

Five kite flights were made at Ellendale, N. Dak., from 8:33 a. m., January 24 to 5:05 a. m., January 25. It was impossible to continue the series, as a sixth flight reached an altitude of only 350 meters above the surface, due to diminishing wind velocities. In all of these flights easterly winds prevailed to the highest altitudes reached. Pilot balloon ascensions at Ellendale on the 24th, likewise indicated easterly winds with decreasing velocities in the higher levels up to 3,600 meters and 3,400 meters for the a. m. and p. m. observations, respectively. In both cases the balloons burst before they had reached the A.St. cloud layer which was observed to be moving from the SW. On the morning of the next day, however, clouds were observed here as follows: 6/10 Ci.St., E., 1/10 A.St., E., and 2/10 A.Cu., E. The balloon during this run burst at the 3,500-meter level and indicated easterly winds to this height.

Four kite flights were made at Royal Center, Ind., from 8:16 a. m. to 9:30 p. m., January 26, and easterly winds were found at all altitudes reached. On the morning of the same day A.St. clouds were observed moving from the east but unfortunately the pilot balloon was obscured by the instrument tower when the 2,500-meter level was reached. The afternoon balloon run indicated an easterly wind to 4,000 meters shifting to north-northeast at 4,800 meters when the balloon was observed to burst.

At Lansing, Mich., the easterly winds were not of such great depth as at Ellendale and Royal Center. The afternoon balloon run of the 26th indicated northeast to south-east winds from the surface to 1,500 meters, then shifting through north to west and northwest to 8,000 meters, at which altitude the balloon was lost to view.

The cause of these easterly winds at high altitudes is made apparent by an examination of the free-air temperatures observed at Drexel and Ellendale. Figure 1 shows that on the morning of the 24th there was a large temperature difference at the surface, but that up to 2,500 meters practically isothermal conditions prevailed at Drexel, whereas there was a large inversion at Ellendale, the result being that in the upper levels the horizontal temperature gradient between the two stations was comparatively slight. The effect of this temperature distribution on the free-air pressures is shown in Table 2.

TABLE 2.—Free-air pressures at Ellendale, N. Dak., and Drexel, Nebr., on the morning of Jan. 24, 1921.

Station.	Altitude (meters) above sea level—							
	500	750	1,000	1,250	1,500	2,000	2,500	3,000
Ellendale.....	mb. 970.7	mb. 939.8	mb. 909.6	mb. 880.3	mb. 852.6	mb. 800.5	mb. 751.6	mb. 704.7
Drexel.....	962.6	932.8	904.2	876.7	850.0	798.5	750.0	704.3

It will be noted that the pressures at Ellendale remain higher than those at Drexel up to 3 kilometers. It is apparent, though, that a reversal occurred at a slightly greater altitude than this—a condition favorable for westerly winds, and this is in agreement with the observed northeastward movement of the A.St. clouds.

By the morning of the 25th the easterly winds extended to a still greater height, as shown by the pilot balloon and upper-cloud observations made at that time. Comparison of free-air temperatures in this case is not possible, owing to the relatively low altitude reached at Drexel, but it is to be noted that the daily weather map shows on this day a weaker latitudinal temperature grad-

ient than on the preceding day, and it is to be presumed that a correspondingly weak gradient prevailed in the upper levels. The same statement and deduction may be made with respect to the easterly wind that extended at least to 5 kilometers on the afternoon of the 26th at Royal Center. An isothermal condition existed during all four kite flights at Royal Center but because there

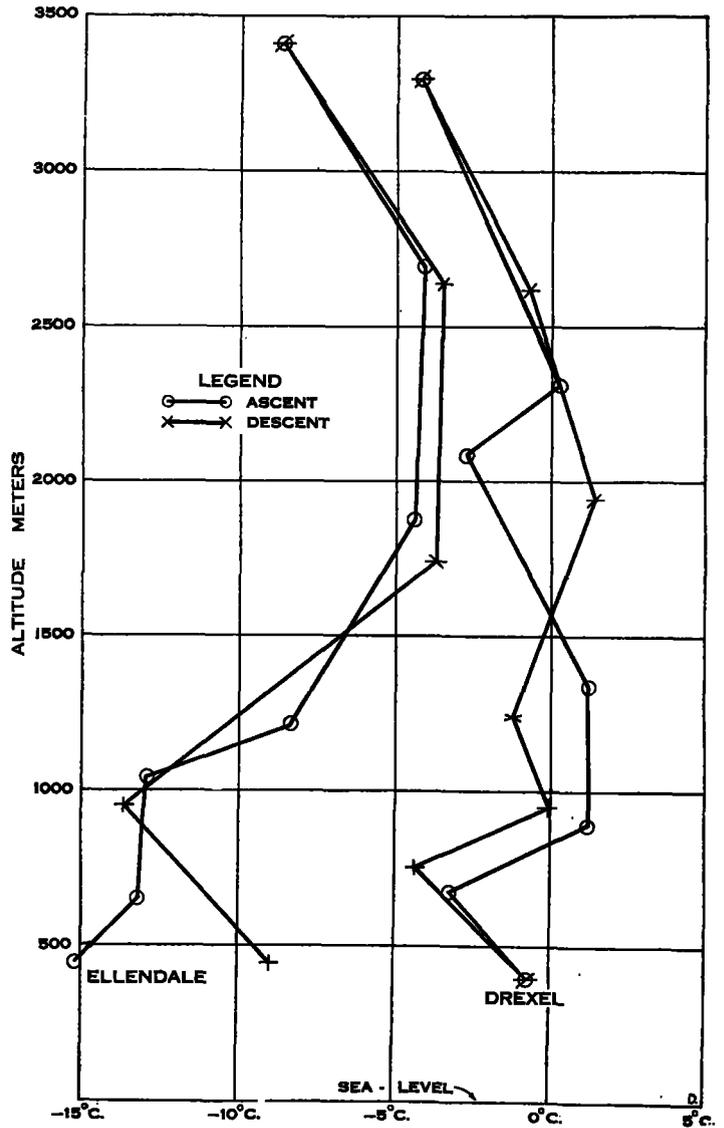


FIG. 1.—Simultaneous free-air temperatures, °C., at Ellendale, N. Dak., and Drexel, Nebr., on the morning of Jan. 24, 1921.

are no kite stations within a reasonable distance to the south, actual comparisons can not be made.

551.578.4 (756)

ICE STORM AND GALE OF JANUARY 25-27 AT WILMINGTON, N. C.

By R. M. DOLE, Observer.

[Weather Bureau, Wilmington, N. C., Jan. 30, 1921.]

The morning map of January 25 showed an oval depression in eastern Kansas which had moved to Mississippi by night and become a round and weak LOW surrounded by abnormally high pressure. The isobars were rather far apart, but the range in pressure and temperature to the northeastward was large, pressure being over 30.6

inches over the Lakes. Temperature in New England was near zero, while it was above 60° F. along the Gulf coast.

The alto-stratus clouds moving from the west the night of the 25th were typical, showing the presence of warm currents aloft running ahead of the low. The shape of the depression and its enveloping high pressure were indicative of heavy snow in the northwest quadrant and sleet through its axis running southwest to northeast. Wilmington was in the northeast quadrant. Sleet fell from 7:08 p. m. to 7:14 p. m., a short pelting of ice particles (sleet) only, while at 10:05 p. m. a mixture of sleet and rain fell, continuing all night and until 1:05 p. m. of the 26th. This was caused by a cold inflowing current near the land surface from the cold, high pressure area to the northeastward. This was proved by the fact that the precipitation fell partly as rain and partly as ice particles (sleet), the chilling taking place at the lower level, otherwise it would have been snow as in the western and central parts of the State. The lowest temperature was 26° F. at 10 a. m. of the 26th.

On the morning of the 26th everything was loaded down with an icy covering measuring four-tenths of an inch, part sleet and part frozen rain. The whole landscape was as if encased in cut glass or as if candied. The weight bore down weak telegraph and telephone poles and many branches of trees, but luckily the precipitation was very light and intermittent, the sleet amounting to 0.05 of an inch and rain 0.10. The damage from the frozen coating was surprisingly small locally but considerable some distance around.

Glimpses of the upper clouds on the 26th showed an extremely slow movement of the alto-stratus clouds from the south, and as the warmer overhead currents became more established the temperature rose above freezing after 6 p. m. By 10 p. m. rain began heavily and continued steadily, washing away and melting the ice coating. The wind increased to a gale after midnight of the 27th, accompanied by occasional bright lightning over the Gulf Stream with heavy but distant detonating thunder, which lasted from 11 p. m. of the 26th to 6:25 a. m. of the 27th. The total precipitation was 3.07 inches.

By careful watching, the alto-stratus clouds on the 27th at sunset were observed to be moving from the unusual direction of southeast and extremely slowly. The direction of these clouds, the heavy rain and mild temperature of the 27th seemed to be explained by a strong overhead current of warm air, mixing with the surface wind and raising the temperature below, for only a few miles north there was snow with a temperature around 20° F. and below freezing at localities farther south. The pressure was irregular, up and down, a great struggle going on, as if the low pressure were trying to move north or northwest, but was being prevented by too strong a high pressure. The rain and strong gusts came as the pressure dipped and as the wind backed, but slackened as the pressure rose. Although the low pressure was forced very slowly out to sea, yet it ate up the strength of its stronger opponent.

The highest wind in the city as recorded by the station anemometer was 38 miles an hour from the northeast at 9:54 a. m. of the 27th, while fishermen and boat captains estimated it as 60 miles or more at the beach, stating that it was one of the roughest and highest winter seas in many years. The winds were noticeably gusty and caused peculiar whirls like waterspouts in the Cape Fear River similar to ones observed by the captain of the cutter *Seminole* on the Pacific coast. The beach, which is one of the finest in the Southeast, underwent a terrific

bombardment, the combination of high tides and great rollers cutting into some of the sand dunes at the northern end. These bulwarks of defense were sliced into as by a snowplow, and the sand on the beach was pounded hard like a cement floor. Concrete piers, iron pipes, stoves, beds, and even a large brick oven were carried like chips up the beach, showing the enormous force of the tide and breakers. The beach has undergone severe pounding before, but not for a good many years has it been subjected to such a test. The damage was considerable to property, but not beyond repair. It is believed that wind and tide will build up the beach as it has done before, and steps have been taken to permanently preserve it by means of jetties at strategical points.

551.510.4 (782)

DUST CLOUD OVER DREXEL, NEBR., JANUARY 15, 1921.

By H. L. CHOATE, Observer.

[Weather Bureau, Drexel, Nebr., Jan. 25, 1921.]

That haze is sometimes produced by dust aloft was proved at this station on January 15, 1921. Although the air near the surface remained clear, the kite flight of that date showed evidence of a considerable dust cloud between 900 meters and 2,200 meters above ground.

In making the flight 3,100 meters of wire were reeled out. This wire was wiped clean as it came off the reel. The flight was delayed by engine trouble and the kites remained stationary for over an hour at the farthest point out. They were then reeled in slowly by hand. There was, therefore, a long period of time in which dust could accumulate on the wire and kites. On reeling in, a fairly heavy coating of light brown dust was found on the wire from 1,800 meters to the head kite. When rubbed off with the fingers, this dust felt smooth like clay, showing that the particles were very fine.

By computing the height of the wire at 1,300 meters (the difference between 1,800 meters and 3,100 meters) it was found that the lower limit of the dust-laden air was about 900 meters above ground. The dust cloud probably extended above this point a few hundred meters. Its upper boundary could not be determined exactly because the kites were reeled in so slowly that dust would accumulate on the wire even though the air at the higher levels remained clear. The kites were partially obscured when about 1,000 meters high and became nearly invisible after reaching 1,500 meters.

Cirro-stratus [really dust (?)] clouds from the northwest covered the sky throughout the flight. These clouds were creamy white in color and their outlines were indistinct.

In the following table are given the free-air data for the flight of January 15, 1921.

Time (90th Mer.).	Surface.			Aloft.			
	Temperature.	Humidity.	Wind.	Altitude.	Temperature.	Humidity.	Wind.
	° C.	Per ct.	m. p. s.	Meters. ¹	° C.	Per ct.	m. p. s.
8:04 a. m.	-7.6	91	SSE. 6.3	400	-0.3	46	SSW. 14.5
8:14 a. m.	-7.5	92	SSE. 5.3	1,000	4.2	38	W. 17.6
8:28 a. m.	-7.7	91	SSE. 5.3	1,800	-1.8	56	NW. 14.5
8:45 a. m.	-7.2	86	SSE. 4.4	2,200	-6.8	78	NW. 29.0

¹ Altitude above ground.

The above record shows that a temperature inversion of 11.7° C. occurred at the 1,000 meter level. The dust probably occurred in this inversion and for a short distance above and below. Above the inversion the