AEROLOGICAL OBSERVATIONS

By WELBY R. STEVENS

Free-air temperatures for the month averaged mostly below normal, with the negative departures decreasing with altitude.

Relative humidities averaged slightly above normal; vapor-pressure departures were unimportant.

Resultant winds were about normal, although there was a tendency toward a more northerly component at most stations.

On the last four days of the month, when a HIGH of moderate intensity was moving from the Lake Region and slowly settling down over the Southern States, deep easterly winds were observed in the South Atlantic and Gulf States, as shown in the following table.

Stations	27		28		29		30	
	Height (km.)	Velocity (m. p. s.)	Height (km.)	Velocity (m. p. s.)	Height (km.)	Velocity (m. p. s.)	Height (km.)	Velocity (m. p. s.)
Atlanta					5	ESE. 8	5	ESE. 6.
Broken Arrow	11	NE. 10	7	SE. 11				
Due West			5	NE. 11	12	ESE. 18	13	E. 13.
Groesbeck	7	ENE. 17	4.5	E. 13				
Jacksonville					5	ENE. 10	11	ENE. 7
Memphis	7	ENE. 12	5	ESE. 10				
New Orleans			7	ESE. 8			9	E. 1.

Kite ascents were made at Broken Arrow and Groesbeck on the 1st during a period of thunderstorm activity in Oklahoma, Arkansas, Kansas, and western Missouri. On the morning of this date an area of high pressure covered the upper Lake Region and the northern Plains States; pressure was low over the southwest (El Paso, 29.74 inches). A well-defined discontinuity between polar and equatorial air extended from western Virginia southwestward to northern Mississippi, westward to the Texas Panhandle, thence southwestward to southern New Mexico. The aerological chart shows that a southerly current of high humidity, which had been accelerated northward under the influence of the southwest LOW, was flowing up over the layer of cold surface air. The kite flight at Broken Arrow shows a lapse rate of only 0.04 per 100 meters from surface to 1,000 meters. However, above 1,000 meters there was a southwest current of high relative humidity and high lapse rate (0.59, adiabatic for saturated air) extending to at least 2,300 meters. Since the humidity was high, only a small upgrade movement was necessary to start condensation. Once condensation begins ascent will be spontaneous as long as there is any water vapor left. The upgrade movement was produced by ascent over the relatively cold surface layer. The flight at Groesbeck on this date showed much the same conditions as at Broken Arrow, except for the fact that Groesbeck was in the warm sector; consequently there was no surface layer of cold air to produce an upgrade movement, condensation, and spontaneous convection. This is a type of warm front rain which plays an important rôle in the weather of the Southern States and has been studied and described in considerable detail by Rossby and Weightman.[1]

A flight was made at Groesbeck on the 13th just a few hours in advance of the arrival of a cold front. Severe thunderstorms occurred in the vicinity and 2.05 inches of rain fell at the station. Between the ascent and descent of the kites we find that a layer of south-southeast wind which had extended to an altitude of 750 meters had been replaced by a south current. Temperature increased to an altitude of 750 meters and fell above this height. The greatest fall, 3.3° C., occurred at an altitude of 1,500 meters. The cold current arriving with a southerly wind was due to adiabatic cooling as a result of forced ascent which takes place in advance of the cold wedge.

The highest kite flight of the month (5,897 meters) was made at Royal Center on the afternoon of the 24th, southeast of the center of a deep LOW. This flight is of particular interest on account of the unusually low humidity (11 to 50 per cent) observed at all levels, and on account of the small amount of precipitation attending the advancing LOW. The weather and aerological charts for this date show a strong current of southerly air in front of the LOW. Ordinarily this air would be moist. However, we find that the surface southerly current was not Gulf air but returning polar air, while the winds aloft had come from the arid regions of the southwest. Under conditions of this kind general rains can not be expected until the LOW has advanced far enough to obtain moist air from the Atlantic.

[1] Carl-Gustaf Rossby and Richard Hanson Weightman: Application of the Polar Front Theory to a Series of American Weather Maps. MO. WEATHER REV. Dec., 1926, 54 :485.

TABLE 2.—*Free-air resultant winds (m. p. s.) during June, 1927*

Altitude, m.s.l. (meters)	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		9-year mean		Mean		7-year mean		Mean		10-year mean		Mean		9-year mean		Mean		9-year mean		Mean		7-year mean	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	S. 6°W.	4.0	S. 6°W.	4.1	N. 64°E.	1.1	S. 78°W.	1.0	N. 52°W.	1.2	N. 56°W.	0.4	S. 3°W.	3.6	S. 2° E.	3.4	S. 7°W.	1.6	S. 55°W.	1.6	N. 53°W.	0.5	N. 43°W.	0.7
250	S. 5°W.	4.1	S. 6°W.	4.2	N. 64°E.	1.1	S. 74°W.	1.1					S. 3°W.	4.0	S. 1°E.	4.0	S. 14°W.	1.9	S. 50°W.	1.7	N. 68°W.	1.6	N. 59°W.	1.8
500	S. 13°W.	5.8	S. 10°W.	5.6	N. 59°E.	0.9	S. 80°W.	1.7	N. 83°W.	1.2	N. 71°W.	0.3	S. 6°W.	4.9	S. 3°W.	5.4	S. 25°W.	2.9	S. 52°W.	2.9	N. 50°W.	2.6	N. 53°W.	2.9
750	S. 21°W.	6.3	S. 15°W.	6.1	N. 50°E.	1.2	S. 77°W.	2.3	S. 88°W.	1.9	S. 45°W.	0.9	S. 10°W.	6.0	S. 6°W.	5.8	S. 45°W.	3.3	S. 59°W.	3.9	N. 50°W.	3.8	N. 52°W.	3.5
1,000	S. 28°W.	6.0	S. 24°W.	6.4	S. 19°W.	0.9	S. 76°W.	2.5	N. 70°W.	1.6	S. 48°W.	1.2	S. 14°W.	6.6	S. 10°W.	6.2	S. 55°W.	3.3	S. 70°W.	4.6	N. 35°W.	5.2	N. 46°W.	4.3
1,250	S. 30°W.	6.0	S. 27°W.	6.3	S. 51°W.	3.0	S. 78°W.	3.4	N. 78°W.	2.1	S. 65°W.	1.9	S. 18°W.	6.9	S. 11°W.	6.4	S. 53°W.	2.9	S. 75°W.	5.1				
1,500	S. 42°W.	6.1	S. 33°W.	6.3	S. 58°W.	5.2	S. 80°W.	4.5	N. 73°W.	2.4	S. 70°W.	2.4	S. 16°W.	7.2	S. 12°W.	6.0	S. 63°W.	2.9	S. 84°W.	5.1	N. 46°W.	7.4	N. 54°W.	6.0
2,000	S. 36°W.	5.4	S. 37°W.	6.4	S. 74°W.	8.6	S. 84°W.	6.5	N. 68°W.	3.5	S. 78°W.	3.5	S. 20°W.	7.1	S. 13°W.	5.6	S. 69°W.	4.2	S. 86°W.	7.4	N. 63°W.	7.9	N. 65°W.	7.1
2,500	S. 45°W.	5.5	S. 40°W.	6.5	S. 73°W.	11.0	S. 82°W.	7.2	N. 70°W.	4.5	S. 82°W.	5.3	S. 14°W.	5.8	S. 12°W.	5.2	S. 74°W.	7.5	S. 83°W.	9.3	N. 68°W.	8.5	N. 67°W.	5.8
3,000	S. 53°W.	7.0	S. 43°W.	6.6	S. 85°W.	11.4	S. 86°W.	8.9	N. 58°W.	6.3	S. 88°W.	7.3	S. 14°W.	3.8	S. 15°W.	5.3	S. 82°W.	9.4	S. 88°W.	10.6	N. 72°W.	9.8	N. 80°W.	8.7
3,500	S. 35°W.	8.3	S. 47°W.	7.1	S. 82°W.	12.8	S. 84°W.	10.2	N. 66°W.	8.9	S. 89°W.	9.3	S. 9°W.	6.6	S. 7°W.	5.7	S. 85°W.	11.0	S. 88°W.	10.8				
4,000	S. 46°W.	11.1	S. 60°W.	7.9	S. 67°W.	16.0	S. 82°W.	10.0	N. 69°W.	14.0	N. 87°W.	11.8	S. 1°W.	9.7	S. 7°W.	6.6	S. 86°W.	10.0	N. 85°W.	12.2				
4,500									N. 45°W.	16.0	N. 80°W.	13.4	S.	10.0	S. 10°W.	8.5	N. 45°W.	16.1	N. 67°W.	11.0				
5,000																	N. 45°W.	14.1	N. 42°W.	17.0				

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during June, 1927*

TEMPERATURE (° C.)

Altitude, m. s. l. (meters)	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. (7 meters)
	Mean	Departure from 9-year mean	Mean	Departure from 7-year mean	Mean	Departure from 10-year mean	Mean	Departure from 9-year mean	Mean	Departure from 9-year mean	Mean
Surface	23.5	−1.5	23.5	−2.8	16.8	−2.1	25.6	−0.5	19.0	−3.4	24.2
250	23.4	−1.5	23.2	−2.7			24.7	−0.4	18.7	−3.4	22.6
500	22.0	−1.0	20.7	−2.5	16.4	−2.1	22.6	−0.5	16.3	−3.1	19.9
750	20.7	−0.8	19.2	−2.2	15.0	−1.9	21.2	−0.4	15.0	−2.5	18.2
1,000	19.6	−0.6	18.2	−1.7	14.1	−1.4	20.2	−0.2	13.7	−2.2	16.7
1,250	18.5	−0.4	17.3	−0.9	13.0	−1.2	19.1	−0.1	12.5	−1.9	15.1
1,500	17.2	−0.3	16.1	−0.4	12.0	−0.9	18.0	0.0	11.5	−1.5	13.5
2,000	15.0	+0.3	13.0	−0.1	9.1	−1.0	15.2	−0.5	9.3	−1.1	10.8
2,500	12.2	+0.3	9.9	0.0	6.3	−1.0	12.8	−0.3	6.5	−1.1	8.5
3,000	10.0	+1.1	7.2	+0.4	3.9	−0.6	9.9	−0.6	3.8	−1.0	6.5
3,500	6.4	+0.7	3.6	+0.1	1.1	−0.5	6.5	−1.2	1.2	−0.9	
4,000	3.4	+0.8	0.2	−0.5	−1.6	−0.4	3.1	−1.9	−1.4	−1.0	
4,500					−4.2	+0.1	0.1	−1.9	−5.4	−2.1	
5,000									−9.2	−2.1	

RELATIVE HUMIDITY (%)

Altitude, m. s. l. (meters)	Broken Arrow, Okla. (233 meters) Mean	Departure from 9-year mean	Due West, S. C. (217 meters) Mean	Departure from 7-year mean	Ellendale, N. Dak. (444 meters) Mean	Departure from 10-year mean	Groesbeck, Tex. (141 meters) Mean	Departure from 9-year mean	Royal Center, Ind. (225 meters) Mean	Departure from 9-year mean	*Washington, D. C. (7 meters) Mean
Surface	77	+5	70	+8	75	+5	80	+6	70	+6	62
250	77	+5	70	+8			82	+7	70	+6	65
500	73	+1	73	+8	75	+6	86	+9	73	+8	66
750	72	0	72	+6	73	+6	86	+10	72	+6	62
1,000	70	−1	73	+6	69	+3	79	+7	70	+4	62
1,250	68	−1	75	+7	68	+3	74	+6	68	+2	60
1,500	66	−1	77	+8	65	+2	70	+6	63	−1	56
2,000	57	−5	78	+8	64	+3	65	+9	57	−3	57
2,500	53	−3	75	+6	69	+10	54	+2	54	+1	44
3,000	47	−5	70	+4	61	+6	52	+3	51	+2	40
3,500	53	+1	62	−2	58	+7	54	+7	44	+2	
4,000	62	+10	68	+10	55	+8	62	+15	40	+6	
4,500					45	0	70	+19	45	+11	
5,000									55	+11	

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during June, 1927*—Continued

VAPOR PRESSURE (*mb.*)

Altitude, m. s. l. (meters)	Broken Arrow, Okla. (233 meters) Mean	Departure from 9-year mean	Due West, S. C. (217 meters) Mean	Departure from 7-year mean	Ellendale, N. Dak. (444 meters) Mean	Departure from 10-year mean	Groesbeck, Tex. (141 meters) Mean	Departure from 9-year mean	Royal Center, Ind. (225 meters) Mean	Departure from 9-year mean	*Washington, D. C. (7 meters) Mean
Surface	22.04	−0.57	20.12	−0.72	14.79	−0.71	25.98	+1.39	15.74	−1.88	19.33
250	21.79	−0.61	19.81	−0.70			25.33	+1.60	15.57	−1.77	17.68
500	19.06	−0.96	18.07	−0.28	14.33	−0.69	23.35	+1.64	13.96	−1.14	15.75
750	17.15	−0.91	16.21	−0.54	12.71	−0.47	21.45	+1.77	12.74	−1.03	13.43
1,000	15.42	−0.98	15.38	−0.13	11.23	−0.64	18.44	+1.24	11.32	−1.32	12.33
1,250	13.95	−0.73	14.80	+0.46	10.14	−0.57	15.97	+0.91	10.15	−1.43	10.86
1,500	12.52	−0.53	13.93	+0.77	8.96	−0.56	13.95	+0.84	8.63	−1.71	9.33
2,000	9.24	−0.73	11.68	+0.92	7.41	−0.31	10.64	+0.69	6.33	−1.61	7.79
2,500	7.23	−0.12	9.14	+0.66	6.61	+0.25	7.25	−0.60	5.04	−0.58	4.82
3,000	5.71	+0.16	7.09	+0.47	5.05	+0.14	5.49	−0.80	3.96	−0.19	3.90
3,500	5.23	+0.79	5.00	−0.09	4.21	+0.30	4.42	−0.73	2.82	+0.07	
4,000	5.06	+1.44	4.27	+0.53	3.68	+0.49	3.84	−0.51	2.23	+0.53	
4,500					2.88	+0.37	3.21	−0.65	1.90	+0.62	
5,000									1.81	+0.62	

* Naval air station.

WEATHER IN THE UNITED STATES

GENERAL CONDITIONS

The weather of the current June was similar to that of June, 1926, to the extent that both were cool east of the Rocky Mountains. The explanation of the cool weather may be found in the distribution and movement of HIGHS and LOWS. To what extent this is conditioned upon world-wide pressure distribution is not at present apparent. Atmospheric pressure was unusually low over the northeast Pacific; it was also low over western Europe, except Spain and Italy, and high from Spitzbergen and Iceland to the Azores. In the United States it was high east of the Rocky Mountains and there was a decided increase from the previous month as may be seen from the insets on Charts I and II of this REVIEW.—*A. J. H.*

CYCLONES AND ANTICYCLONES

Six HIGHS and 13 LOWS were plotted during June. This is the least number for any month so far this year. A minimum number would be expected during June or July, since the temperature contrast between Pole and Equator is likewise at a minimum, with a corresponding reduction of air interchange.

Low No. XI showed an unusual movement. It was first noted on June 28 as the pinched-off lower end of a trough in the Atlantic near latitude 40° N., longitude 55° W; and with high pressure building up to the north and east, it was forced southwestward to Bermuda on the evening of the 30th. From Bermuda it moved slowly northwest to the New England coast during the first few days of July.—*W. P. Day.*

THE WEATHER ELEMENTS

By P. C. DAY

PRESSURE AND WINDS

The distribution of pressure during the month favored continued cool weather over nearly all central and northern districts from the Rocky Mountains eastward, where the preceding month had likewise been cool, and general coolness extended into most southern districts also, where in some sections monthly temperatures had been continuously above normal since January. It also favored frequent precipitation over many southern districts where the State averages were mainly in excess of the normal.

June opened with general low pressure over the Southwest, and by the morning of the 3d a well-defined cyclone was central over the eastern portions of Kansas and Oklahoma, and considerable precipitation had occurred over the central valleys, and from the middle Mississippi Valley eastward to the Atlantic coast where secondary lows had developed. By the morning of the 4th the main storm center had advanced to the lower Lakes and important rains had fallen from the lower Missouri Valley eastward to the Appalachian Mountains, continuing during the following 24 hours to New England and the lower St. Lawrence Valley.

Rain again set in on the 5th and 6th over the southern Plains and local thundershowers prevailed over the Southeast for several days following. At the same time a moderate cyclone passed along the northern border from western Montana to New England, attended by rather general but mostly light precipitation.