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.

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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	1,600	−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

temperature fell at nearly the adiabatic rate for dry air. The state of stable equilibrium below the inversion point would probably tend to confine the greater part of the dust to a stratum of air of limited depth.

The morning weather map of January 15 showed a trough-shaped LOW extending from British Columbia to Kansas, with the lowest sea level pressure, 29.35 inches, at Helena, Mont. The pressure was also low, 29.2 inches, over the Gulf of St. Lawrence. Between the two LOWS was a ridge of relatively high pressure extending from east of Winnipeg to the Gulf of Mexico. Temperatures in this HIGH were low, ranging from −10° F. north of the Great Lakes to 40° F. along the eastern Gulf coast. Cheyenne, Sheridan, Rapid City, and Denver reported temperatures close to 50° F. with wind velocities between 20 and 34 miles an hour. Stations in Iowa reported zero temperatures. There was, therefore, a difference in temperature between the eastern and western stations of about 50 degrees.

Kansas and the eastern half of Nebraska had received precipitation within the preceding 48 hours. Undoubtedly the ground was wet for several hundred miles west and southwest of the station. This condition would prevent the formation of dust in the vicinity of Drexel. It is believed that the high wind drove the dust into the air somewhere along the eastern slope of the Rocky Mountains, probably in Colorado or Wyoming. The altitude of Denver, Colo., is about 1,200 meters greater than that of Drexel. As the warm air flowed east along the gradient of the LOW it moved into a region of lower temperature. This condition compelled the warm west wind to blow above the colder south wind without mixing with the latter. The dust cloud, therefore, passed over this station at practically the same altitude above sea level as that at which it originated.

Such a condition is often observed in the lower strata at this station in connection with smoke clouds. It usually occurs as the lower wind blows from an easterly direction immediately after the passage of a high pressure area. Smoke from the city of Omaha, about 20 miles east-southeast of Drexel, can then be seen moving toward the station in a thin sheet a few hundred meters above ground. Kite flights made under these conditions always show a temperature inversion from the ground to some altitude above the upper surface of the smoke.

FURTHER EVIDENCE AS TO THE WESTERN ORIGIN OF DUST WHICH FELL IN CENTRAL STATES, FEBRUARY 12–15, 1919.

In an article on "The Great Cyclone of Mid-February, 1919," in the October MONTHLY WEATHER REVIEW (pp. 582–586) there was a brief discussion of the character of the dust collected at Des Moines, Iowa, samples of which had been examined by Mr. Jacques W. Redway of Mount Vernon, N. Y. Since the publication of that article, Mr. Redway has written to the author telling of further examinations which he has made. He says, in part: "It was not until I had received the last of half a dozen samples that I was enabled to designate its character. The last sample, which was coarse, showed that the substance was magnetic oxide of iron, Fe_3O_4, and not metallic iron. In other samples the substance so closely resembled smeltery dust that I was deceived. The dust was very clearly from the Rocky Mountains." The article above referred to stated that it was probable that the small iron particles were of local origin, perhaps from foundries in the vicinity.—*C. L. M.*

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THE OBSERVATION OF DUST FALLS.

By ERIC R. MILLER.

[Presented before the American Meteorological Society, at Chicago, Dec. 28, 1920.]

[Author's abstract.]

Observation of the frequence and extent of dust falls and collection of the dust for examination are important services that the meteorologist can render the geologist, soil physicist, and plant pathologist.

Questionnaires sent out on the occasion of dust falls brought replies indicating that less than 10 per cent of the official and cooperative observers had noticed the dust.

This paper describes the appearance of rain and snow containing dust, and suggests methods of separating the dust without destroying living organisms, driving off volatile constituents, or contaminating the sample.

DISCOLORATION OF SNOW IN NORTHERN NEW YORK.

That the atmosphere in northern New York is very clean is proved by the pure whiteness of the snow, even after it has remained on the ground for a long time. At Alexandria Bay, where only hard coal is burned and there is no railroad closer than 6 miles and no factories closer than 30, there is no reason why the snow should be other than dazzling white. However, for all this, it has often come to my notice that there is a faint brownish tinge to the snows that come with the south and west winds when the temperature is near or a little above the freezing point, making a strong contrast with the extreme whiteness of the snows which are brought with the cold northerly and northeasterly winds. For instance, we will have a snow from the north, then a few days later there will be a rise in temperature with southerly or westerly winds, and with it snowfall. This snow has a dirty appearance as it lies upon the snow that fell before it. It is not always that snow with these winds is discolored. Is it not possible that the discoloration of the snow is due to the higher temperature at which it is formed? This brownish snow is generally in very large flakes and often mixed with snow pellets or soft hail (graupel), while the snow from the north is of finer texture and drier. As far as the eye can observe the brownish snow seems as clean as the other. I am curious to learn the cause of this phenomenon.—*Douglas F. Manning.*

DISCUSSION.

There would seem to be no reason to expect a difference in color on account of any difference in the crystals or the amount of water they may have. The most obvious explanation that suggests itself is that the smoke from the industrial cities south and southwest of Alexandria Bay makes the snow dirty, crystallization taking place perhaps directly on the smoke particles, and thus bringing them to the ground. On rare occasions the snow there may be discolored by dust carried from the Great Plains. A chemical analysis of this "dirty" snow would be interesting, and would reveal the cause of its discoloration.—EDITOR.

NOTE IN REGARD TO THE CLINGING QUALITIES OF SNOW.

Other things being equal, the clinging quality of snow will depend upon the form of the snowflake. This was exemplified at Binghamton, N. Y., on February 11, 1921.