DETAILS OF WEATHER OF THE MONTH IN THE UNITED STATES.

CYCLONES AND ANTICYCLONES.

There were more than the usual number of low and of high pressure areas during the month, but with minor exceptions these were of the usual summer intensity and did not call for the issue of storm warnings. During the month as shown by Chart III 11 primary low pressure areas were observed over the United States and southern Canada, and of these seven were of the Alberta type and these either passed eastward along the northern border and left the field of observation in the vicinity of the Gulf of St. Lawrence or else turned northward into Canada; two belonged to the South Pacific type and one to the Northern Rocky Mountain type and these passed east-northeastward across the Great Lakes into southern Canada; one was of the East Gulf type and it passed inland immediately east of Pensacola on the 4th and dissipated over Tennessee on the 5th. There were five secondary low-pressure area developments, one of these occurring over the middle Mississippi Valley on the 4th; three formed over the middle Atlantic States, one on the 6th, another on the 7th, and yet another on the 10th; and one formed over the Missouri Valley on the 30th. The number of lows exceeded the average number, 8.6, for the month of July.—*E. H. Bowie.*

The outstanding feature of the weather on the Pacific coast during the month of July was the persistence with which depressions formed over the plateau region. These depressions would form over the valley of the Colorado and the plateau of southern Nevada, slowly increase in energy and extend northward until they covered the entire plateau region, remaining in that section for a few days, and then, in most cases, would unite with a depression moving southeastward through British Columbia and Alberta and pass east, only to be followed within a few days by a recurrence of a similar depression. Several high areas appeared on the northern coast, but only on one or two occasions did they move inland, and then only with greatly diminished energy.—*G. H. Willson.*

Eleven high-pressure areas were charted (see Chart III), and of these five belonged to the Alberta type, three to the North Pacific type and three to the Northern Rocky Mountain type. All of these HIGHS except two moved eastward north of latitude 35° N. The two exceptions passed southward from the northern Rocky Mountain region and disappeared over Texas. The HIGHS of the month were not abnormal in any respect, but in number exceeded the average number for July for 21 years.—*E. H. Bowie.*

THE WEATHER ELEMENTS.

By P. C. DAY, Climatologist and Chief of Division.

[Dated Weather Bureau, Washington, Sept. 1, 1919.]

PRESSURE AND WINDS.

The distribution of the mean atmospheric pressure over the United States and Canada, and the prevailing direction of the winds for July, 1919, are graphically shown on Chart VII, while the means at the several stations, with the departures from the normal, are shown on Tables I and III.

At the beginning of the month a strong high-pressure area that had moved from the Lake region during the closing days of June still persisted over the eastern third of the country. West of the Mississippi River pressure was somewhat lower, particularly in the Central Mountain and Plateau States, but without a distinctive storm center.

By the middle of the first decade the eastern HIGH had disappeared, and pressure remained low over practically all other districts. During the latter part of the decade high pressure again developed over the Great Lakes and moved eastward to New England, and there was a general rise in pressure over most parts of the country, although at the close sharp falls had occurred in the northeastern districts and pressure was falling in the South and far West.

During the second decade pressure was comparatively high off the Atlantic coast, and with more or less constancy this condition persisted during the greater part of the month, but no important anticyclones moved into or developed over the interior portion of the country during the last two decades, and the changes in pressure from day to day were mainly small.

The month as a whole was distinctly free from well-developed low areas, no single storm center of material importance extending over a wide area. The small tropical storm that approached western Florida from the Gulf on the morning of the 4th quickly dissipated on reaching the coast. (See page 500 and Chart XI.)

The pressure for the month showed no marked departure from the normal, the averages being uniformly slightly above normal from the Mississippi Valley eastward, and over the Southwest, and slightly below normal from the Missouri Valley westward, except over a small area in the far Northwest and the adjacent portions of British Columbia, where there was a small excess.

In the absence of any marked displacement of the pressure distribution usual to a midsummer month, the winds assumed the normal southerly course prevalent during the warmest periods of the year over nearly all districts from the Rocky Mountains eastward. In the mountain districts of the West variable winds, dependent mostly on the topography, prevailed, while along the Pacific coast the winds were, as usual, from the ocean toward the land, but they had a very general trend from the northwest.

TEMPERATURE.

The beginning of the month was marked by decidedly cool weather over most eastern districts, particularly along the south Atlantic coast, where, on the morning of the 1st, the lowest temperatures for the month were reported, and in a few localities the temperatures were the lowest ever observed in July. Likewise, in the far West temperatures were low for the season, but throughout the interior and northern portions of the country the weather was generally warm, and at a few points in the Great Lakes region the highest temperatures for the month were reported during the first few days.

As the month advanced there was a very general increase in temperature over the eastern districts, the maximum for the month occurring over large areas during this period. Temperatures were also higher for a few days in the more western districts, although near the middle of the first decade cooler weather set in over the northern Rocky Mountain States and gradually overspread the districts to the eastward, reaching New England about the 8th and 9th, at which time some of the lowest temperatures of the month were recorded.

The latter part of the first decade was mainly warm, except that cool weather was advancing into the upper Missouri Valley at the end, and during the following few days the lowest temperatures of the month were reported near the Great Lakes and locally to the eastward. At the same time warm weather prevailed throughout the middle section of the country from the Pacific coast eastward to the Great Plains, the highest temperatures of the month occurring very generally over the abovementioned region during this period. The heated area extended into the more eastern and southern districts by the middle of the second decade, when maximum temperatures of 100° or somewhat higher were reported locally in the Gulf and south Atlantic States.

No important temperature changes were noted during the middle and latter portion of the second decade, except about the 18th, when a decided fall was reported in the far Northwest due to an area of high barometer moving inland over the North Pacific coast. As this cool area advanced eastward during the close of the second and the early part of the third decade, some of the lowest temperatures of the month were observed over the central districts as far eastward as the Mississippi River.

The early part of the last decade of the month brought temperatures close to normal in nearly all parts of the country, except as noted above. With the advent of a low pressure area into the upper Missouri Valley about the 26th, there was a very general rise in temperature to the eastward and southward and during the following few days the highest temperatures of the month were observed at points in these regions. The latter part of the month was without important temperature changes and at the close near normal conditions prevailed in all districts.

Maximum temperatures of 100° or more were reported from practically all portions of the country, although extreme heat was not registered continuously over extended areas for any considerable period of time. In Florida the maximum temperature did not rise above 100°, while in the Dakotas and Montana extremes of 105° to 111° were recorded, and in the plateau region the highest reached ranged from 117° in Arizona to 110° and 111° in the plains of eastern Washington and southern Idaho.

Minimum temperatures were below freezing on several different dates during the month in the mountain districts of the West. Readings as much as 10° below freezing being reported at exposed points in Oregon and nearly 20° below freezing locally in the mountains of Montana. Over the great agricultural regions the lowest temperatures were generally between 40° and 50°, although at points in the Upper Lake region, northern New York, and interior New England they were occasionally below freezing.

The average temperature for the month was above normal over the greater part of the country, the excesses ranging generally from 2° to 5°. From Texas westward to Arizona the monthly averages were slightly below normal, and there were small areas in the southeastern States and along the North Pacific coast that had averages slightly less than normal.

PRECIPITATION.

Generally fair weather prevailed at the beginning of the month, and, save for general rains in the far Southwest, and local showers at widely scattered points elsewhere, there was little precipitation until the middle of the first decade, when considerable rain occurred from the middle Plains northeastward to the upper Lakes and in the east Gulf States, extending during the following few days to most of the country from the Mississippi River eastward. During the latter part of the first decade rains became general over the east Gulf States, and by the first of the second decade had again extended over much of the country from the Mississippi River eastward. This inaugurated a period of wet weather along the Atlantic and east Gulf coasts that continued almost without interruption until the early part of the last decade. During much of this period rain continued almost daily in the mountain regions of the far Southwest, but over many of the interior States the rainfall was scattered and frequently insufficient for crop needs, particularly in the far Northwest and over portions of the southern Plains States where severe drought persisted.

The latter part of the second and the early portion of the third decade brought heavy rains in portions of the west Gulf States, particularly in Texas, where the precipitation was frequently heavy. The middle and latter parts of the third decade were without material rainfall over the more eastern districts except in the Gulf States, where rains continued at frequent intervals until near the close. In the far Southwest the rains became less frequent during the last decade, although near the end another rainy period set in and some of the heaviest falls of the month occurred in the mountains of Colorado and New Mexico during this time. But little relief had come to the drought conditions in the middle Plains region at the close of the month, and similar conditions prevailed in the far Northwest. Much of the rain during the month was associated with thunder storms, although there appears to have been a rather marked absence of the more severe types of these storms.

For the month as a whole, rainfall was heavy and greatly above normal over the Atlantic coast districts from southern New England to Florida, in much of Texas, and generally in the far Southwest. There was a small excess in the upper Mississippi Valley and locally in the adjoining regions, but over the great interior valleys and west to the Pacific coast the rainfall was nearly everywhere deficient. For the State of Arizona as a whole the rainfall was the greatest of record and similar conditions prevailed, but to a less extent, in portions of New Mexico and Colorado. Heavy rains, approaching the intensity of cloudbursts, were of frequent occurrence and much damage resulted to bridges and roads on account of the high waters. In the Atlantic coast districts the period from about the 13th to the 23d, inclusive, was remarkable for the continued and heavy character of the rainfall, particularly in the eastern districts of the Carolinas, where the falls were in some cases recordbreaking, and the run-off caused much damage to crops in the lowlands.

The rainfall for the month presented many unusual features, particularly in its distribution over comparatively small areas. Despite the heavy rainfall so general in the eastern and southern districts, where monthly falls of 10 to 15 inches or more were common, small areas had

less than 2 inches, and, in some cases, less than 1 inch during the entire month. In Texas, Arizona, New Mexico and Colorado the variations were greater. In the portions of the country where rainfall was deficient local areas in all the States had good rains at some period. This was particularly noticeable in the West and far Northwest where local heavy falls afforded occasional relief from the general drought prevailing. In portions of the northern Plateau and Pacific coast States, the period from May to July, inclusive, of the present year has been the driest in the history of the respective localities. In California water for power and irrigation purposes is growing alarmingly low and much anxiety exists least the supply become exhausted before the rainy season sets in. (See p. 507, below.)

RELATIVE HUMIDITY.

The averages of the relative humidity for the 8 a. m. and 8 p. m. observations present some unusual features, particularly along the Atlantic and Gulf coasts, where, although rainfall and damp weather seemed to persist almost constantly, the average relative humidity was frequently below the normal and usually only slightly above. In portions of Arizona and surrounding States where rainfall was likewise heavy, but not more continuous, this element was far above normal.

The persistence of drought conditions in the central Plains and far Northwest is well illustrated in the marked decrease in the relative humidity for the month as compared with the normal, the negative departures at some points being the greatest ever known.

LOCAL STORMS.

Considering the rainy character of the month over the eastern and southern districts there was a marked absence of high winds, in fact the early part of the month was notable for the small amount of wind movement in portions of the middle Atlantic States.

At Williston, N. Dak., a severe wind and hail storm on the night of the 6th and 7th caused much damage to crops.

At Dubuque, Iowa, a severe rainstorm and freshet on the 9th caused the death by drowning of seven persons, and much loss to property resulted from the high waters. The rate at which rain fell during this storm was the greatest in the history of the city. (See pp. 468, 506 in this issue of the REVIEW.)

In Pennsylvania a series of severe storms occurred on the 10th. A severe storm occurred in the vicinity of Pittsburgh on that date, several persons being killed or injured and much damage done. At Bradford a tornado passed over the town, killing two persons and causing much damage to buildings and crops; and a damaging storm occurred at Wellsboro on the 22d, causing losses estimated at over $100,000.

A severe thunderstorm swept western Long Island and the neighboring mainland on the 30th destroying trees, buildings, hangars, and airplanes at Mineola and leveling several acres of large trees in the lee of the reservoir at Purchase, N. Y.

Average accumulated departures for July, 1919.

Districts.	Temperature.			Precipitation.			Cloudiness.		Relative humidity.	
	General mean for the current month.	Departure for the current month.	Accumulated departure since Jan. 1.	General mean for the current month.	Departure for the current month.	Accumulated departure since Jan. 1.	General mean for the current month.	Departure from the normal.	General mean for the current month.	Departure from the normal.
	°F.	°F.	°F.	In.	In.	In.	P. ct.		P. ct.	
New England	69.9	+1.3	+15.9	3.01	− .59	+ 0.91	5.5	+0.4	78	− 2
Middle Atlantic	75.1	+4.5	+18.7	6.40	+2.10	− 1.70	5.3	+0.4	74	+ 1
South Atlantic	78.8	+2.6	+ 7.7	7.71	+1.70	− 0.30	5.6	+0.8	80	+ 1
Florida Peninsula	81.5	−0.8	− 3.6	7.65	+1.30	+10.10	6.0	+1.0	77	− 1
East Gulf	79.9	−0.4	− 1.1	6.88	+1.60	+ 5.26	6.1	+0.7	81	+ 3
West Gulf	81.6	−4.4	− 9.4	3.47	0.00	+ 2.30	4.6	+0.3	76	+ 1
Ohio Valley and Tennessee	78.3	+1.7	+ 9.9	3.32	−0.70	− 2.20	4.3	−0.5	67	− 4
Lower Lakes	72.9	+1.2	+18.0	2.63	−0.80	− 1.30	3.8	−0.8	63	− 7
Upper Lakes	70.9	+2.7	+26.3	2.35	−0.60	− 2.10	3.8	−0.9	65	− 8
North Dakota	71.6	+2.5	+25.2	2.35	−0.60	− 1.35	3.8	−0.4	65	− 1
Upper Mississippi Valley	78.1	+2.4	+18.4	3.66	+0.20	− 0.20	3.3	−1.1	64	− 5
Missouri Valley	79.9	+3.3	+19.9	2.09	−1.70	− 2.70	2.9	−1.3	64	− 1
Northern slope	71.9	+3.8	+21.6	1.63	.00	− 3.00	3.7	0.0	47	− 9
Middle slope	79.2	+2.8	+ 6.7	1.88	−1.10	− 3.20	3.3	−0.8	59	− 2
Southern slope	78.4	−2.1	−12.5	1.72	−1.10	− 2.40	3.8	−0.4	66	+ 6
Southern Plateau	81.2	−0.2	− 6.2	1.40	+0.20	+ 0.60	3.4	0.0	50	+10
Middle Plateau	76.2	+3.1	+11.1	0.37	−0.20	− 2.40	2.2	−0.8	35	− 1
Northern Plateau	73.9	+3.0	+12.4	0.07	−0.40	− 2.90	2.2	−0.6	31	−12
North Pacific	61.5	+5.0	+ 8.4	0.16	−5.40	− 4.00	4.0	−0.6	61	−14
Middle Pacific	64.7	−4.7	− 5.4	0.00	0.00	− 2.00	2.9	0.0	59	− 2
South Pacific	71.4	+0.8	+ 5.2	0.00	0.00	− 3.80	1.8	−0.9	65	+ 1

Winds of 50 mis./hr. (22.4 m./sec.) or more during July, 1919.

Station.	Date.	Velocity.	Direction.	Station.	Date.	Velocity.	Direction.
Charleston, S. C.	14	51	ne.	New York, N. Y.	26	65	sw.
Columbus, Ohio	12	52	nw.	Do.	28	51	nw.
Dayton, Ohio	31	51	nw.	Norfolk, Va.	29	56	nw.
Jacksonville, Fla.	16	51	sw.	Pensacola, Fla.	4	58	ne.
Louisville, Ky.	15	54	sw.	Pittsburgh, Pa.	10	58	nw.
Do.	31	56	n.	Point Reyes Light, Calif.	11	50	nw.
Minneapolis, Minn.	13	50	nw.	Do.	12	55	nw.
Mobile, Ala.	7	57	n.	Do.	31	50	nw.
Mount Tamalpais, Calif.	5	56	nw.	St. Paul, Minn.	13	57	sw.
Do.	11	58	nw.	Williston, N. Dak.	6	64	n.
Do.	12	52	nw.	Do.	7	52	nw.
New York, N. Y.	22	50	s.				