DETAILS OF THE WEATHER IN THE UNITED STATES.

GENERAL CONDITIONS.

ALFRED J. HENRY.

The outstanding feature of the weather of the Continent of North America appears to have been the prevailing low atmospheric pressure and relatively high temperature in high latitudes. (See pp. 529–530.) In the United States the center of maximum mean pressure was over the Missouri Valley—a natural result of the concentration of anticyclones in a group that moved southeastward from Montana and adjacent parts of Canada. It seems clear that the origin of these anticyclones was mostly within the field of observations as shown on Chart No. I of this REVIEW. The movement of the anticyclones in connection with the development and north/northeast movement of secondary cyclonic systems (see Chart II) will fully account for the heavy rains in Oklahoma and the Southwest.

CYCLONES AND ANTICYCLONES.

By W. P. DAY.

High pressure prevailed over the Northwestern States during a rather large portion of the month and there was a corresponding decrease in the number of low-pressure areas of the Alberta type. The total number of LOWS charted was below the normal and the more important depressions were of tropical or subtropical origin. In general, the movement of air of tropical origin was northward over lower middle latitudes instead of the normal northeastward flow. This is evidenced by the northward or even northwestward trend of the storm tracks.

The HIGHS were about normal in number, but were frequently reinforced. For instance, No. VIII appeared on the 23d as a North Pacific HIGH and moved eastward, was reinforced by an impulse of cold air from the Canadian interior and immediately took on the characteristics of a HIGH of the Alberta type and moved southward. As soon as this impulse died, the HIGH resumed its eastward movement. Also the high-pressure area which continued from the preceding month until the 13th was maintained by no less than four reinforcements.

FREE-AIR SUMMARY.

By L. T. SAMUELS, Meteorologist.

It may be seen from Table 1 that the average free-air temperatures were below normal at practically all levels reached by the kites. In accord with Climatological Chart III the region of greatest departures included the Broken Arrow and Drexel stations.

As would be expected with negative temperature departures relative humidities averaged mostly above normal, the largest departures occurring at Broken Arrow above the surface. Vapor pressures averaged in general below normal except where humidity departures were large and positive.

From Table 2 it may be seen that the resultant winds for the month differed appreciably from the normal particularly at Broken Arrow, Groesbeck, and Royal Center. The resultant movement of the air for the month as shown by 14 pilot-balloon stations east of the Rocky Mountains indicated a westerly drift north of latitude 37°, approximately, and easterly south of this latitude. At 3,000 m. altitude and above, however, the resultant direction was westerly at all stations except San Juan at which station the westerly drift was found at 5,000 m. and above.

In the section on Storms and Weather Warnings for the Washington Forecast District reference is made to the continuation of a high-pressure area over the States east of the Mississippi River during the first two weeks of the month. During the first part of this period pilot-balloon observations at Ellendale revealed some rather unusual winds aloft which may, it seems, be considered as closely related to the sluggish movement of this HIGH. From the 2d to the 6th Ellendale was situated, progressively, in its eastern, southern, and western quadrants. When in the eastern quadrant there were found northwesterly winds veering to east-northeasterly at about 2,500 m. altitude and continuing to 9,000 m. These ENE. winds increased steadily in velocity and reached nearly 30 m. p. s. at the highest level observed. When in the southern quadrant northeasterly winds prevailed to 6,000 m. When in the western quadrant on the 5th and 6th, the former date showed north winds from 2,000 m. to 7,000 m., while the 6th showed northerly winds at 3,000 m., gradually becoming northeasterly and continuing so to 10,000 m. These easterly winds found at such altitudes indicate a pressure distribution at these heights contrary to that normally prevailing. It has been found that the surface temperatures for western Canadian stations were appreciably above normal for this part of the month, while those for Alaskan stations were decidedly above for the entire month. The relatively high temperatures in the northern region would account for the abnormally high pressure in the higher levels over this region and the resulting easterly winds.

At Groesbeck on the 8th a two-theodolite observation showed an easterly wind of moderate velocity extending from the ground to 8,500 m. Abruptly at this height it veered to westerly and increased in velocity from 3 m. p. s. at 8,500 m. to 41 m. p. s. at 11,500 m. Above this height it again decreased to 24 m. p. s. at 14,000 m., the limit of the observation. This easterly wind resulted from the great circular HIGH central that date over the Great Lakes, the sluggish movement of which has already been referred to. On the same date Royal Center, situated less than 200 miles to the southwest of the center of the HIGH, showed east winds to 2,000 m., then backing to northwest, the latter increasing to 37 m. p. s. at 7,500 m., the top level reached. Easterly winds at high altitudes were observed during this period at Broken Arrow on the 8th and 9th from the ground to 7,000 m., and at Memphis on the 9th to 10,000 m. On the 11th when this HIGH was centered over the southwestern Virginia region the observations at Washington, D. C., showed northwesterly winds from the surface to 5,000 m., above which a sharp backing to easterly occurred to 9,000 m., where the observation ended.

From the 20th to the 24th there was observed over the southeastern and eastern sections of the country at altitudes above 3,000 m. a strong current from the south, with recorded velocities as high as 40 m. p. s. at 5,000 m. and 6,000 m. During this period a tropical storm made its appearance and was moving northward along the Atlantic coast waters. When, on the 23d, it had become centered to the southeast of Cape Hatteras and pressure to the north and west was high, ordinarily there would have been expected a movement during the next 24 hours toward the east or northeast. However, with the aerological observations showing the persistent

southerly winds aloft, an accurate prediction of the storm's movement with the attendant rain area considerably to the westward from that usually found was possible. An apparent cause of the upper southerly winds may be seen on the weather map of the 20th. It is found that the isotherms extend in a nearly N.-S. direction along the eastern part of the country, so that a morning temperature of 21° C. (70° F.) at Hatteras occurs simultaneously with a temperature of 2° C. (36° F.) at Nashville on practically the same latitude. With probably even higher temperatures to the eastward out at sea it is obvious that a steep east-to-west pressure gradient would be set up in the upper air and result in southerly winds of considerably velocity as were observed.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during October, 1923.*

TEMPERATURE (°C.).

Altitude. m. s. l. (m.)	Broken Arrow, Okla. (233 m.)		Drexel, Nebr. (396 m.)		Due West, S. C. (217 m.)		Ellendale, N. Dak. (444 m.)		Groesbeck, Tex. (141 m.)		Royal Center, Ind. (225 m.)	
	Mean.	Departure from 6-yr. mean.	Mean.	Departure from 8-yr. mean.	Mean.	Departure from 3-yr. mean.	Mean.	Departure from 6-yr. mean.	Mean.	Departure from 6-yr. mean.	Mean.	Departure from 6-yr. mean.
Surface	13.7	−3.3	8.6	−2.9	15.5	−0.7	6.9	−0.9	17.8	−1.2	12.3	−1.7
250	13.6	−3.3	.....	.....	15.2	−0.7	.....	.....	17.3	−1.4	12.2	−1.7
500	12.7	−2.9	8.4	−2.8	13.2	−0.9	7.0	−0.9	16.5	−1.2	10.4	−2.1
750	11.8	−2.7	7.9	−2.4	12.1	−0.7	6.1	−1.5	15.4	−1.2	8.4	−2.7
1,000	10.5	−2.8	6.7	−2.8	11.1	−0.7	4.9	−2.0	14.2	−1.2	6.8	−3.0
1,250	9.7	−2.7	5.6	−3.3	9.9	−0.8	3.9	−2.2	13.2	−1.2	5.6	−3.0
1,500	8.6	−2.8	4.9	−3.1	8.8	−0.9	3.0	−2.3	11.8	−1.4	4.3	−3.1
2,000	6.5	−2.8	2.9	−2.8	6.9	−0.9	1.3	−1.8	8.8	−2.1	2.3	−2.9
2,500	4.4	−2.4	0.6	−2.4	5.3	−1.0	−0.6	−1.2	6.6	−2.0	0.5	−2.4
3,000	1.6	−2.4	−1.3	−1.6	3.5	−0.6	−2.9	−0.8	4.8	−1.7	−1.5	−2.0
3,500	−1.4	−2.6	−4.0	−1.6	1.4	−0.1	−5.4	−0.5	2.5	−1.9	−1.9	+0.1
4,000	−3.4	−1.8	−6.4	−1.4	−1.0	+0.1	−8.1	−0.5	0.9	−1.2	.....	.....
4,500	−4.8	−0.6	−8.4	−1.3	−3.6	−0.1	−11.4	−0.9	−1.5	−0.9	.....	.....
5,000	−7.6	−0.8	.....	.....	−6.3	−0.2	.....	.....	.....	.....	.....	.....

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during October, 1923*—Continued.

RELATIVE HUMIDITY (%).

Altitude. m. s. l. (m.)	Broken Arrow, Okla. (233 m.)		Drexel, Nebr. (396 m.)		Due West, S. C. (217 m.)		Ellendale, N. Dak. (444 m.)		Groesbeck, Tex. (141 m.)		Royal Center, Ind. (225 m.)	
	Mean.	Departure from 6-yr. mean.	Mean.	Departure from 8-yr. mean.	Mean.	Departure from 3-yr. mean.	Mean.	Departure from 6-yr. mean.	Mean.	Departure from 6-yr. mean.	Mean.	Departure from 6-yr. mean
Surface	77	+11	72	+11	64	+1	66	0	74	+1	61	−5
250	76	+10	.....	.....	64	+1	.....	.....	72	+1	61	−5
500	69	+5	68	+9	66	+3	65	+1	67	−1	63	−1
750	67	+5	64	+7	68	+5	62	+2	68	0	64	+2
1,000	71	+10	64	+9	68	+6	63	+5	68	+1	65	+4
1,250	70	+11	63	+10	67	+6	62	+7	66	+1	60	+1
1,500	68	+11	59	+7	66	+7	59	+7	66	+3	57	0
2,000	67	+16	58	+6	63	+9	51	+2	70	+12	48	−3
2,500	67	+21	51	0	53	+7	43	−4	66	+14	41	−6
3,000	67	+25	42	−7	52	+8	37	−8	56	+12	29	−15
3,500	65	+25	42	−5	50	+9	33	−12	55	+14	21	−21
4,000	53	+16	37	−8	49	+10	32	−11	53	+16	.....	.....
4,500	27	−4	33	−10	48	+11	33	−10	53	+16	.....	.....
5,000	18	−7	.....	.....	48	+11	.....	.....	.....	.....	.....	.....

VAPOR PRESSURE (*mb.*).

Surface	12.56	−0.37	8.51	+0.01	11.44	−0.22	6.84	−0.07	15.54	−0.94	8.80	−1.85
250	12.41	−0.42	.....	.....	11.25	−0.26	.....	.....	14.80	−1.03	8.77	−1.76
500	10.88	−0.68	8.07	−0.14	10.24	−0.18	6.78	−0.04	13.32	−1.02	8.23	−1.06
750	9.94	−0.62	7.32	−0.18	9.97	+0.23	6.15	−0.23	12.68	−0.68	7.40	−0.89
1,000	9.75	+0.08	6.76	−0.21	9.35	+0.34	5.64	−0.23	11.90	−0.29	6.72	−0.80
1,250	9.10	+0.36	6.16	−0.21	8.48	+0.37	5.17	−0.15	10.88	−0.09	5.94	−0.79
1,500	8.26	+0.44	5.45	−0.41	7.76	+0.57	4.70	−0.08	9.91	+0.07	5.18	−0.76
2,000	7.09	+1.20	4.69	−0.30	6.39	+0.67	3.52	−0.33	8.45	+0.83	3.98	−0.60
2,500	6.01	+1.51	3.38	−0.67	4.65	+0.36	2.57	−0.57	6.73	+0.75	2.99	−0.57
3,000	5.42	+1.96	2.19	−1.01	4.03	+0.46	1.85	−0.67	4.90	+0.43	1.65	−1.17
3,500	4.23	+1.50	1.54	−1.00	3.64	+0.76	1.34	−0.70	4.03	+0.45	0.48	−1.77
4,000	3.20	+1.03	0.86	−1.18	3.41	+1.00	1.04	−0.52	3.45	+0.67	.....	.....
4,500	2.06	+0.38	0.38	−1.29	3.19	+1.04	0.91	−0.27	2.98	+0.51	.....	.....
5,000	1.56	+0.28	.....	.....	3.06	+1.10	.....	.....	.....	.....	.....	.....

TABLE 2.—*Free-air resultant winds (m. p. s.) during October, 1923.*

Altitude, m. s. l. (meters).	Broken Arrow, Okla. (233 meters).				Drexel, Nebr. (396 meters).				Due West, S. C. (217 meters).			
	Mean.		6-year mean.		Mean.		8-year mean.		Mean.		3-year mean.	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	N. 63° E.	1.3	S.	2.1	S. 22° W.	1.1	S. 29° W.	1.5	N. 61° E.	3.8	N. 49° E.	2.4
250	N. 68° E.	1.4	S. 1° E.	2.3	.....	.....	.....	.....	N. 60° E.	4.2	N. 49° E.	2.6
500	S. 72° E.	1.9	S. 7° W.	3.2	S. 28° W.	1.8	S. 32° W.	2.1	N. 59° E.	6.0	N. 51° E.	3.6
750	S. 39° E.	1.7	S. 14° W.	3.9	S. 31° W.	2.6	S. 44° W.	3.3	N. 62° E.	6.1	N. 58° E.	3.4
1,000	S. 19° E.	1.0	S. 23° W.	3.9	S. 50° W.	3.0	S. 57° W.	3.7	N. 73° E.	5.1	N. 67° E.	2.5
1,250	S. 55° W.	0.9	S. 36° W.	4.0	S. 61° W.	2.9	S. 63° W.	4.4	N. 76° E.	5.3	N. 78° E.	1.9
1,500	S. 80° W.	1.4	S. 45° W.	4.0	S. 65° W.	3.3	S. 70° W.	5.2	N. 75° E.	4.1	S. 86° E.	0.8
2,000	N. 68° W.	1.4	S. 53° W.	4.4	S. 71° W.	4.7	S. 78° W.	6.9	N. 57° E.	4.0	S. 80° W.	0.9
2,500	N. 49° W.	2.8	S. 67° W.	4.8	S. 77° W.	6.3	S. 80° W.	8.1	N. 49° E.	2.5	S. 88° W.	3.1
3,000	N. 79° W.	3.9	S. 72° W.	5.9	S. 62° W.	6.4	S. 84° W.	9.4	N. 50° E.	1.0	S. 82° W.	4.8
3,500	N. 62° W.	6.7	S. 74° W.	7.1	S. 64° W.	7.2	N. 88° W.	10.5	S. 60° W.	1.3	W.	6.7
4,000	S. 88° W.	8.1	S. 68° W.	8.8	S. 61° W.	9.4	S. 89° W.	11.0	N. 22° E.	9.3	S. 78° W.	10.2
4,500	W.	11.4	S. 79° W.	10.3	S. 74° W.	12.1	N. 83° W.	11.3	N. 22° E.	9.9	N. 78° W.	8.2
5,000	N. 68° W.	13.4	S. 76° W.	11.4	N. 45° W.	21.7	N. 61° W.	10.4	N. 22° E.	12.7	N. 30° W.	10.5

Altitude, m. s. l. (meters).	Ellendale, N. Dak. (444 meters).				Groesbeck, Tex. (141 meters).				Royal Center, Ind. (225 meters).			
	Mean.		6-year mean.		Mean.		6-year mean.		Mean.		6-year mean.	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	S. 60° W.	2.7	N. 70° W.	1.8	N. 57° E.	2.0	S. 74° E.	0.7	N. 69° W.	2.5	S. 48° W.	2.3
250	.....	.....	.....	.....	N. 68° E.	2.6	S. 51° E.	1.4	N. 69° W.	2.5	S. 48° W.	2.6
500	S. 60° W.	3.6	N. 76° W.	1.9	S. 87° E.	3.4	S. 27° E.	2.5	N. 79° W.	3.3	S. 55° W.	4.5
750	S. 62° W.	5.4	N. 81° W.	2.8	S. 84° E.	3.2	S. 17° E.	2.8	N. 80° W.	3.9	S. 63° W.	5.6
1,000	S. 63° W.	5.5	N. 80° W.	3.2	S. 87° E.	2.5	S. 6° E.	2.7	N. 76° W.	4.1	S. 68° W.	6.4
1,250	S. 74° W.	5.5	N. 82° W.	4.0	N. 86° E.	2.1	S. 6° W.	2.8	N. 66° W.	5.8	S. 72° W.	7.4
1,500	S. 79° W.	5.8	N. 84° W.	4.7	N. 63° E.	1.3	S. 22° W.	2.8	N. 66° W.	7.9	S. 77° W.	8.2
2,000	S. 89° W.	6.3	N. 81° W.	6.4	N. 11° E.	1.3	S. 47° W.	2.7	N. 69° W.	10.4	S. 79° W.	9.4
2,500	N. 87° W.	7.4	N. 78° W.	8.0	S. 85° W.	0.4	S. 57° W.	2.9	N. 70° W.	11.4	S. 84° W.	10.4
3,000	N. 89° W.	8.8	N. 80° W.	9.3	S. 56° W.	1.0	S. 62° W.	3.4	N. 60° W.	9.9	S. 86° W.	11.2
3,500	N. 86° W.	9.7	N. 83° W.	11.1	S. 42° W.	1.7	S. 50° W.	3.4	N. 23° W.	1.6	S. 83° W.	13.0
4,000	N. 76° W.	10.9	N. 87° W.	11.5	N. 53° W.	1.8	S. 48° W.	2.4	S. 22° E.	20.2	S. 82° W.	11.8
4,500	S. 56° W.	12.8	S. 80° W.	13.2	N. 51° W.	5.0	N. 85° E.	1.2	.....	.....	.....	.....
5,000	W.	16.6	N. 86° W.	14.6	N. 49° W.	5.0	N. 1° W.	4.6	.....	.....	.....	.....