

AEROLOGICAL OBSERVATIONS

By L. T. SAMUELS

Negative temperature departures, many of unusually large magnitude, occurred at all stations and levels. (See Table 1.) At Ellendale and Royal Center, the two northernmost stations, the departures continued large to the highest levels.

Free-air relative humidities, as might be expected with subnormal mean temperatures, averaged mostly above normal, especially at Ellendale and Royal Center and the vapor pressures practically all below normal.

It is surprising, in view of the low temperatures, to note in Table 2 that in many cases the free-air resultant wind direction for the month contained a greater south component than normal. This is particularly pronounced at Broken Arrow, Due West, and Royal Center. The resultant velocities were appreciably less than normal from the surface to 2,500 meters at all stations, except Royal Center and Washington where they were slightly in excess of the normal.

The following is taken from the report of the official in charge, Broken Arrow:

A fully developed thunderstorm passed over Tulsa and Broken Arrow between 1:30 a. m. and 2:30 a. m. on the 19th. Precipitation evidently formed at a considerable height near the top of a marked inversion shown on the kite records of the 18th and 19th. The total precipitation was not great, 0.06 inch. Part of it was hail, about the size of peas; part of it sleet, hard particles of various sizes, and there may have been some water droplets. However, there was no evidence of glaze the following morning. The thunderstorm passage was followed by light snowfall, with light flurries until 12:20 p. m.

Conditions favorable for strong convection at altitudes above 2,000 meters are strikingly shown by these kite records. Temperatures at Broken Arrow on the 19th rose with increasing altitude from -11° C. at the ground to slightly above freezing at 2,200 meters. The temperature fell at the rate of 0.4° C. per 100 meters for the next 500 meters, where the flight ended. It is probable that with further increase in altitude a superadiabatic lapse rate prevailed in view of the fact that a solid layer of A Cu clouds was observed through a break in the St clouds at 11:11 a. m.

This condition was the accompaniment of a strong triangular-shaped anticyclone having its center over Sioux City, Iowa, and straight isobars along its front extending in a NE.-SW. direction. Winds at Broken Arrow at the time were N. and NNE. from the ground to 1,000 meters, above which they gradually backed to WSW. at the maximum altitude (2,664 meters). Sleet was reported at several stations along the front of this HIGH on the same morning. On the preceding morning (18th) when the front of the HIGH had just reached the Broken Arrow region, NNE. surface winds were overrun by southerly winds from 1 to 3 km.

It is significant to note that ice formed on the kite wire and meteorograph on the 18th when the temperatures within the St cloud layer ranged from 3° C. to -8° C., whereas no ice formed on the 19th when the temperatures within the clouds were all below -8° C.

Conditions favorable for the formation of ice on the kite wire occurred at Groesbeck on the 8th when surface winds from the NNE. incident to an oncoming HIGH veered to ESE. at 1,350 meters, the maximum altitude. A strong temperature inversion prevailed from 500 meters to the maximum altitude with temperatures ranging from -6.4° C. to 8.6° C. The air was saturated from the ground to the highest level and the kite wire was heavily coated with ice when it was reeled in. A fine mist changed to heavy sleet when the flight ended.

TABLE 1.—Free-air temperatures, relative humidities, and vapor pressures during February, 1929

TEMPERATURE ($^{\circ}$ C.)												
Altitude m. s. l.	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)		Washington, D. C. ¹ (7 meters)	
	Mean	De- parture from normal	Mean	De- parture from normal	Mean	De- parture from normal	Mean	De- parture from normal	Mean	De- parture from normal	Mean	De- parture from normal
Meters												
Surface	-2.9	-7.8	5.1	-3.0	-15.7	-6.0	3.2	-6.6	-6.0	-4.5	-0.8	-3.2
250	-3.0	-7.8	5.0	-2.9	-----	-----	2.9	-6.5	-6.2	-4.5	-1.9	-3.2
500	-3.8	-7.5	4.9	-2.0	-15.6	-6.9	2.7	-5.9	-7.5	-4.0	-2.6	-3.2
750	-3.7	-6.7	4.3	-1.9	-14.2	-4.9	3.3	-5.0	-8.0	-3.8	-3.1	-2.7
1,000	-2.8	-5.6	3.3	-2.1	-13.6	-5.0	4.6	-3.6	-8.6	-4.1	-3.4	-2.2
1,250	-2.4	-4.9	2.3	-2.2	-13.7	-5.6	4.8	-2.9	-8.9	-4.0	-4.4	-1.8
1,500	-2.5	-4.4	1.2	-2.4	-13.6	-5.6	4.2	-2.7	-9.4	-4.0	-4.9	-1.6
2,000	-3.3	-3.6	-0.4	-2.1	-14.6	-5.2	2.7	-2.2	-11.0	-4.2	-6.1	-1.8
2,500	-5.4	-3.4	-2.3	-1.6	-17.1	-5.4	0.3	-2.2	-13.0	-4.3	-8.1	-1.9
3,000	-7.4	-2.8	-3.9	-0.8	-19.5	-5.1	-1.6	-1.7	-15.1	-3.9	-10.8	-1.8
3,500	-9.8	-2.7	-----	-----	-21.9	-4.8	-3.5	-1.2	-18.1	-4.1	-----	-----
4,000	-11.7	-1.9	-----	-----	-24.5	-4.8	-5.1	-0.4	-21.9	-4.7	-----	-----
4,500	-----	-----	-----	-----	-28.7	-6.1	-8.1	-0.7	-26.0	-5.2	-----	-----

RELATIVE HUMIDITY (%)												
Surface	78	+9	73	+4	83	+2	85	+11	83	+5	70	0
250	78	+9	72	+3	-----	-----	81	+9	83	+5	68	0
500	76	+10	65	0	83	+3	71	+3	84	+6	64	-1
750	71	+9	59	-3	80	+6	63	0	80	+5	60	-4
1,000	63	+6	60	-1	78	+9	55	-2	77	+7	58	-6
1,250	60	+6	55	-5	77	+12	53	-1	72	+7	56	-7
1,500	59	+7	53	-5	75	+14	51	+1	68	+7	54	-7
2,000	49	+2	50	-5	70	+12	48	+3	61	+6	48	-7
2,500	45	0	42	-11	74	+16	49	+6	62	+9	43	-8
3,000	42	-2	37	-13	76	+19	45	+4	62	+8	37	-13
3,500	35	-8	-----	-----	76	+21	44	+5	64	+10	-----	-----
4,000	33	-10	-----	-----	76	+22	42	+6	67	+12	-----	-----
4,500	-----	-----	-----	-----	71	+18	42	+10	85	+23	-----	-----

VAPOR PRESSURE (mb.)												
Surface	3.98	-2.26	7.23	-0.77	1.58	-1.01	7.10	-2.39	3.47	-1.05	4.14	-1.11
250	3.95	-2.24	7.14	-0.74	-----	-----	6.66	-2.40	3.43	-1.02	3.74	-0.96
500	3.62	-1.85	6.57	-0.50	1.59	-0.95	5.84	-2.31	3.08	-0.85	3.30	-0.96
750	3.44	-1.40	5.93	-0.63	1.72	-0.67	5.34	-2.06	2.77	-0.81	2.92	-0.96
1,000	3.19	-1.20	5.54	-0.60	1.70	-0.61	4.99	-1.62	2.54	-0.69	2.70	-0.88
1,250	3.12	-0.86	4.56	-1.03	1.61	-0.61	4.62	-1.30	2.29	-0.57	2.46	-0.80
1,500	3.01	-0.56	3.79	-1.21	1.53	-0.54	4.28	-0.88	2.07	-0.49	2.28	-0.70
2,000	2.25	-0.56	2.64	-1.30	1.32	-0.41	3.68	-0.34	1.61	-0.42	1.87	-0.55
2,500	1.81	-0.50	1.75	-1.34	1.10	-0.32	3.30	+0.05	1.34	-0.34	1.41	-0.48
3,000	1.51	-0.37	1.52	-0.85	0.92	-0.19	2.77	+0.08	1.10	-0.26	0.86	-0.57
3,500	1.23	-0.34	-----	-----	0.76	-0.09	2.64	+0.42	0.88	-0.19	-----	-----
4,000	1.09	-0.21	-----	-----	0.65	-0.02	2.58	+0.81	0.78	-0.07	-----	-----
4,500	-----	-----	-----	-----	0.45	-0.09	2.54	+1.20	0.80	-0.01	-----	-----

¹ Naval Air Station.

TABLE 2.—Free-air resultant winds (m. p. s.) during February, 1929

Altitude m. s. l.	Broken Arrow, Okla. (233 meters)				Due West, S. C. (217 meters)				Ellendale, N. Dak. (444 meters)				Groesbeck, Tex. (141 meters)				Royal Center, Ind. (225 meters)				Washington, D. C. (34 meters)			
	Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal	
	Dirac- tion	Vel- locity	Dirac- tion	Vel- locity	Dirac- tion	Vel- locity	Dirac- tion	Vel- locity	Dirac- tion	Vel- locity	Dirac- tion	Vel- locity	Dirac- tion	Vel- locity	Dirac- tion	Vel- locity	Dirac- tion	Vel- locity	Dirac- tion	Vel- locity	Dirac- tion	Vel- locity	Dirac- tion	Vel- locity
Meters																								
Surface	N. 27 W.	0.8	N. 80 W.	0.5	S. 72 E.	0.7	S. 80 W.	1.3	N. 40 W.	2.2	N. 48 W.	3.2	N. 27 E.	2.2	N. 73 W.	0.5	S. 52 W.	1.9	S. 80 W.	1.9	N. 37 W.	1.2	N. 48 W.	1.5
250	N. 35 W.	0.6	N. 63 W.	0.4	S. 66 E.	0.8	S. 80 W.	1.4	N. 47 W.	2.0	N. 52 W.	3.4	N. 41 E.	2.4	S. 76 W.	0.6	S. 45 W.	2.3	S. 78 W.	2.2	N. 41 W.	4.2	N. 61 W.	3.4
500	S. 38 W.	0.5	S. 56 W.	0.8	S. 1 E.	2.1	S. 78 W.	3.1	N. 83 E.	1.9	S. 45 W.	1.0	N. 83 E.	1.9	S. 45 W.	1.0	S. 63 W.	4.2	S. 68 W.	4.0	N. 51 W.	6.4	N. 66 W.	5.3
750	S. 38 W.	0.8	S. 58 W.	1.9	S. 34 W.	2.9	S. 78 W.	4.2	N. 56 W.	2.6	N. 57 W.	4.5	S. 61 E.	0.7	S. 54 W.	2.3	S. 73 W.	5.4	S. 71 W.	5.7	N. 57 W.	7.8	N. 66 W.	6.8
1,000	S. 28 W.	1.6	S. 67 W.	2.8	S. 54 W.	3.8	S. 83 W.	5.6	N. 62 W.	3.6	N. 56 W.	5.3	S. 21 W.	1.8	S. 63 W.	3.5	S. 77 W.	7.8	S. 80 W.	7.0	N. 54 W.	8.9	N. 69 W.	8.1
1,250	S. 47 W.	2.6	S. 85 W.	3.8	S. 65 W.	6.0	S. 84 W.	7.3	N. 62 W.	4.6	N. 57 W.	6.3	S. 47 W.	2.7	S. 73 W.	4.5	S. 77 W.	8.9	S. 95 W.	8.0				
1,500	S. 65 W.	4.2	S. 89 W.	4.7	S. 65 W.	7.9	S. 87 W.	9.4	N. 65 W.	4.6	N. 60 W.	7.2	S. 81 W.	3.2	S. 78 W.	5.8	S. 83 W.	10.5	W.	9.3	N. 60 W.	8.9	N. 68 W.	11.6
2,000	S. 74 W.	6.1	N. 86 W.	6.6	S. 73 W.	10.8	S. 87 W.	12.4	N. 62 W.	7.1	N. 62 W.	9.4	S. 77 W.	5.5	S. 86 W.	7.4	S. 80 W.	12.3	N. 86 W.	11.4	N. 69 W.	10.9	N. 70 W.	11.9
2,500	S. 83 W.	9.3	N. 85 W.	7.8	S. 77 W.	18.3	W.	14.4	N. 64 W.	10.4	N. 63 W.	11.4	S. 88 W.	7.1	S. 87 W.	8.8	S. 84 W.	13.7	N. 85 W.	13.0	N. 85 W.	11.8	N. 74 W.	15.0
3,000	S. 85 W.	9.5	N. 83 W.	9.7					N. 70 W.	12.8	N. 65 W.	12.7	N. 89 W.	12.0	S. 86 W.	10.8	S. 89 W.	15.5	N. 88 W.	13.9	N. 80 W.	13.0	N. 76 W.	15.0
3,500	S. 76 W.	11.7	N. 73 W.	10.9					N. 76 W.	13.7	N. 68 W.	13.0	N. 78 W.	15.3	W.	11.8	S. 86 W.	16.4	N. 88 W.	15.8	N. 87 W.	16.2	N. 76 W.	16.9
4,000	N. 87 W.	12.0	N. 74 W.	11.0					N. 58 W.	12.4	N. 67 W.	13.8	N. 80 W.	15.6	N. 88 W.	11.9	S. 88 W.	19.0	S. 86 W.	15.3	N. 85 W.	19.0	N. 78 W.	18.2
4,500									N. 68 W.	16.9	N. 68 W.	15.4	N. 68 W.	15.0	N. 84 W.	12.7	S. 68 W.	21.0	S. 76 W.	19.4	N. 78 W.	21.6	N. 76 W.	18.0
5,000									N. 68 W.	18.0	N. 85 W.	17.0	W.	17.0	N. 70 W.	10.5					W.	20.0	N. 89 W.	16.2

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WEATHER IN THE UNITED STATES

THE WEATHER ELEMENTS

By P. C. DAY

GENERAL CONDITIONS

Like the first month of the year, February, 1929, continued colder than normal over most parts of the country and decidedly so in the northern districts from the Great Lakes westward, particularly in the far Northwest, where in some localities the month, as a whole, was the coldest of record for February, and over many other sections it stands as the second coldest February in more than 50 years.

It was also a notable month for the depth of the accumulated snow and the length of time it remained on ground over portions of the upper Mississippi Valley and near-by areas. The month was also among the wettest of record for February in a few of the Southeastern States and the driest in the far Northwest.

PRESSURE AND WINDS

The atmospheric pressure showed no unusual conditions, save the anticyclone persisted rather steadily over the Plateau area during the early part of the month and cyclones were rather frequent during the latter part over the eastern and southeastern sections.

Cold weather prevailed at the beginning over most central districts and was advancing eastward with sharp changes to colder in the Gulf States and lower Ohio Valley and a change to warmer was overspreading the northern Rocky Mountains and Plains States. Within a few days the weather became somewhat settled and steady cold existed in most northern districts.

By the morning of the 6th a cyclone had moved from the central Rocky Mountains to the middle Gulf coast and general rains had overspread the Gulf and South Atlantic States, and local snows, mostly light, had occurred over a wide area from the middle Rocky Mountains northeastward to the upper-Lakes. By the morning of the 7th the eastern precipitation area had moved to the southern New England coast and important rains had occurred over the near-by areas while light snow continued in the western areas, the precipitation extending during the following day into the central and southern parts, the snow becoming very general in the Lake region and changing to sleet in portions of the southern Plains.

This precipitation area extended during the 9th and 10th into most eastern districts and was followed by mostly clear to fair weather for several days.

During the 15th to 17th considerable rain occurred over the Gulf and South Atlantic States and light snows occurred at the same time over a considerable area along the northern border from the Rocky Mountains to the Great Lakes, extending southward to the Great Plains and Ohio Valley during the following day or two, and finally changing to rain over most districts from Texas and the Gulf States northeastward at the beginning of the third decade, the precipitation becoming heavy on the 21st and 22d and changing to snow or sleet along the middle Atlantic coast and to the northward.

During the early part of the month local precipitation prevailed in the middle and southern portions of the more western districts, but in the far Northwest there was little or no important precipitation until after the end of the second decade, and even after that time the precipitation in this region was light and generally local.

By the morning of the 24th a cyclone had developed over the southern Rocky Mountains and precipitation had occurred during the preceding 24 hours over the North Pacific coast and southeastward to Wyoming and Colorado. On the 25th the precipitation area had extended to the lower Mississippi Valley and by the next morning the center of the storm area had moved to Wisconsin and rain had overspread much of the country from the Mississippi Valley eastward, the falls becoming heavy in portions of the lower Mississippi and Ohio Valleys. During the 27th this rain area passed off the Atlantic coast, and another had advanced to the west Gulf coast, which during the last day moved northeast to the Carolinas, attended by heavy rains along the South Atlantic coast and by local snows over the northern portions of the precipitation area. At the same time other areas of low pressure had moved to the southern Plains and southern Rocky Mountain regions and precipitation was threatening over the entire Gulf region at the end of the month.

The averages of pressure and departures from normal and the changes in pressure from the preceding month are shown on Chart VI, and on the insets to Charts II and III, respectively, and the more important facts concerning the high winds of the month appear in the table at the end of this section.