DETAILS OF THE WEATHER IN THE UNITED STATES

GENERAL CONDITIONS

The single outstanding feature of the month was the sharply contrasted distribution of temperature and precipitation in the various sections of the country.

These contrasts are traceable to the prevalence of two different types of pressure distribution; the first, which prevailed until about the 20th, favored the free movement of cyclonic systems along the average path; the second was practically the reverse, since anticyclones that originated in the North Pacific and Alaska progressed almost in a due-east direction over Canada and the northern part of the United States rather than from northwest to southeast. Pressure in the North Pacific HIGH was somewhat below the normal.—*A. J. H.*

CYCLONES AND ANTICYCLONES

By W. P. DAY

With the exception of a small tropical disturbance, which caused moderately high winds and heavy rain over the lower Rio Grande on the night of the 6th–7th, low-pressure areas were generally ill defined and of slight barometric gradient until the 19th, when a rather important storm area developed over the northern Rocky Mountain region and moved eastward. High-pressure areas were likewise unimportant until the last decade. Near the beginning of this period pressure began rising over the Aleutian Islands. This HIGH developed and spread eastward over the Gulf of Alaska and into the interior of Alaska and then into Canada and by the end of the month a great area of high pressure covered much of Canada, Alaska, and the northern portion of the United States. Due, however, to the oceanic origin of this HIGH there was no important depression of temperature associated with it.

FREE AIR SUMMARY

By V. E. JAKL

The principal feature of upper-air temperature averages for the month was a general well-pronounced excess at all stations as compared with the normal. (See Table 1.) It was most pronounced over Due West, and showed no well-defined variation with altitude; therefore the surface departures, as shown in Chart III of this REVIEW, fairly well represent the distribution of the free-air departures also. Notwithstanding this general excess in temperature, relative humidities averaged about normal, indicating a generally greater moisture content of the air than is usual for the time of year.

Resultant free-air winds were, with few exceptions, southwesterly, becoming westerly at 4,000 meters and above. The principal exception was at Key West, where winds were practically due east at all levels observed. Easterly winds aloft were of infrequent occurrence over mid-continental stations, although they were persistent over the southern Plains States during the first few days of the month, of which good examples are shown in the kite and pilot balloon observations at Groesback on the 1st, and the two-theodolite pilot balloon observation at Broken Arrow on the 2d. In the former observation, nearly due-east winds were recorded from the ground to about 7,000 meters, and in the latter, southerly winds in the lower levels backed to easterly at 8,000 meters, remaining due east thence to 12,000 meters. Weak high pressure covered the greater portion of the country during this period. The principal instance of easterly wind to high altitudes over northern stations occurred at Ellendale on the 22d, when a two-theodolite observation showed westerly winds near the ground, veering with altitude and becoming northeasterly from 6,000 to 9,000 meters. On this date a ridge of moderately high pressure overlay the northern portion of the country, Ellendale lying along its northern border.

Comparing the resultant winds with the normal, it is found that the deviations were on the whole slight (see Table 2), being apparent principally at Groesbeck, where the resultants showed south-southwest at all altitudes, as compared with slightly east of south for normal. Wind resultants from kite observations at Due West are based on too few observations to be reliable, but balloon observations at that station showed more definitely that the winds were principally northwesterly at all altitudes, except that in the lowest 500 meters the wind changed from prevailing northeasterly in the morning to northwesterly in the afternoon. The abnormally high temperatures at Due West were therefore associated with winds of continental (presumably near by) origin both at the surface and aloft. This is particularly shown in connection with the maximum temperature for the month, 105° on the 8th, which was accompanied by light northwesterly winds to 4,000 meters, becoming westerly at 5,000 meters.

The following record of the upper-air observation at Ellendale on the 4th, and comments of the official in charge relative thereto, is descriptive of the conditions attending a kite flight made immediately preceding a thunderstorm of the "wind shift line" type. The stratus approaching from the northwest when the winds aloft were still from directions ranging from east to south with altitude, apparently represented the top of the turbulent column of the approaching "cold front."

Surface wind became northwest soon after the flight.

"During the latter half of the flight of the 4th severe thunderstorm conditions developed. Storms were located to the south and northwest of the station. The storm to the northwest seemed to develop very rapidly. Wind directions aloft shifted from south to east within the range of altitude from 1,500 meters down to the ground. A thin line of stratus clouds was observed to be moving from the northwest before landing the head kite. When close enough to be more carefully observed it was noted that a violent rolling motion was present. A maximum surface wind of 58 miles an hour from the northwest was recorded at 2:18 p. m., with a light but rapid fall of rain."

Time, p. m.	Altitude, m. s. l.	Temperatures	$\frac{\Delta t}{100\ m.}$	Relative humidity	Wind direction	Wind velocity
	Meters	°C.		*Per cent*		
12:43	4,941	−5.0	0.41	49	S.	15
12:55	4,573	−3.5	.34	92	S.	14
1:00	4,515	−3.3	.62	74	S.	14
1:04	4,288	−1.9	.77	94	S.	13
1:33	3,078	7.4	.71	80	S.	15
1:40	1,951	15.4	.96	53	S.	16
1:52	1,152	23.1	.75	45	ESE.	14
2:01	[1] 444	28.4	----------	48	ESE.	5

[1] Surface.

The following record of the kite flight at Groesbeck on the 24th, including an excerpt from the report of the official in charge, shows upper-air conditions at that sta-

tion attending the development of a LOW in the southwest. An abrupt shift from northerly to southwesterly evidently took place just above the point where the wind movement was reduced to almost a calm at 2,266 meters, as subsequent pilot balloon and cloud observations showed a southwesterly drift at and above that altitude. The alignment of the LOW was NE. to SW., showing that at the place of observation the winds were in agreement with the surface gradient direction in the lower levels, and opposite thereto in the upper levels. "The flight of the 24th was made in a typical "norther" condition at this station. A general rain began falling shortly after the completion of the flight and continued during the greater part of the day."

Altitude, m. s. l.	Temperature	Relative humidity	Wind direction	Wind velocity
Meters	° *C.*	*Per cent*		
2,266	9.7	100	N.	1
1,070	15.7	70	N.	15
820	17.1	65	N.	14
697	15.1	100	NNE.	14
[1] 141	20.0	86	NNE.	5

[1] Surface.

An illustration of the varied changes in wind velocity with height is shown by the pilot balloon records at Burlington on the 20th and 25th. On the 20th Burlington was in a region of strong pressure gradient in front of a pronounced LOW. The wind increased from 19 m. p. s. from the south on the ground to 31 m. p. s. from the south-southwest at 500 meters above ground, diminishing thence to 19 m. p. s. from the west-southwest at 1,000 meters. On the 25th, in the front portion of a HIGH with a pronounced LOW to the east, the wind increased steadily and quite uniformly with altitude from 3 m. p. s. from the north near the ground to 31 m. p. s. from the north-northwest at 3,700 meters. On the 20th, the increase from the ground to 500 meters represented the normal increase with altitude depending on surface friction and turbulence, while the abrupt fall in velocity thereafter with its attendant large change in direction can be attributed to change in pressure gradient with height. On the 25th, the gradual increase in velocity was due to a gradual increase in slope of pressure gradient with altitude. This latter is characteristic of the vertical wind structure to the rear of—and just outside the scope of the surface isobars of—a vigorous LOW. Another type of wind structure with altitude is shown by the two-theodolite pilot balloon observation at Ellendale on the 17th, taken in the rear of a moderate low pressure area. In this observation the wind rose from 3 m. p. s. from the northwest on the ground to 23 m. p. s. at 1,000 meters above ground from the same direction, fell abruptly to 6 m. p. s. from the west at 2,600 meters, and rose rapidly to 38 m. p. s. from the west-southwest at 4,500 meters. In this observation the first rapid increase in velocity was largely a "nocturnal inversion" effect, while the succeeding changes in velocity and direction with altitude were caused by changing direction and steepness of pressure gradient.

TABLE 1.—*Free-air temperatures, relative humidities and vapor pressure during September, 1925*

TEMPERATURE (°C.)

Altitude m. s. l. (*meters*)	Broken Arrow, Okla. (233 *meters*) Mean	Departure from 8-yr. mean	Drexel, Nebr. (396 *meters*) Mean	Departure from 10-yr. mean	Due West, S. C. (217 *meters*) Mean	Departure from 5-yr. mean	Ellendale, N. Dak. (444 *meters*) Mean	Departure from 8-yr. mean	Groesbeck, Tex. (141 *meters*) Mean	Departure from 7-yr. mean	Royal Center, Ind. (225 *meters*) Mean	Departure from 8-yr. mean
Surface	26.2	+2.8	20.4	+1.7	27.4	+3.5	16.1	+1.2	25.7	+1.3	22.0	+0.8
250	26.2	+3.0			27.0	+3.5			24.9	+1.1	21.7	+0.7
500	25.8	+4.1	20.1	+1.8	24.9	+3.8	15.8	+0.9	22.9	+0.6	19.9	+1.1
750	24.8	+4.3	19.6	+2.3	23.4	+4.0	15.1	+0.8	21.5	+0.6	18.8	+1.6
1,000	23.3	+4.1	18.9	+2.6	22.2	+4.0	14.6	+1.1	20.8	+1.1	17.5	+1.8
1,250	21.8	+3.9	18.1	+2.8	20.8	+3.8	13.4	+0.8	19.9	+1.4	16.2	+2.0
1,500	20.1	+3.5	16.8	+2.7	19.2	+3.5	12.4	+0.9	18.9	+1.5	15.1	+2.3
2,000	16.9	+2.9	13.8	+2.4	16.0	+2.9	10.2	+1.2	16.6	+1.5	12.0	+1.9
2,500	13.7	+2.5	10.6	+2.3	12.2	+2.1	7.4	+1.3	14.2	+1.6	8.5	+1.2
3,000	10.5	+2.2	7.3	+2.1	8.0	+0.8	4.5	+1.3	11.8	+1.6	5.5	+0.7
3,500	7.8	+2.6	3.8	+1.6	6.6	+2.1	1.3	+0.9	9.7	+2.0	2.4	+0.4
4,000	4.7	+2.6	0.8	+1.4			−1.9	+0.4	6.6	+1.7	0.0	+0.4
4,500	2.0	+2.7	−0.7	+2.7			−4.7	+0.3	3.5	+1.4		
5,000			−3.7	+2.3			−7.4	+0.2	1.7	+1.8		

RELATIVE HUMIDITY (%)

Surface	63	−4	72	+6	55	−9	75	+8	79	+3	70	+4
250	63	−4			55	−9			81	+5	70	+4
500	61	−4	69	+5	55	−12	75	+9	85	+9	69	+3
750	60	−3	65	+4	55	−14	71	+8	83	+8	69	+3
1,000	59	−3	61	+2	56	−13	67	+6	71	0	69	+3
1,250	59	−2	58	+1	57	−11	65	+7	61	−7	66	+1
1,500	60	+1	58	+2	58	−11	62	+6	56	−9	61	−3
2,000	57	+2	55	+1	59	−6	59	+6	50	−10	59	−1
2,500	54	+3	52	−3	62	−3	58	+6	47	−7	59	+3
3,000	48	−1	50	−4	64	+2	57	+5	43	−7	59	+6
3,500	46	−5	47	−5	39	−19	53	+3	26	−20	52	+3
4,000	44	−5	45	−6			52	+4	26	−17	43	−3
4,500	51	+2	42	−10			44	0	24	−18		
5,000			38	−11			39	−2				

VAPOR PRESSURE (MB.)

Surface	20.93	+1.59	17.52	+3.13	19.17	+0.41	13.38	+1.99	25.79	+2.56	18.19	+1.62
250	20.87	+1.65			18.64	+0.17			25.14	+2.71	17.96	+1.60
500	19.90	+2.59	16.66	+2.92	16.47	−0.31	13.09	+1.90	23.43	+2.94	16.02	+1.49
750	18.39	+2.81	15.07	+2.75	15.11	−0.36	11.92	+1.70	21.18	+2.55	15.01	+1.78
1,000	16.78	+2.56	13.81	+2.63	14.38	+0.05	10.87	+1.60	17.45	+0.96	13.76	+1.70
1,250	15.19	+2.34	12.38	+2.26	13.43	+0.36	9.70	+1.43	14.04	−0.66	12.37	+1.51
1,500	13.95	+2.58	11.17	+2.07	12.41	+0.33	8.73	+1.27	11.96	−1.01	10.88	+1.20
2,000	10.76	+2.10	8.79	+1.41	10.49	+0.71	7.19	+1.13	9.00	−1.15	8.32	+0.81
2,500	8.25	+1.79	6.85	+0.76	8.77	+0.64	5.95	+0.93	7.10	−0.75	6.49	+0.85
3,000	5.78	+0.89	5.37	+0.41	7.17	+0.43	4.93	+0.69	5.42	−0.75	4.94	+0.80
3,500	4.53	+0.49	3.91	−0.05	4.31	−1.41	3.69	+0.22	2.70	−2.17	2.87	+0.08
4,000	3.33	+0.32	2.81	−0.46			2.90	+0.05	1.89	−2.00	1.37	−0.47
4,500	2.62	+0.22	1.98	−0.74			1.80	−0.44	1.19	−2.13		
5,000			1.07	−1.13			1.20	−0.51				

TABLE 2.—*Free-air resultant winds (m.p.s.) during September, 1925*

Altitude, m. s. l. (meters)	Broken Arrow, Okla. (233 meters) Mean Dir.	Vel.	8-year mean Dir.	Vel	Drexel, Nebr. (396 meters) Mean Dir.	Vel.	10-year mean Dir.	Vel.	Due West, S. C. (217 meters) Mean Dir.	Vel.	5-year mean Dir.	Vel.	Ellendale, N. Dak. (444 meters) Mean Dir.	Vel.	8-year mean Dir.	Vel.	Groesbeck, Tex. (141 meters) Mean Dir.	Vel.	7-year mean Dir.	Vel.	Royal Center, Ind. (225 meters) Mean Dir.	Vel.	8-year mean Dir.	Vel.
Surface	S. 23° W.	3.6	S. 1° W.	3.1	S. 5° W.	2.1	S. 10° W.	1.7	N. 37° E.	2.8	N. 59° E.	2.7	N. 77° E.	0.6	W.	0.6	S. 23° W.	3.6	S. 20° E.	1.8	S. 8° W.	1.4	S. 45° W.	1.3
250	S. 24° W.	3.9	S. 2° W.	3.3					N. 35° E.	2.8	N. 56° E.	2.5					S. 22° W.	3.8	S. 19° E.	2.4	S. 14° W.	1.6	S. 45° W.	1.6
500	S. 36° W.	5.8	S. 10° W.	4.5	S.	2.8	S. 7° W.	2.5	N. 27° E.	2.8	N. 52° E.	2.8	S. 60° E.	0.6	S. 75° W.	0.8	S. 22° W.	4.9	S. 11° E.	3.8	S. 35° W.	3.7	S. 45° W.	3.3
750	S. 39° W.	7.0	S. 17° W.	5.1	S. 18° W.	4.0	S. 22° W.	3.7	N. 39° E.	2.9	N. 60° E.	3.2	S. 35° E.	0.7	S. 60° W.	1.6	S. 19° W.	5.5	S. 5° E.	4.1	S. 48° W.	4.8	S. 56° W.	4.3
1,000	S. 41° W.	6.8	S. 26° W.	4.9	S. 25° W.	5.4	S. 31° W.	4.1	N. 60° E.	2.6	N. 66° E.	3.2	S. 6° E.	1.1	S. 60° W.	2.2	S. 19° W.	5.9	S. 4° W.	4.3	S. 62° W.	5.3	S. 63° W.	4.9
1,250	S. 43° W.	6.3	S. 33° W.	4.8	S. 28° W.	5.3	S. 46° W.	4.3	N. 48° E.	1.7	N. 53° E.	3.0	S. 28° W.	2.0	S. 64° W.	2.8	S. 27° W.	7.5	S. 2° E.	4.4	S. 69° W.	6.0	S. 68° W.	6.0
1,500	S. 43° W.	6.7	S. 42° W.	4.9	S. 30° W.	5.8	S. 55° W.	4.9	N. 53° E.	0.6	N. 56° E.	2.2	S. 46° W.	3.2	S. 72° W.	3.6	S. 24° W.	7.9	S. 1° E.	4.2	S. 77° W.	7.0	S. 72° W.	6.5
2,000	S. 41° W.	7.3	S. 49° W.	5.7	S. 40° W.	5.5	S. 67° W.	5.7	S. 45° E.	1.5	N. 60° E.	1.6	S. 65° W.	4.8	S. 77° W.	5.0	S. 18° W.	8.2	S.		S. 80° W.	9.3	S. 75° W.	8.3
2,500	S. 40° W.	7.8	S. 57° W.	5.4	S. 42° W.	7.0	S. 74° W.	7.3	S. 22° E.	7.0	N. 65° E.	1.2	S. 70° W.	6.7	S. 83° W.	6.7	S. 12° W.	7.3	S. 3° E.	3.7	S. 82° W.	11.2	S. 75° W.	9.9
3,000	S. 37° W.	8.8	S. 51° W.	6.3	S. 49° W.	8.3	S. 80° W.	9.1	S. 22° E.	8.0	S. 5° E.	0.2	S. 74° W.	9.0	S. 87° W.	8.7	S. 13° W.	7.2	S. 2° E.	3.7	S. 89° W.	13.8	S. 73° W.	12.6
3,500	S. 42° W.	9.3	S. 57° W.	6.4	S. 63° W.	5.9	W.	10.2	N. 45° W.				S. 72° W.	9.5	S. 88° W.	9.8	S. 20° W.	6.7	S. 3° W.	3.0	N. 86° W.	10.9	S. 80° W.	11.9
4,000	S. 34° W.	9.4	S. 69° W.	7.7	S. 78° W.	5.8	N. 78° W.	11.5	N. 45° W.				S. 89° W.	11.9	N. 77° W.	11.7	S. 16° W.	10.5	S. 1° W.	3.4	S. 82° W.	10.7	W.	10.2
4,500	S. 78° W.	7.9	N. 89° W.	9.8	N. 87° W.	3.8	N. 72° W.	11.9					N. 76° W.	12.9	N. 74° W.	12.8	S. 13° W.	12.3	S. 2° W.	5.2	S. 22° W	15.0	N. 83° W.	9.9
5,000	S. 67° W.	7.0	S. 89° W.	11.4	N. 31° W.	4.0	N. 62° W.	13.7					N. 78° W.	15.2	N. 79° W.	14.4	S. 68° E.		S. 24° E.	4.4				

TABLE 3.—*Mean free-air temperature, humidity, vapor pressure and resultant wind (m. p. s.) during September, 1925, at Washington, D. C.*

Altitude m. s. l. (meters)	Naval air station (7 meters)			Weather Bureau (34 meters)	
	Temperature, °C.	Relative humidity per cent	Vapor pressure, md.	Wind	
				Direction	Velocity
Surface	20.4	81	19.94	N. 16° W.	1.0
250	19.5	76	17.67	N. 42° W.	1.3
500	19.0	71	16.12	N. 60° W.	1.8
750	18.1	69	14.79	N. 49° W.	1.8
1,000	17.1	70	14.08	N. 55° W.	3.8
1,250	16.2	69	12.94		
1,500	15.4	68	12.00	N. 65° W.	6.2
2,000	13.4	60	9.31	N. 64° W.	7.4
2,500	10.9	55	7.23	N. 66° W.	7.8
3,000	7.6	51	6.16	N. 67° W.	8.3
3,500	3.8	45	5.60	N. 70° W.	8.7

THE WEATHER ELEMENTS

By P. C. DAY, In Charge of Division

PRESSURE AND WINDS

The day-to-day fluctuations of atmospheric pressure were on the whole moderate, but the distribution of cyclonic and anticyclonic areas at times greatly influenced the temperature and precipitation conditions over large areas, most notably during the first decade, when unusually stagnant atmospheric conditions existed over most central and southeastern districts. An anticyclone of only moderate dimensions became established over the Southeastern States, while moderately low pressure was maintained over the more northern districts from the Rocky Mountains eastward, due to the passage over that region of several unimportant low-pressure areas.

Due to the slight pressure gradients over the eastern half of the country there was little air movement, and under the influence of clear skies and a generally dry condition of the soil due to previous long periods without material precipitation, particularly over the Gulf States and portions of the Ohio and Mississippi Valleys, the atmosphere became unduly heated and one of the longest periods of intense heat ever experienced in September resulted. The maximum effects were felt from about the 4th to the end of the first decade, the highest temperatures over large portions of the area referred to ranging from 100° to 110° or even higher daily, records in many cases never before reached in September, and in some cases not previously exceeded in any summer month. At the same time the drought conditions that had previously existed over much of the same region grew daily more severe due to the extreme heat, the combination of heat and lack of rain resulting in one of the longest and severest droughts ever known, the more important details of which are given later in this section.

By the end of the first decade the pressure distribution had become reversed; cyclonic conditions developed in the Southwest and gradually overspread the districts to the eastward, while an anticyclone entered the Northwest bringing cooler weather as it moved to the eastward.

Shortly after the middle of the month moderately high pressure again became established over the Southeastern States and unseasonably hot weather again prevailed over the South and Southeast, though the daily maxima did not reach the high points registered earlier in the month.

Near the end of the second decade the atmospheric circulation became more active; a cyclone of considerable proportions, developing over the Northwest, moved rapidly eastward, quickly followed by the first important anticyclone of the month, which overspread the upper Missouri Valley by the morning of the 20th, attended by sharp falls in temperature over northern districts. As it moved rapidly eastward the cooling effects extended into the central and southern districts to some extent, though not sufficiently to lower the temperature to normal.

The last decade of the month, save as indicated above, was without important pressure variations, though low pressures persisted over the central valleys and considerable precipitation occurred between the Great Plains and Appalachian Mountains, though little fell over the dry areas of the Southeast.

The average pressure was mainly below normal, slight excesses occurring along the immediate Gulf coast, from Lake Superior to Montana and northward into Canada, and along the coast of California. The greatest deficiencies occurred over the central valleys. Compared with the preceding month the pressure averaged considerably lower in nearly all portions, the exception being a small area over the extreme Northeast, locally in northern California, and in portions of the upper Missouri Valley and adjacent Canadian areas.

In the absence of persistent important high or low pressure areas, as shown by the chart of average pressure, there was much local diversity in the directions of the prevailing winds, though they were mainly from the south in the east Gulf and South Atlantic States and over the Great Plains, and from northerly points along the Pacific coast.

Despite the general absence of extensive cyclonic areas there were apparently more than the usual number of wind or other damaging storms distributed through all portions of the month and in nearly all sections east of the Rocky Mountains, and a few to the westward. No important loss of life occurred, however, save that occasioned by the wreck of the airship *Shenandoah* in Ohio on the 3d. The more important facts in connection with the severe storms of the month appear in the table immediately following this section.

TEMPERATURE

September, 1925, set a mark for heat over the territory from the lower Mississippi Valley eastward, and from the Ohio drainage area southward to the Gulf, that in many instances has probably not been surpassed in the authentic history of that part of the country, and that will probably stand unsurpassed for as long in the future.

The center of this heated area embraced the interior of the Gulf and South Atlantic States, the southern Ohio drainage, and portions of the middle Mississippi Valley. In the central portion of this area the average daily temperatures were normal or above on every day of the month, and at many points in the outlying portions only one or two days had temperatures below. Here, too, the averages and the maxima for the month were the highest ever known in September and in a number of cases the highest for any month. Despite the intense and long-continued heat few cases of prostration occurred, and the ordinary occupations were pursued without material hindrance, due probably to the dry condition of the atmosphere.

Aside from the intense heat over the regions referred to above, temperature conditions over the country were not