

AEROLOGICAL OBSERVATIONS

By L. T. SAMUELS

Free-air temperature departures for the month were negative generally and of moderate magnitude at all levels observed at Due West, Ellendale, and Royal Center. (Table 1.) The mean temperatures were practically normal at Broken Arrow and Groesbeck and above normal at Washington.

Relative humidity departures were mostly negative except at Due West where large positive values occurred, especially at the 2,500 and 3,000 meter levels.

Vapor pressures were mostly below normal with positive departures in the upper levels at Due West, Royal Center, and Washington. It is significant to note that at Ellendale, where negative temperature departures occurred together with negative relative humidity departures and exceptionally large negative vapor pressure departures up to the 1,000 meter level the total monthly precipitation was only 0.47 inch as compared to a normal of 4.59 inches. Also at Due West where an excess in the relative humidity and vapor pressures occurred with negative temperature departures, the total precipitation was 5.2 inches the highest amount for June, excepting one, since the establishment of the station in 1921.

TABLE 3.—Observations by means of kites, captive and limited height sounding balloons, and airplanes during June, 1929

	Broken Arrow, Okla.	Due West, S. C.	Ellendale, N. Dak.	Groesbeck, Tex.	Royal Center, Ind.	Naval Air Station, D. C.
Mean altitudes, (meters) M. S. L., reached during month.....	2,601	2,010	2,532	2,309	2,763	3,344
Maximum altitude (meters), M. S. L., reached and date.....	14,363	14,159	14,448	14,715	14,965	16,190
Number of flights made.....	25	17	31	26	27	16
Number of days on which flights were made.....	25	17	29	26	25	16

1 25th. 2 29th. 3 18th. 4 3d. 5 10th.

In addition to the above there are approximately 100 pilot balloon observations made daily at 45 Weather Bureau stations in the United States.

The resultant winds for the month below the 1,000-meter level were variable. (Table 2.) At the 3,000-meter level the resultant direction was westerly at practically all stations except the extreme South, where it was easterly and the resultant velocities ranged from 8 m. p. s. in the North to 1 m. p. s. in the South. At 5,000 meters the

resultant air movement was mostly from the northwest. From the 20th to 24th, inclusive, the 7 a. m. balloon observation at Oakland, Calif., extended to 11 kilometers. From 5 kilometers to this level the resultant direction was slightly west of south and the velocity about 15 m. p. s.

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

Altitude m. s. l.	TEMPERATURE (° C.)											
	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. (Naval air station) (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
Surface.....	23.9	-1.0	23.4	-2.3	18.2	-0.5	23.3	-2.6	21.4	-0.4	23.2	-0.1
500.....	21.8	-1.1	20.9	-1.8	17.7	-0.6	22.3	-0.8	18.6	-0.3	19.8	0.0
1,000.....	20.1	0.0	17.8	-1.6	14.4	-0.9	20.7	+0.4	15.1	-0.5	17.9	+0.9
1,500.....	17.6	+0.1	14.3	-1.8	11.6	-1.1	18.7	+0.6	12.1	-0.7	15.3	+1.3
2,000.....	14.8	0.0	11.3	-1.5	8.7	-1.1	15.7	-0.1	9.1	-1.1	12.4	+1.3
2,500.....	12.2	+0.2	8.0	-1.6	5.8	-1.1	13.0	-0.2	6.4	-1.1	9.4	+1.1
3,000.....	8.7	-0.3	5.3	-1.2	2.0	-2.1	10.3	-0.2	3.6	-1.2	6.4	+1.0
4,000.....	4.3	+1.5	-0.1	-0.6	-3.4	-1.8	4.5	-0.5	-1.2	-1.0	2.7	+3.7
5,000.....											-3.5	+3.7

RELATIVE HUMIDITY (%)

Surface.....	75	+3	74	+9	58	-12	86	+11	64	-2	62	-3
500.....	75	+3	74	+6	58	-11	81	+3	67	-1	62	-3
1,000.....	63	-8	75	+6	59	-8	63	-9	68	-1	54	-9
1,500.....	57	-10	82	+11	56	-8	53	-9	65	-2	56	-7
2,000.....	49	-12	83	+12	52	-10	52	-2	64	+2	57	-8
2,500.....	40	-14	96	+24	49	-12	46	-3	59	+3	55	-6
3,000.....	41	-9	96	+27	49	-8	40	-6	49	-3	47	-9
4,000.....	3	-46	20	-36	53	+3	20	-24	33	-8	37	-13
5,000.....											28	-13

VAPOR PRESSURE (mb.)

Surface.....	22.42	-0.20	20.89	-0.03	12.14	-3.15	24.76	+0.15	16.74	-0.58	18.69	-0.49
500.....	19.74	-0.35	18.18	-0.23	11.78	-3.04	21.77	+0.06	15.82	-0.06	15.11	-0.30
1,000.....	14.68	-1.86	15.28	-0.19	9.70	-2.03	15.33	-1.71	12.10	-0.39	11.73	-0.63
1,500.....	11.22	-1.90	13.45	+0.49	7.83	-1.60	11.17	-1.60	9.70	-0.57	10.26	+0.06
2,000.....	8.26	-1.75	11.06	+0.57	6.02	-1.58	9.32	-0.30	8.08	+0.18	8.65	+0.10
2,500.....	5.48	-1.89	10.57	+2.00	4.71	-1.55	7.25	-0.25	6.37	+0.61	6.85	+0.37
3,000.....	4.14	-1.44	8.73	+1.99	3.77	-1.06	5.73	-0.20	4.80	+0.51	5.02	+0.06
4,000.....	0.34	-3.33	0.60	-2.85	3.12	+0.01	3.19	-0.80	3.11	+0.93	3.13	+0.30
5,000.....											1.72	+0.30

TABLE 2.—Free-air resultant winds (meters per second) based on pilot-balloon observations made near 7 a. m. (E. S. T.) during June, 1929

Altitude m. s. l.	Broken Arrow, Okla. (233 meters)		Burlington, Vt. (132 meters)		Cheyenne, Wyo. (1,868 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Havre, Mont. (762 meters)		Jacksonville, Fla. (65 meters)		Key West, Fla. (11 meters)		Los Angeles, Calif. (40 meters)		
	Dirrec-tion	Veloc-ity	Dirrec-tion	Veloc-ity	Dirrec-tion	Veloc-ity	Dirrec-tion	Veloc-ity	Dirrec-tion	Veloc-ity	Dirrec-tion	Veloc-ity	Dirrec-tion	Veloc-ity	Dirrec-tion	Veloc-ity	Dirrec-tion	Veloc-ity	Dirrec-tion	Veloc-ity	
	°	m. p. s.	°	m. p. s.	°	m. p. s.	°	m. p. s.	°	m. p. s.	°	m. p. s.	°	m. p. s.	°	m. p. s.	°	m. p. s.	°	m. p. s.	°
Surface.....	S 39 E	1.6	S 14 W	2.2	N 78 W	3.1	S 74 W	0.8	N 23 W	0.6	S 24 E	1.0	S 56 W	1.8	S 45 W	0.8	S 21 E	1.9	N 65 E	1.5	
500.....	S 14 W	5.5	S 42 W	3.9			S 82 W	2.7	N 45 W	0.8	S 19 W	7.0	S 56 W	1.8	S 24 W	2.2	S 37 E	4.0	S 54 E	1.1	
1,000.....	S 33 W	7.5	N 88 W	4.7			S 88 W	3.6	S 76 W	1.1	S 16 W	6.3	S 72 W	3.9	S 39 W	1.9	S 33 E	3.9	N 21 W	1.0	
1,500.....	S 60 W	5.6	S 84 W	5.9			N 85 W	3.6	N 66 W	2.6	S 12 W	4.2	N 81 W	4.5	S 66 W	1.7	S 35 E	3.7	N 46 W	2.3	
2,000.....	S 74 W	4.8	S 79 W	7.0	S 87 W	6.7	S 89 W	4.1	N 70 W	3.4	S 27 W	2.6	N 87 W	5.6	S 69 W	1.9	S 30 E	2.6	N 68 W	2.7	
2,500.....	N 88 W	4.8	S 87 W	6.9	N 88 W	7.7	S 85 W	4.4	N 83 W	6.2	S 35 W	1.7	N 81 W	5.8	S 52 W	1.6	S 45 E	1.5	N 80 W	3.9	
3,000.....	N 49 W	5.0	S 88 W	7.5	N 82 W	7.2	W	4.0	N 79 W	7.0	N 51 E	0.3	N 80 W	6.3	S 62 W	2.5	S 30 E	1.4	N 84 W	4.4	
4,000.....	N 51 W	5.1	N 87 W	9.3	N 83 W	9.0	N 48 W	3.9	N 83 W	9.4	N 42 E	3.0	N 84 W	8.5	S 59 W	2.1	S 64 W	1.5	N 88 W	5.5	
5,000.....	N 52 W	6.5			N 80 W	11.7	N 73 W	3.3	N 78 W	10.4	N 19 E	3.4	S 89 W	10.6	S 72 W	2.9			S 66 W	6.1	

TABLE 2.—Free-air resultant winds (meters per second) based on pilot-balloon observations made near 7 a. m. (E. S. T.) during June, 1929—Continued

Altitude m. s. l.	Medford, Oreg. (446 meters)		Memphis, Tenn. (145 meters)		New Orleans, La. (25 meters)		Omaha, Nebr. (313 meters)		Royal Center, Ind. (225 meters)		Salt Lake City, Utah (1,280 meters)		San Francisco, Calif. (60 meters)		Sault Ste. Marie, Mich. (198 meters)		Seattle, Wash. (67 meters)		Washington, D. C. (34 meters)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface	N 24 W	0.5	S 76 E	1.8	N 33 E	0.5	S 28 E	0.9	S 20 E	0.8	S 12 E	2.4	S 6 E	0.4	N 81 E	0.6	S 43 E	0.8	N 76 W	0.3
500	N 29 W	0.7	S 44 W	3.6	S 58 E	1.2	S 5 W	2.5	S 45 W	2.5			N 17 W	2.6	S 63 W	1.6	S 28 E	0.6	N 27 W	2.6
1,000	S 76 W	0.6	S 74 W	4.3	S 20 E	1.8	S 56 W	5.2	W	4.0			N 3 W	3.9	N 83 W	3.5	S 7 W	1.2	N 28 W	3.2
1,500	S 13 W	1.7	S 80 W	4.5	S 18 E	1.6	S 79 W	5.1	N 89 W	5.0	S 12 E	3.4	N 20 W	2.9	N 75 W	4.5	S 35 W	1.8	N 41 W	3.6
2,000	S 59 W	2.3	N 79 W	4.1	S 23 E	1.6	S 86 W	5.5	N 80 W	5.6	S 7 W	4.2	N 36 W	2.7	N 78 W	5.7	S 17 W	1.8	N 53 W	6.2
2,500	S 72 W	4.5	N 71 W	3.3	N 88 E	0.8	N 81 W	6.3	S 89 W	5.1	S 32 W	3.8	N 69 W	3.1	N 74 W	7.6	S 25 W	3.0	N 62 W	6.2
3,000	S 79 W	5.9	N 68 W	2.8	N 68 E	1.3	N 72 W	7.5	N 32 W	6.2	S 51 W	4.5	N 72 W	4.6	N 67 W	8.3	S 59 W	4.7	N 65 W	6.7
4,000	S 80 W	9.6	N 38 W	3.8	N 27 E	2.5	N 52 W	12.6	N 73 W	10.5	S 54 W	6.2	N 87 W	6.5	N 60 W	10.0	S 70 W	5.3	N 47 W	7.9
5,000	S 50 W	12.6	N 28 W	4.0	N 14 E	3.0			N 79 W	11.8	S 82 W	8.8	S 86 W	7.7					N 66 W	7.2

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WEATHER IN THE UNITED STATES

THE WEATHER ELEMENTS

By P. C. DAY

GENERAL SUMMARY

June, 1929, was unmarked by important variations from normal summer weather, and, on the whole, was not physically uncomfortable, save in a few localities. It was generally favorable for the occupations of the season and conducive in the main to the favorable development of crops and the orderly progress of business.

PRESSURE AND WINDS

The pressure changes during the month were unusually slight from day to day and cyclonic storms that preserved their identity sufficiently from day to day to permit of charting on successive days were the exception.

The month opened with rainy conditions existing during the preceding 24 hours over a considerable area in the southern Rocky Mountains and Great Plains region, some heavy rains having fallen in the lower Missouri Valley, and local heavy rains had occurred also at a few scattered points in Virginia, Florida, and Alabama. The following day local showers continued in the Missouri Valley, extending into the upper Mississippi Valley, with heavy falls at points in Iowa and southern Illinois. By the morning of the 3d the main precipitation area had advanced to the south Atlantic coast with fairly well-defined cyclonic formation, attended by rather general and locally heavy precipitation over the Southeastern States, and showers still continued in portions of the central valleys. The rainy conditions in the Southeast passed off the coast by the morning of the 4th and fair weather prevailed over most districts for several days.

At the morning observation of the 7th rain had set in over the middle Plains, becoming locally heavy in a few instances, and by the following morning rain had extended into many eastern sections, becoming heavy locally in widely separated portions of the Mississippi and Ohio Valleys and Gulf States, the rains continuing on the 9th in portions of the Atlantic Coast States where, during the following 24 hours, there was some evidence of an increase in the cyclonic development as it passed northeastward up the coast, though without any extensive precipitation.

By the morning of the 11th rainy conditions had overspread portions of the northern districts from the Rocky Mountains to the upper Lakes, though without important precipitation except in portions of the last-named region.

During the following day the pressure continued low to the eastward and local thundershowers prevailed over extensive areas in the upper Mississippi Valley, Lake region, and northern drainage of the Ohio River, thundershowers with high winds and destructive hail storms being reported from numerous points in Iowa and portions of near-by States. This area of atmospheric disturbance continued during the following day, becoming rather general over the Ohio Valley with some heavy rains at points in Tennessee and near the lower Ohio River, showers continuing during the 14th over a rather extensive area from the upper Lakes southward to the middle Gulf coast, and to some extent over the Atlantic coast districts on the following day or two.

The latter half of the second decade was without important precipitation, save that on the 19th showers were reported from scattered points in the Southeastern States, locally in the Mississippi Valley and upper Lakes region, and in the far Northwest, and showers continued during the following day in the same or near-by areas.

During the first half of the last decade precipitation was scattered and mostly light to eastward of the Rocky Mountains and practically none occurred to the westward. On the 25th showers were fairly general in the southern Plains and to eastward of the Mississippi River, heavy rains occurring in portions of the Gulf States, particularly in western Florida and southern Alabama and in Arkansas and near-by portions of Texas. Showers continued during the following day over the more eastern part of the rain area and in the district from the upper Lakes westward to the Rocky Mountains, though here the precipitation was mostly in the form of light showers.

On the 27th showers prevailed in many portions of the Southeastern States and also in the near Northwest, the rains becoming light, however, in this area. During the following day the precipitation area extended eastward into the Great Lakes region and northern Ohio drainage with local heavy rains at points in Wisconsin and Michigan, and another rain area developed over the Gulf coast district, the combination of the two rain areas covering the more eastern portions of the entire country by the following morning.

At the close of the month the main agricultural areas of the country were not greatly in need of rain where it may usually be expected at that season of the year. While no great barometric depressions favored the occurrence of high winds over extensive areas, yet local storms were numerous and occurred at some point east of the Rocky Mountains on practically every day of the month,