoubtedly playing an important role in the intensification process.

Note that six-hour temperature drops exceeded 25° in Kentucky, Indiana, and Ohio, 20° in South Carolina, and rises of almost 20° occurred in Pennsylvania. Temperatures reached 70° as far north as Virginia at 0700 GMT (more typical of a July night), while gales swept subzero readings into Illinois, Indiana, Iowa, and Missouri. Lack of space precludes showing hourly surface analyses.**

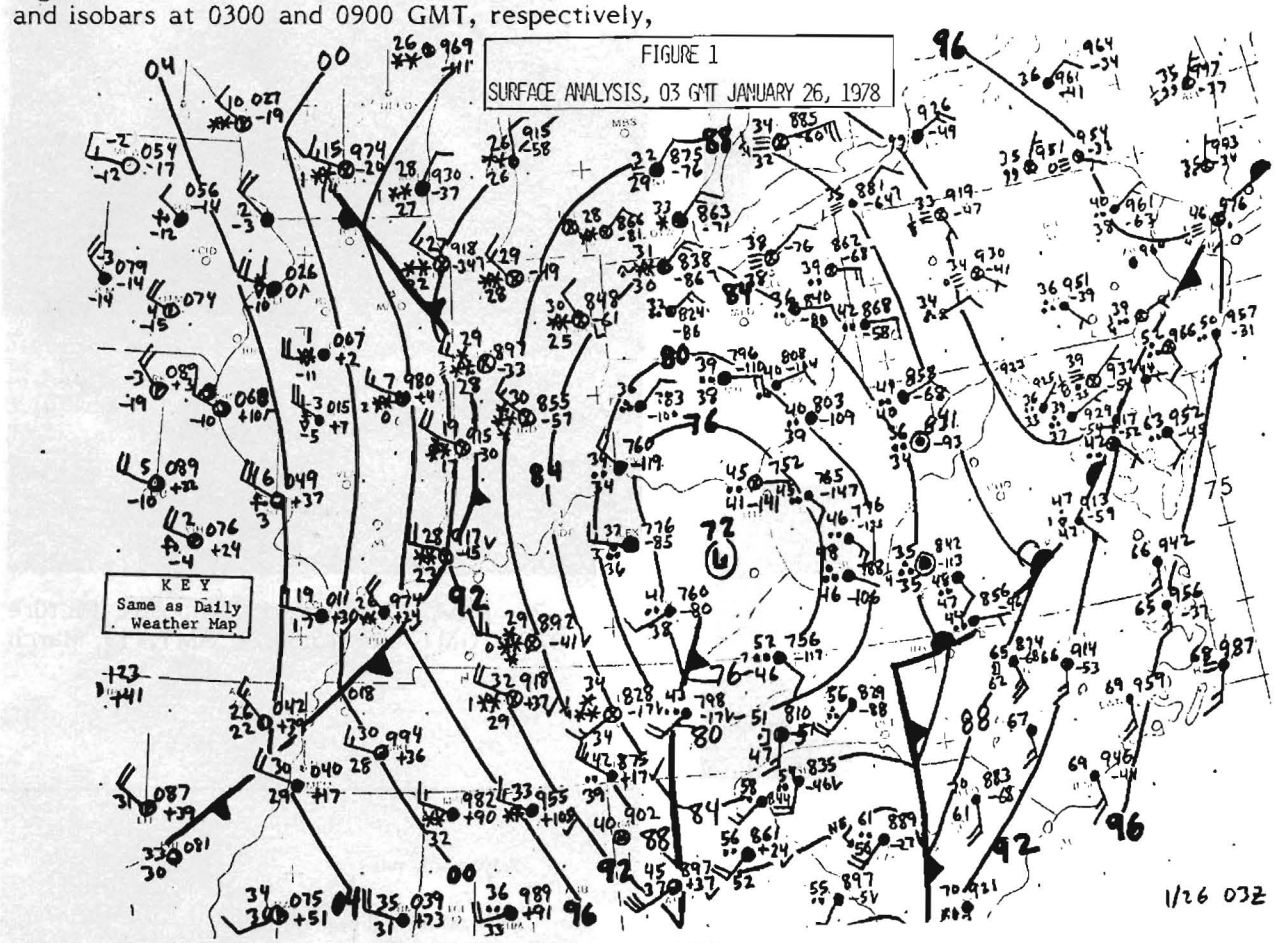

Figure 1. Surface Analysis, 0300 GMT, 26 January 1978.

*Daily Weather Maps, Weekly Series, U.S. Department of Commerce, NOAA Environmental Data Service.

**Hourly surface analyses and various other charts may be obtained free by writing Thomas Blackburn, W1x5, NOAA National Weather Service, Silver Spring, MD 20910.

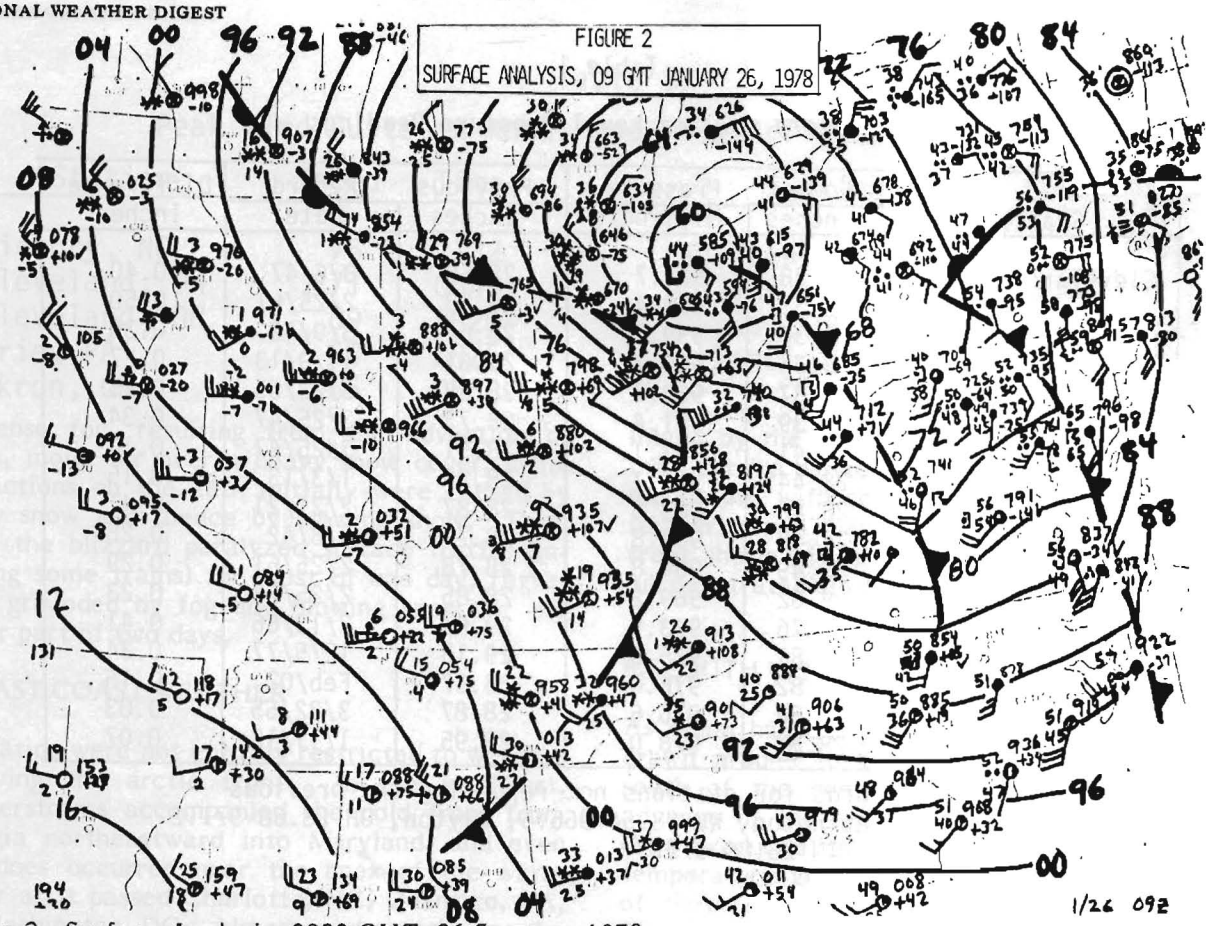

Figure 2. Surface Analysis, 0900 GMT, 26 January 1978.

3. PRESSURE AND PRESSURE CHANGE

Pressure-tendency plots in Figures 1 and 2 show 3-hourly falls and rises exceeding 14 and 12 mb ahead and behind the low center, respectively. With the possible exception of New England and the Pacific Northwest, 3-hourly falls and rises exceeding 16 mb are probably new records for the 48 states for extratropical cyclones. (Maps showing the greatest 3-hourly rises and falls are available from the author.)

Many all-time record low barometric pressure readings were established, as shown in Table 1. Note that Cleveland's lowest pressure (28.28" or 957.7 mb) is a full .40 inch (13 mb) lower than the previous record of 28.68 set on March 6, 1947.

Figure 3 shows the lowest sea-level pressure (SLP) in mb reported in the eastern U.S. on 25-26 January. Station plots show SLP in mb and tenths, with the time of occurrence (GMT). Also plotted are the positions and lowest central pressures of the major low center and a smaller wave on the eastern front (isobars drawn at four mb intervals). All low centers were moving at about 40 knots.

4. FRONTS AND ASSOCIATED WEATHER AND WINDS

The first low to form, on the morning of the 25th, was in eastern Virginia, accompanied both by moderate rain and by pressure falls as great as 8.8 mb/3 hrs. The warm front ahead of this low brought sudden temperature rises, averaging over 20°F. Southwest of (behind) the low center a stationary front remained, and marked the dividing line between temperatures in the upper 30's and mid 60's. Perhaps, by more than coincidence, this front lay along the southeastern edge of a heavy snow cover. Richmond, VA was briefly in the warm air at 1800 GMT. When temperatures shot up to 63°F, but then dropped to the mid 40's with the cold front passage two hours later.

Figure 4 shows the hourly progress of the two most important weather-producing fronts. Also shown are the lowest SLP on the arctic front and the greatest two-hour temperature rises and falls accompanying frontal passage. The most precipitous fall was 30°F at Canton Akron Airport, OH. The lowest pressure along the arctic front dropped even faster than the central pressure of the main low, indicating the front rapidly being drawn closer to the center of the low. The severe blizzard conditions behind this low closed virtually all highways and claimed at least 70 lives. States of emergency were declared in Kentucky, Ohio, Indiana, and Michigan. Table 2 shows a sampling of the peak-wind gusts (knots) following this and the southeastern front, and Table 3 the number of hours in which the visibility was 1/4 mile or less. Visibility restrictions on the 25th were attributed

Table 1

New Record Low Sea Level Pressure Readings

Station	Lowest Pressure Inches	Lowest Pressure Millibars	Previous Record Inches	Record Date	Difference Inches
Cleveland, OH	28.28	957.7	28.68	3/6/47	0.40
Akron, OH	28.33	959.4	28.83	2/25/61	0.50
Detroit, MI	28.34	959.7	28.64	3/9/42	0.30
Erie, PA	28.34	959.7	28.61	11/9/13	0.27
Flint, MI	28.37	960.7	28.82	3/22/55	0.45
Youngstown, OH	28.39	961.4	28.73	3/25/47	0.34
Buffalo, NY	28.41	962.1	28.51	3/25/47	0.10
Syracuse, NY	28.44*	963.1	28.29	1/3/13	-0.15
Columbus, OH	28.46	963.8	28.87	2/21/21	0.41
Toledo, OH	28.49	964.8	28.77	3/8/42	0.28
Pittsburgh, PA	28.49	964.8	28.78	2/25/61	0.29
Elkins, WV	28.62	969.2	28.85	2/25/65	0.23
Bristol, TN	28.76	973.9	29.07	2/13/66	0.41
Cincinnati, OH	28.81	975.6	29.15	12/5/77	0.34
Lexington, KY	28.82	976.0	28.97	Feb/02	0.15
South Bend, IN	28.84	976.6	28.87	3/22/55	0.03
Knoxville, TN	28.88	978.0	28.95	1/11/18	0.07

Additional records for stations not reporting the previous record were Huntington, WV 28.54 966.5, Dayton, OH 28.68 971.2 and Fort Wayne, IN 28.80 975.3.

* No record.

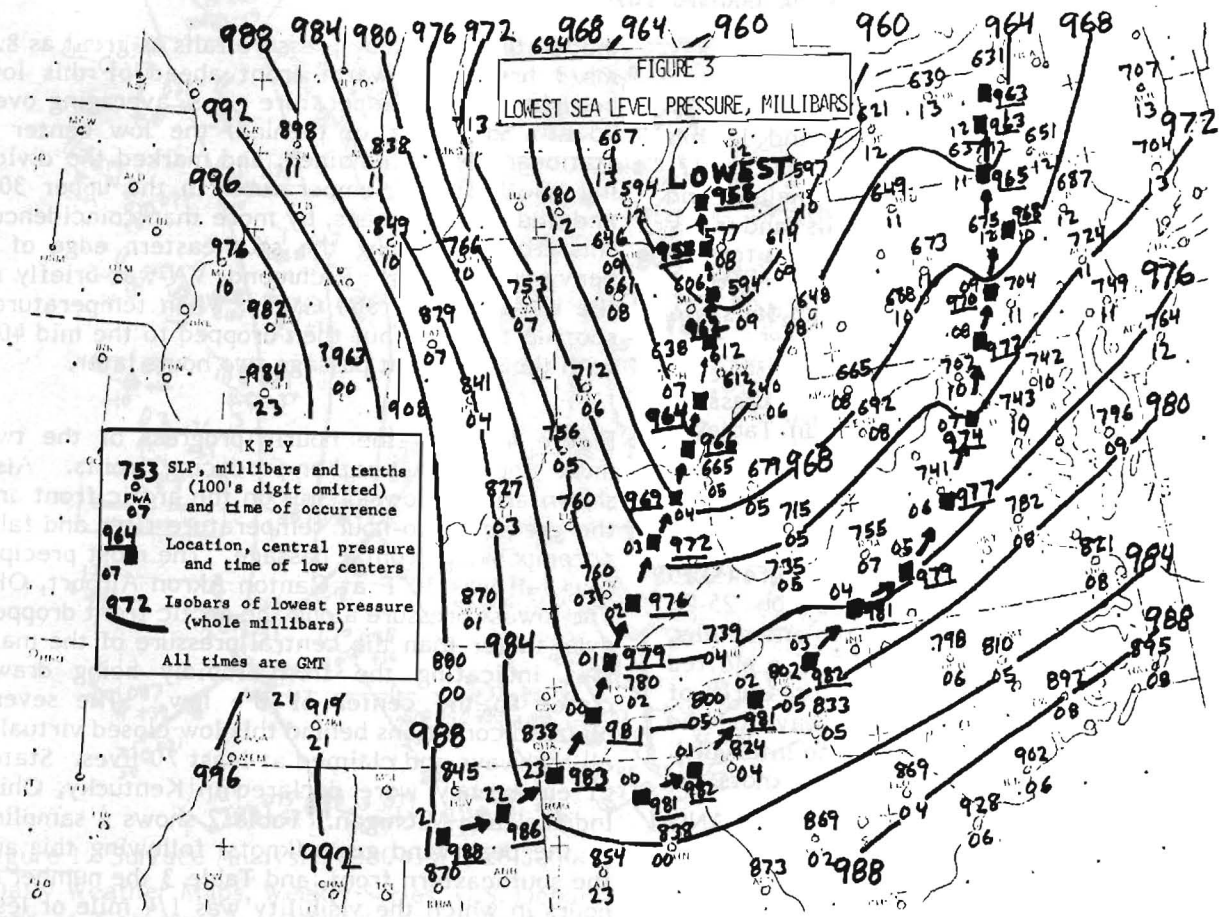

Figure 3. Lowest Sea-Level Pressure Observed During the Storm.

Table 2

Peak Wind Gusts in Knots and Times of Occurrence, GMT

Station	Speed	Time	Station	Speed	Time
Hickory, NC	75	2132	Spartanburg, SC	60	0031
Cleveland, OH	71	0540	Columbus, OH	60	0330
Cleveland, OH	69	0820	Dayton, OH	60	0752
Erie, PA	68	0825	Atlantic City, NJ	60	0501
Akron, OH	66	0552			

to dense fog, resulting from the advection of warm, moist air over a heavy snow cover, while restrictions on the 26th initially were caused by heavy snow and thence by blowing snow. Thus, while the blizzard paralyzed surface traffic (including some trains) for most of one day, flights were grounded by fog and blowing snow for the better part of two days.

5. EAST COAST WEATHER

Dramatics were not entirely restricted to weather following the arctic front. In the southeast, thunderstorms accompanied the cold front from Georgia northeastward into Maryland, and even tornadoes occurred near the apex of the warm sector as it passed Charlotte, NC, Quantico, VA, and Washington, DC. Almost as dramatic was the distance to which warm, Atlantic air was brought inland by the warm front. Normally, the mountains form a barrier that traps cold air east of the mountains, with coastal fronts failing to advance farther inland than the position of the stationary front shown in Figure 3. But in this case, warm air penetrated almost into central Pennsylvania.

6. SOUTH BEND'S REVERSE FRONT

As often happens in intense storms, warm air is drawn around to the north and cold air to the south of the center. In this storm, the rapid advance of the arctic front through Indiana and Ohio produced an extremely intense north-south temperature gradient through the northern parts of these states, with the cold air to the south. This part of the front remained almost stationary for several hours through the town of South Bend,

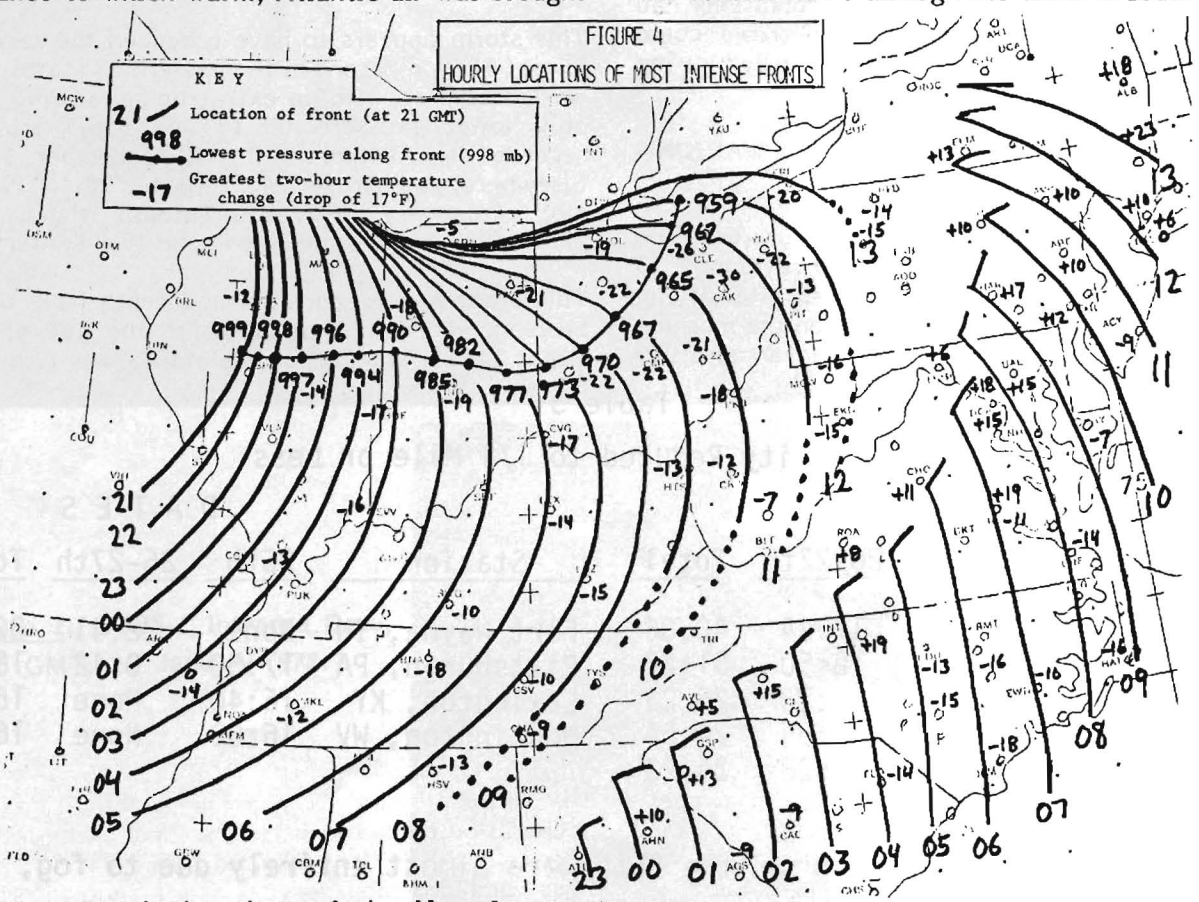

Figure 4. Hourly locations of the Most Intense Fronts.

IN. For one hour (10-1100 GMT) the front actually moved a few hundred yards to the north of the South Bend airport (located northwest of the town), dropping the temperature from 30 to 25°F with a windshift from WNW to W. By the next hour the wind was again WNW as the temperature climbed to 31. A north-south temperature gradient of about one degree per two miles and wind-chill factor gradient approaching one degree per mile persisted for hours south of South Bend, as Fort Wayne's temperature held steady at 6°F with a 35-kt wind from the WSW and zero visibility due to blowing snow. At 1000 GMT the Findlay, OH, temperature was 12°F with 45-kt gusts, while 50 miles to the north, Toledo reported 30°F. By 1400 GMT Toledo's temperature had plunged to 9, vs. 31 at Detroit and 3 at Findlay.

7. RAPID MODERATION FOLLOWING STORM

The storm's circulation was so intense that by midday (1800 GMT) of the 26th, the coldest air had already been drawn into eastern Ohio, and 12 hours later temperatures in Indiana and Ohio had risen 10-15°F from their lows. At Cincinnati, for example, readings dived below zero at 13 and 1400 GMT, but climbed to 13°F above by 0200 GMT. By this time, the Ohio Valley's "storm of the century" was weakening rapidly as it accelerated eastward through Canada. Blizzard conditions gradually slackened. By the following day conditions had calmed enough that snow-removal crews could plow snow from roads without it promptly blowing back.

8. NWS FORECAST AND WARNING ACCURACY***

Automated forecasts issued by the Limited Fine Mesh II Model (LFM II) Monday evening, 23 January, correctly predicted that an intensifying low would be over the Great Lakes on the morning of the 26th. Forty-eight hours in advance, a 989 mb low was progged to be near Erie, PA for 1200 GMT of the 26th. By the evening of the 24th, major cyclogenesis with blizzard conditions were predicted to begin over the Great Lakes by the evening of the 25th, with very heavy snow over Lower Michigan.

While the LFM II underforecast the deepness of the low-pressure area's central pressure, associated weather events were forecast with almost uncanny accuracy. Heavy-snow warnings were issued 12 to 18 hours in advance from the Ozarks to northern Ohio, and blizzard warnings 8 to 10 hours ahead of the onset in Indiana, Illinois, and Ohio, and 2-4 hours in advance in Michigan. South Bend, IN recorded 21.2 inches of new snow. Farther east, flash-flood watches were issued as early as January 24, and changed to warnings the following day, as widespread areas received over two inches of rain on top of the heavily snow-covered ground.

NWS employees suffered from the blizzard along with the general public. One employee worked continuously for 24 hours at Fort Wayne, while observers in Mansfield and Akron, OH, and Indianapolis, IN were on duty for 36, 32, and 48 hours, respectively, including several hours without heat in Mansfield.

9. CONCLUSIONS

This storm appears to have produced the second-lowest SLP on record in the eastern 48 states that was associated with an extratropical storm. The only lower pressure (28.14" or 956.3 mb)was recorded at Eastport, ME, 16 December 1916. Elsewhere, Anchorage, AK, reported 28.14" (952.9 mb) in January 1948, and Tatoosh Island, WA, 27.69" (937.7 mb) sometime in the 19th century.

This storm's snow duration and depth have often been exceeded in local areas to the Lee of the Great Lakes, but January rainfall amounts in the

Table 3

Hours Visibility Reduced to 1/4 Mile or Less

	DATES				DATES		
Station	25th	26-27th	Total	Station	25th	26-27th	Total
Cincinnati, OH	22:42	17:24	40:06	Fort Wayne, IN	None	22:41	22:41
Dayton, OH	12:37	18:50	31:27	Pittsburgh, PA	17:50	0:42	18:32
Cleveland, OH	7:00	18:23	25:23	Lexington, KY	16:40	None	16:40
South Bend, IN	None	24:54	24:54	Huntington, WV	16:00	None	16:00
Columbus, OH	8:55	15:28	24:23				

Restrictions to visibility on the 25th were almost entirely due to fog, vs. blowing snow on the 26-27th.

***Compiled by Richard Coleman, Public Services Branch, NWS, Silver Spring, MD.

east have seldom been matched where Washington's total of 2.03" in 24 hours was second only to 2.13" in 1976.

Excellent forecasts and warnings were issued for nearly all severely affected areas, and we can only speculate as to whether the relatively large number of weather-related deaths were due to inadequate local warning dissemination, failure to hear or heed warnings, or merely to the fact that the storm was so severe and covered such a large area.

RECORD MAKING SNOWSTORMS OF 1978

Two major snowstorms occurring within a week of each other, paralyzed much of the northeastern portion of the country in late January and early February.

The first storm system developed on the 25th of January (see article by Blackburn). AT 0130 GMT, 26 January, Figure 1, cloudiness from this deepening system covered most of the states east of the Mississippi River. Snow was reported from southern Missouri northeastward to Ohio at this time; heavy rains were reported south of this area. By 1230 GMT, the thick, convective cloudiness was located off the Mid-Atlantic Coast and across New England and New York state. Cyclonically-curved middle and low clouds, stretching from (A to B) continued to produce sonw over the Great Lakes states. The strong winds accompanying this storm reduced visibilities and drifted snow, making travel impossible.

The second storm moved rather slowly. It began to develop late on the 5th of February and produced light snow through the Mid-Atlantic states. Eastward progress of this coastal storm was blocked, and the storm became nearly sta-

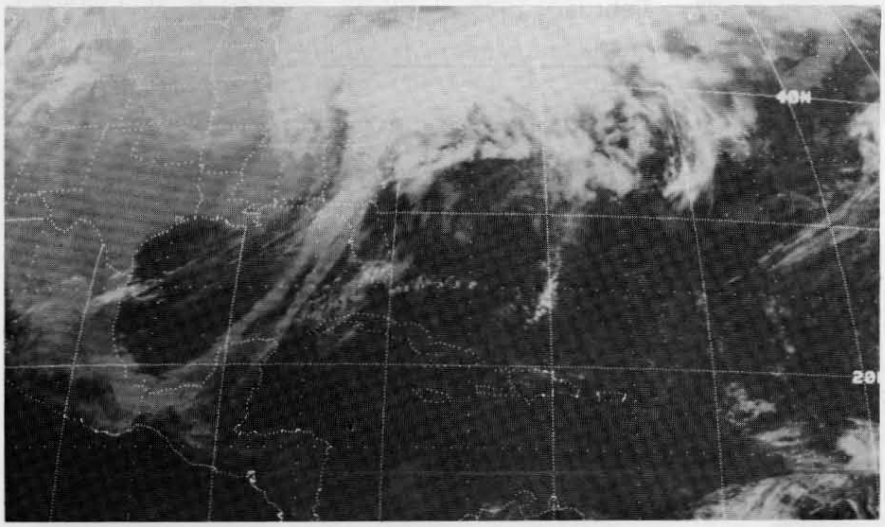

Figure 1. GOES-1 Infrared Data, 0130 GMT, 26 January 1978.

Figure 2. GOES-1 Infrared Data, 1230 GMT, 26 January 1978.