AEROLOGICAL OBSERVATIONS

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A striking example of a marked increase in free-air temperatures while winds remained northwesterly throughout the period was revealed by the morning kite records of Ellendale on December 4 and 5. During this 24-hour interval the temperature rose 9° C. at 1,000 meters, 12° C. at 2,000 meters, and 11° C. at 3,000 meters. In explanation thereof it may be stated that the air arriving over Ellendale on the 4th was apparently coming directly from a high-pressure area centered over Montana, whereas that on the 5th came from the rear of a secondary low forming on the rear of a primary depression centered over Ontario. Twenty-four hours later, on the 6th, this secondary remained practically unchanged and free-air temperatures at Ellendale continued relatively high.

An unusually deep layer of saturated air occurred over Due West on the morning of the 17th. With fog at the surface the kite record showed a practically saturated condition up to an altitude of 2,170 meters, where an abrupt surface of discontinuity occurred and the temperature rose 6° C. within the next 120 meters, while the relative humidity dropped from 100 to 16 per cent. The average lapse rate throughout this saturated air column was 0.74° C. per 100 meters. This condition occurred in the front of a long trough of low pressure.

Table 1 shows some striking contrasts in the free-air temperatures at the various stations. At Ellendale and Royal Center, the two northernmost stations, these departures were all positive and of considerable magnitude, especially in the lower levels. At Due West and Groesbeck the temperatures were practically all below normal with the greatest departures occurring in the upper levels.

Free-air relative humidities were below normal at practically all stations and levels, the most striking instance being at Due West, where the negative departures were appreciable notwithstanding the large free-air temperature deficiency at this station. In view of this abnormal relationship it is not surprising to find a deficiency in the total precipitation for the month, viz, 1.20 inches, which is the lowest on record for December at this station.

Resultant winds (Table 2) for the month conform in general with the temperature departures, particularly at Due West, where a pronounced northerly component predominated instead of the normal southerly component. Resultant velocities were close to normal at practically all stations and levels.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during December, 1928*

TEMPERATURE (° C.)

Altitude m. s. l.	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Grosbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)	
	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal
Meters										
Surface	4.8	+0.6	6.6	−1.4	−5.9	+3.6	8.2	−0.9	1.3	+3.0
250	4.8	+0.6	6.5	−1.4	------	------	8.5	−0.5	1.2	+3.0
500	4.5	+0.8	6.3	−1.3	−5.8	+3.6	8.8	+0.2	0.0	+3.0
750	4.2	+0.7	6.0	−1.4	−4.5	+3.8	8.9	+0.5	−0.9	+2.6
1,000	3.9	+0.7	5.3	−1.7	−4.0	+3.1	8.3	−0.2	−1.6	+2.0
1,250	3.5	+0.5	4.5	−1.9	−4.4	+2.2	7.6	−0.6	−2.2	+1.4
1,500	2.9	+0.1	3.6	−2.0	−5.0	+1.6	7.1	−0.6	−2.6	+1.2
2,000	1.0	−0.5	1.9	−2.1	−6.3	+1.4	5.5	−0.7	−3.9	+1.1
2,500	−0.6	−0.1	−0.2	−2.3	−8.6	+1.1	3.3	−0.9	−6.2	+0.6
3,000	−2.7	+0.1	−3.1	−3.0	−10.4	+1.8	1.2	−0.7	−8.4	+0.6
3,500	−5.5	−0.3	−6.0	−3.6	−13.0	+1.9	−1.4	−0.8	−10.4	+1.2
4,000	−8.8	−0.7	−9.7	−4.4	−16.0	+1.7	−4.4	−1.1	−13.2	+1.5
4,500	------	------	−13.4	−4.9	−17.6	+2.6	−6.4	−0.7	------	------

RELATIVE HUMIDITY (%)

Surface	67	−3	70	−2	77	−4	73	−1	76	−4
250	67	−3	69	−2	------	------	68	−3	76	−4
500	63	−2	59	−6	75	−4	59	−8	75	−3
750	59	−1	54	−8	66	−5	51	−12	75	+1
1,000	55	+1	51	−9	61	−3	46	−11	73	+5
1,250	53	+5	51	−8	59	−1	42	−11	66	+4
1,500	50	+6	51	−7	56	−1	37	−12	60	+2
2,000	44	+5	46	−8	49	−5	28	−14	54	0
2,500	36	−1	39	−10	50	−4	25	−14	52	−1
3,000	35	−2	37	−7	46	−7	18	−18	54	+1
3,500	27	−8	36	−8	38	−15	15	−18	39	−12
4,000	27	−8	35	−8	35	−17	23	−12	41	−13
4,500	------	------	34	−7	17	−29	19	−16	------	------

VAPOR PRESSURE (mb.)

Surface	5.82	−0.45	7.25	−1.21	3.13	+0.45	8.42	−1.01	5.32	+0.69
250	5.79	−0.43	7.11	−1.25	------	------	8.03	−1.05	5.27	+0.70
500	5.29	−0.27	6.17	−1.49	3.09	+0.45	7.15	−1.17	4.84	+0.79
750	4.75	−0.25	5.54	−1.62	2.83	+0.31	6.15	−1.47	4.57	+0.88
1,000	4.26	−0.20	4.93	−1.67	2.52	+0.10	5.24	−1.53	4.16	+0.83
1,250	4.04	+0.10	4.61	−1.54	2.36	+0.04	4.60	−1.43	3.55	+0.55
1,500	3.73	+0.16	4.32	−1.31	2.16	−0.03	3.85	−1.41	3.12	+0.38
2,000	2.97	+0.08	3.33	−1.24	1.73	−0.14	2.47	−1.49	2.56	+0.27
2,500	1.98	−0.38	2.17	−1.43	1.49	−0.09	1.90	−1.26	2.10	+0.14
3,000	1.51	−0.48	1.75	−1.12	1.20	−0.06	1.20	−1.34	1.77	+0.07
3,500	0.88	−0.79	1.39	−1.13	0.88	−0.09	0.97	−1.03	0.91	−0.46
4,000	0.56	−0.86	1.04	−1.00	0.72	−0.06	1.03	−0.82	0.84	−0.35
4,500	------	------	0.76	−0.69	0.61	+0.03	0.72	−0.90	------	------

TABLE 2.—*Free-air resultant winds (m. p. s.) during December, 1928*

Altitude m. s. l. (meters)	Broken Arrow, Okla. (233 meters)				Due West, S. C. (217 meters)				Ellendale, N. Dak. (444 meters)			
	Mean		Normal		Mean		Normal		Mean		Normal	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°	
Surface	S. 41 W.	0.9	S. 63 W.	1.1	N. 66 W.	0.6	S. 73 W.	1.0	N. 68 W.	3.5	N. 54 W.	3.4
250	S. 50 W.	1.0	S. 55 W.	1.2	N. 52 W.	0.6	S. 68 W.	1.1	------	------	------	------
500	S. 50 W.	2.5	S. 49 W.	2.9	N. 24 W.	1.7	S. 69 W.	2.8	N. 67 W.	4.1	N. 58 W.	[illegible]
750	S. 60 W.	3.5	S. 55 W.	3.8	N. 42 W.	2.4	S. 74 W.	4.4	N. 59 W.	5.9	N. 57 W.	[illegible]
1,100	S. 78 W.	3.9	S. 67 W.	4.3	N. 58 W.	3.0	S. 80 W.	5.8	N. 54 W.	7.0	N. 56 W.	[illegible]
1,250	S. 79 W.	4.2	S. 77 W.	5.0	N. 59 W.	4.2	S. 80 W.	7.3	N. 56 W.	7.6	N. 57 W.	7.4
1,500	S. 87 W.	5.2	S. 80 W.	5.9	N. 65 W.	5.2	S. 85 W.	8.8	N. 58 W.	9.2	N. 57 W.	8.2
2,000	N. 82 W.	4.3	S. 85 W.	7.1	N. 78 W.	8.5	S. 86 W.	11.0	N. 61 W.	10.0	N. 59 W.	9.8
2,500	N. 79 W.	5.8	N. 88 W.	9.2	N. 82 W.	10.2	S. 89 W.	11.6	N. 60 W.	11.6	N. 62 W.	11.7
3,000	N. 76 W.	7.2	N. 88 W.	10.4	N. 67 W.	10.6	N. 85 W.	13.2	N. 65 W.	13.0	N. 65 W.	13.0
3,500	N. 80 W.	8.3	N. 88 W.	12.1	N. 47 W.	8.4	N. 82 W.	13.0	N. 68 W.	15.0	N. 71 W.	14.9
4,000	N. 74 W.	6.8	N. 85 W.	11.7	N. 11 W.	15.7	N. 71 W.	12.0	N. 28 W.	13.7	N. 69 W.	13.8
4,500	S. 67 W.	7.1	N. 88 W.	12.2	N. 22 W.	15.0	N. 72 W.	14.7	N. 32 W.	14.9	N. 83 W.	14.1
5,000	------	------	------	------	------	------	------	------	------	------	------	------

Altitude m. s. l. (meters)	Groesbeck, Tex. (141 meters)				Royal Center, Ind. (225 meters)				Washington, D. C. (34 meters)			
	Mean		Normal		Mean		Normal		Mean		Normal	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°	
Surface	W.	1.6	N. 68 W.	1.1	S. 34 W.	2.4	S. 54 W.	2.4	N. 51 W.	1.1	N. 44 W.	1.4
250	S. 83 W.	2.5	S. 85 W.	1.2	S. 32 W.	2.7	S. 53 W.	2.6	N. 64 W.	3.3	N. 62 W.	3.6
500	S. 88 W.	3.2	S. 60 W.	2.4	S. 37 W.	5.3	S. 58 W.	5.4	N. 71 W.	5.3	N. 67 W.	5.9
750	S. 89 W.	3.8	S. 62 W.	3.4	S. 50 W.	6.4	S. 67 W.	7.0	N. 60 W.	6.1	N. 68 W.	7.4
1,100	W.	4.4	S. 62 W.	4.5	S. 63 W.	6.4	S. 77 W.	8.1	N. 63 W.	7.1	N. 68 W.	8.0
1,250	W.	4.9	S. 68 W.	5.6	S. 69 W.	6.4	S. 82 W.	9.5	------	------	------	------
1,500	N. 87 W.	5.3	S. 70 W.	6.4	S. 70 W.	7.3	S. 87 W.	10.6	N. 63 W.	7.8	N. 68 W.	10.7
2,000	S. 85 W.	6.5	S. 75 W.	7.8	S. 75 W.	9.2	N. 88 W.	12.2	N. 63 W.	10.6	N. 70 W.	12.5
2,500	N. 79 W.	8.5	S. 78 W.	9.5	S. 83 W.	9.6	N. 86 W.	13.8	N. 78 W.	11.6	N. 75 W.	14.9
3,000	N. 74 W.	9.4	S. 81 W.	11.0	W.	8.8	N. 88 W.	13.6	N. 83 W.	12.9	N. 76 W.	16.1
3,500	N. 63 W.	10.5	S. 84 W.	11.7	S. 75 W.	11.5	N. 88 W.	12.8	S. 86 W.	11.1	N. 70 W.	18.8
4,000	N. 66 W.	13.8	S. 86 W.	12.0	S. 72 W.	12.6	S. 71 W.	11.9	S. 77 W.	14.0	N. 79 W.	17.3
4,500	N. 67 W.	18.1	N. 82 W.	12.5	S.	14.0	S. 76 W.	9.7	S. 75 W.	13.2	N. 76 W.	19.6
5,000	------	------	------	------	------	------	------	------	S. 68 W.	20.0	N. 72 W.	18.6