

WEATHER, FORECASTS, AND WARNINGS FOR THE MONTH.

By Prof. H. C. FRANKENFIELD, in charge of Forecast Division.

A period of unusually warm weather that had prevailed over the extreme Southwest during the closing days of May spread thence eastward and northward and gave exceptionally high temperatures over the west Gulf States and the Plateau region during the first week in June; at the same time, the weather remained unusually cool for the season in the Northwestern States, the Mississippi and Ohio valleys, the Lake region, and the northeastern districts, with temperatures near the freezing point along the northern border from Montana to New England. Temperatures as low as or lower than ever before recorded at this season occurred during the first days of the month in New England, over portions of the Middle Atlantic States and Ohio Valley and in the northwest. Low temperatures continued during the second week in June in the Plains States, the Mississippi Valley, and the region east thereof, and on the 11th and 12th minimum temperatures at points in Nebraska, Kansas, Oklahoma, northern Texas, and Missouri equalled the lowest previously recorded in these States at this season of the year. During the above-mentioned period temperatures were uniformly above the normal over the region west of the Rocky Mountains. The middle of the month was marked by a general reversal of temperature conditions over the United States, when for the first time in several weeks the region west of the Rocky Mountains showed a deficiency and practically all regions east of the Rocky Mountains, except the Southeastern States, showed an excess in temperature. This condition continued until the close of the month. The last two weeks of the month were unusually warm and dry in all northern districts east of the Rocky Mountains, and a drought of marked severity prevailed in the Northwestern States.

The first half of the month gave general rains in the Missouri and Middle Mississippi valleys, the Gulf and Atlantic States, and Tennessee, and rains continued at frequent intervals in the Southern and Eastern States until the close of the month. The latter half of the month was without the normal rainfall in the Lake region, and generally over the upper Mississippi Valley, the Plains States, the Rocky Mountain and Plateau regions, and the Pacific States.

During the time of unusually low temperature over the Middle West and the eastern districts, the barometric pressure was considerably in excess of the normal over the North Pacific Ocean, and all disturbances that crossed the country were attended by general precipitation and followed by marked changes to lower temperature; when, however, the pressure fell to below the normal over that region, the North Pacific Ocean, disturbances crossing the country were feeble and were not attended by widespread rains. Another feature that is worthy of note is that the pressure in the region of Iceland was greatly in excess of the normal during the prevalence of the warm weather in the region east of the Rocky Mountains. Disturbances that reached the Atlantic coast districts during the first half of the month were greatly retarded in their eastward progression by the building of high barometric pressure over the Canadian Maritime Provinces. A similar condition existed in several instances during the months of April and May, 1910, in consequence of which there were prolonged periods of unsettled and showery weather in eastern districts attending low areas that moved to the Atlantic States from the West.

June opened with a barometric depression over the Lake region and Middle Atlantic States, which gave frequent showers in the region between the Missouri Valley and the Atlantic coast; this was followed by a second disturbance that moved from the Rocky Mountain region and gave showers and thunderstorms, attended by heavy rains, in the South Atlantic and Gulf States. A severe thunderstorm occurred at Augusta, Ga.,

on the 3d, which gave a maximum wind velocity of 60 miles an hour, uprooted trees, unroofed several buildings, and killed a number of animals. Frosts, which were successfully forecast, occurred on several days during the first week in June, and on the 4th and 5th heavy frosts in northern New York and New England did considerable damage to growing crops. Timely warnings of the frosts in these States were issued.

On June 5 the following special forecast was issued:

The general pressure distribution over the North American Continent and the adjacent oceans is such as to indicate that during the present week more nearly normal weather conditions will prevail over the United States. A general reaction to warmer weather will set in over the Middle West and the Eastern States by the middle of the week. The week will open with showers in the Lake region and the Atlantic States and generally fair weather elsewhere. A disturbance will develop over the western Plateau region during Monday and Tuesday and move thence to the Eastern States by the close of the week. It will be attended by rains and preceded by a general change to warmer weather. Cooler weather will prevail over the region west of the Rocky Mountains during the latter half of the week.

On the 6th an area of low barometric pressure over the St. Lawrence Valley caused showers in the Atlantic States and the Lake region; this area moved eastward and it was followed by fair weather in all eastern districts during the middle of the week. An extensive area of low barometric pressure appeared over the Rocky Mountain region on the 6th, whence it moved eastward attended by widespread rains over all districts east of the Rocky Mountains. It caused heavy rains in the Atlantic and Gulf States, the Ohio, Missouri, and middle Mississippi valleys, and an area of local storms, in some instances tornadic in intensity, developed in the middle Mississippi Valley and the Gulf States on the 7th and 8th. This disturbance, on its approach to the Atlantic coast, encountered high barometric pressure over the Canadian Maritime Provinces and its eastward progress was greatly retarded thereby. A disturbance off the middle Atlantic coast on the morning of June 10, caused high easterly winds with fog and rain on the southern New England coast during the afternoon and night of the 10th. Storm warnings were issued the morning of the 10th for the region threatened. This was the only storm warning issued during the month and it was the only one required. Frost warnings were issued for the cranberry marshes of Wisconsin on the 11th.

A general reaction to higher pressure set in over the region of the Azores and the western Atlantic Ocean, and the barometric pressure over the North Pacific again assumed a normal distribution during the second week of June. These conditions called for the following weekly forecast, issued June 12:

The week beginning June 13 will open with generally fair weather throughout the country, except that there will be a continuation of showers the first part of the week in the Atlantic States. The pressure distribution is such as to indicate that the week as a whole will be one with less than the normal rainfall over practically the entire country and with temperatures near or above the normal over the Eastern and Southern States and the Middle West. A change to cooler weather will overspread the Rocky Mountain and Plateau regions and the Plains States during the first three days of the week, followed by rising temperature in these regions beginning Wednesday. A disturbance that is forming over the Plateau region will move eastward and reach the Atlantic coast during the latter half of the week, but the indications are that it will not be attended by general rains.

The week forecast for was marked by an excess of temperature throughout all districts east of the Rocky Mountains, and in the upper Lake region, the Ohio and Mississippi valleys it was the warmest week thus far this summer. Temperatures were variable, but near or slightly below the normal over the Plateau region and on the Pacific coast and were close to the normal in the Southeastern States. There were frequent showers during the week in the Atlantic States, except that the weather was fair during its latter half in the South Atlantic States. No

general storm area passed eastwardly over the country during the week; the disturbances that developed were local and confined to the Northeastern States and the extreme Northwest. On the 18th a severe local thunderstorm developed over extreme southern New York; it was attended by a wind velocity of 58 miles an hour, and caused the loss of several lives by drowning in waters adjacent to New York, N. Y.

In the special bulletin issued June 12, it was stated that a pronounced storm had appeared on the 12th in the region of Iceland, whence it would move eastwardly, attended by stormy weather over the British Isles and northwestern Europe during the next three or four days. This disturbance moved eastwardly as forecast and caused general rains and destructive floods in northern Europe during the period specified.

On June 19 the following special forecast was issued:

The indications are that the week beginning June 20 will give normal summer conditions over the greater part of the country. The temperature will be above the seasonal average over the Plains States and the Mississippi Valley the first half of the week, followed by a change to lower temperature in these regions after Wednesday. Temperature will be near or above the normal over the Eastern and Southern States during the greater part of the week; and over the Plateau and Rocky Mountain regions and on the Pacific coast, it will be below the normal.

The weather became much warmer during the week beginning June 20 over the eastern districts and a warm wave of moderate intensity set in over the Eastern States and continued in the Middle West and the Plains States during the greater part of the week. During the first half of the week the weather was unusually warm in the Northwestern States and the upper Mississippi Valley, where the highest previously recorded temperatures for June were equalled or exceeded at a number of points. A reaction to lower temperature set in over the Eastern States on the 25th and 26th. Heat prostrations were numerous in the large cities of the Mississippi Valley and the Eastern States during the prevalence of the warm wave, and the hot wave in the Northwest was reported to have been very severe on growing crops. Cooler weather set in on the north Pacific coast about the first of the week and as it advanced eastward lower temperatures gradually overspread the northern Rocky Mountain region and Great Plains States, bringing much needed relief from the intense heat over these districts by Wednesday.

Showers were frequent during the last days of the month in the South Atlantic and Gulf States, and there were scattered showers in the Ohio Valley, the Rocky Mountain region, the northern Plains States, and New England.

Average temperatures and departures from the normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
New England.....	12	62.4	- 1.2	+12.8	+ 2.1
Middle Atlantic.....	15	67.5	- 2.6	+ 8.9	+ 1.5
South Atlantic.....	10	74.6	- 1.6	+ 3.2	- 0.5
Florida Peninsula*.....	8	77.9	- 0.6	- 1.7	- 0.3
East Gulf.....	11	76.1	- 2.0	- 0.7	- 0.1
West Gulf.....	10	77.8	- 1.1	+ 2.4	+ 0.4
Ohio Valley and Tennessee.....	13	70.1	- 3.2	+ 0.3	0.0
Lower Lakes.....	10	64.3	- 2.6	+ 6.6	+ 1.1
Upper Lakes.....	12	64.7	+ 2.6	+16.6	+ 2.8
North Dakota*.....	9	67.3	+ 3.3	+25.8	+ 4.3
Upper Mississippi Valley.....	14	70.7	- 0.2	+ 9.6	+ 1.6
Missouri Valley.....	12	70.5	- 0.4	+15.5	+ 2.6
Northern slope.....	9	63.9	+ 1.8	+20.9	+ 3.5
Middle slope.....	6	72.0	+ 0.2	+13.9	+ 2.3
Southern slope*.....	7	78.5	- 1.4	+ 6.3	+ 1.0
Southern Plateau*.....	10	75.5	+ 0.8	+10.1	+ 1.7
Middle Plateau*.....	10	66.0	+ 2.1	+ 9.3	+ 1.6
Northern Plateau*.....	10	63.2	- 0.4	+ 9.9	+ 1.6
North Pacific.....	7	55.8	- 1.7	+ 1.1	+ 0.2
Middle Pacific.....	5	61.7	- 2.5	+ 0.3	0.0
South Pacific.....	4	64.7	- 1.4	+ 7.1	+ 1.2

*Regular Weather Bureau and selected cooperative stations.

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England.....	6.2	+ 1.0	Missouri Valley.....	4.0	- 0.9
Middle Atlantic.....	5.7	+ 0.7	Northern slope.....	4.2	- 0.6
South Atlantic.....	5.7	+ 0.7	Middle slope.....	4.3	+ 0.2
Florida Peninsula.....	5.3	+ 0.1	Southern slope.....	3.2	- 0.6
East Gulf.....	5.5	+ 0.8	Southern Plateau.....	1.6	- 0.4
West Gulf.....	3.6	- 0.7	Middle Plateau.....	2.4	- 0.9
Ohio Valley and Tennessee.....	5.3	+ 0.3	Northern Plateau.....	3.7	- 0.9
Lower Lakes.....	4.8	- 1.0	North Pacific.....	5.8	- 0.3
Upper Lakes.....	4.1	- 0.1	Middle Pacific.....	2.8	- 0.5
North Dakota.....	3.7	- 1.7	South Pacific.....	2.9	- 0.4
Upper Mississippi Valley.....	3.7	- 1.3			

Average precipitation and departures from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
New England.....	11	Inches. 3.79	123	Inches. + 0.7	- 0.7
Middle Atlantic.....	15	4.96	132	+ 1.2	- 0.3
South Atlantic.....	11	6.15	137	+ 1.3	- 5.5
Florida Peninsula*.....	8	7.98	116	+ 1.1	- 4.9
East Gulf.....	11	7.02	155	+ 2.5	- 4.8
West Gulf.....	10	3.11	84	- 0.6	- 3.8
Ohio Valley and Tennessee.....	13	4.19	100	0.0	- 0.6
Lower Lakes.....	10	1.65	46	- 1.9	- 0.8
Upper Lakes.....	12	0.85	27	- 2.5	- 4.4
North Dakota*.....	9	1.70	47	- 1.9	- 4.1
Upper Mississippi Valley.....	15	1.94	45	- 2.4	- 5.4
Missouri Valley.....	12	2.75	63	- 1.6	- 4.7
Middle slope.....	9	1.32	57	- 1.0	- 2.2
Southern slope*.....	7	0.69	22	- 2.5	- 4.4
Southern Plateau*.....	10	0.37	100	0.0	- 1.7
Middle Plateau*.....	11	0.19	34	- 0.4	- 4.2
Northern Plateau*.....	10	0.59	46	- 0.7	- 2.0
North Pacific.....	7	1.39	62	- 0.7	- 1.7
Middle Pacific.....	7	0.10	33	- 0.2	- 5.8
South Pacific.....	4	T.	0	- 0.1	- 4.9

*Regular Weather Bureau and selected cooperative stations.

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England.....	77	+ 2	Missouri Valley.....	62	- 5
Middle Atlantic.....	76	+ 3	Northern slope.....	53	- 4
South Atlantic.....	78	+ 0	Middle slope.....	56	- 4
Florida Peninsula.....	81	+ 1	Southern slope.....	51	- 9
East Gulf.....	77	+ 2	Southern Plateau.....	34	+ 4
West Gulf.....	74	+ 2	Middle Plateau.....	29	- 8
Ohio Valley and Tennessee.....	72	+ 2	Northern Plateau.....	40	- 11
Lower Lakes.....	71	+ 0	North Pacific.....	73	+ 4
Upper Lakes.....	66	- 1	Middle Pacific.....	64	+ 2
North Dakota.....	59	- 9	South Pacific.....	66	0
Upper Mississippi Valley.....	63	- 7			

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Augusta, Ga.....	2	62	w.	North Head, Wash.....	20	62	se.
Cheyenne, Wyo.....	15	50	nw.	Pittsburg, Pa.....	6	50	nw.
Corpus Christi, Tex.....	5	52	nw.	Point Reyes Light, Cal.....	1	58	nw.
Kansas City, Mo.....	8	64	nw.	Do.....	2	58	nw.
Lewiston, Idaho.....	1	54	w.	Do.....	11	58	nw.
Little Rock, Ark.....	3	56	nw.	Do.....	12	64	nw.
Mount Tamalpais, Cal.....	3	54	nw.	Do.....	13	68	nw.
Do.....	13	92	nw.	Do.....	14	55	nw.
Do.....	14	72	nw.	Do.....	15	51	nw.
Do.....	19	62	nw.	Do.....	20	53	nw.
Do.....	20	76	nw.	Do.....	21	69	nw.
Do.....	21	68	nw.	Do.....	22	64	nw.
Do.....	22	72	nw.	Do.....	23	64	nw.
Do.....	27	72	nw.	Do.....	26	54	nw.
Do.....	28	70	nw.	Do.....	27	76	nw.
Do.....	29	63	nw.	Do.....	28	63	nw.
Mount Weather, Va.....	18	50	w.	Do.....	29	52	nw.
Nantucket, Mass.....	10	55	nw.	Sheridan, Wyo.....	8	50	nw.
Nashville, Tenn.....	24	60	e.	Southeast Farallon, Cal.....	11	50	nw.
New York, N. Y.....	18	58	nw.	Do.....	13	54	nw.
North Head, Wash.....	19	60	se.	Do.....	27	52	nw.

In the special forecast for the week beginning June 27 it was stated that generally fair weather was indicated for the greater part of the country during the week, and that such rains as might occur would be confined mostly to the central valleys, the Southern States, and the Lake region. It was forecast

that the week would give temperatures above the normal in all regions east of the Rocky Mountains, and temperatures slightly below the normal on the Pacific coast and in the Rocky Mountain and Plateau regions. The conditions recorded agreed closely with those forecast.

RIVERS AND FLOODS.

By Prof. H. C. FRANKENFIELD, in charge River and Flood Division.

The floods that occurred during the month were confined to the smaller rivers of the country. They were of the usual short duration and were due to excessive precipitation over their immediate watersheds. The most important were those that occurred in Maryland, Virginia, and the Carolinas about the middle of the month.

Heavy rains over the headwaters of the Shenandoah and Potomac rivers from June 10 to 19, inclusive, forced these rivers above flood stages, and considerable damage was done, especially in the vicinity of Cumberland, Md., and along the south branch of the Potomac River, where the railroads suffered heavy losses from washouts of tracks and bridges, and from temporary suspension of business.

A rise of 19.2 feet in 24 hours in the Shenandoah River at Riverton, Va., brought the stage to 24.8 feet, or 2.8 feet above the flood stage, at that place on the morning of June 17. The river fell almost as rapidly, however, and by the morning of June 19 the stage was 6.0 feet. Considerable damage to growing crops resulted.

At Cumberland, Md., on the Potomac River, the crest stage of 9.6 feet, 1.6 foot above flood stage, occurred at 2 p. m., June 19, and the river was out of its banks and playing havoc with railroads and crops for miles above and below that place. At Harpers Ferry, W. Va., the river reached 19.8 feet, 1.8 foot above flood stage, on June 17. The crest stage of 7.4 feet at Washington, D. C., on June 18, caused considerable damage to small craft along the river front, many small boats being torn from their moorings and sunk.

The heavy rains also extended over the western slopes of the Appalachians, causing floods in the Monongahela River and its tributaries, and decided rises in the Licking and Kentucky rivers, with flood stages in the former. Damage to the amount of about \$100,000 was done in the vicinity of Elkins, W. Va., about equally divided between the railroads and the farmers, and as much more along the Monongahela River.

A general rainy period which set in over the watershed of the James River of Virginia, on June 12, caused that stream to overflow its banks from June 14 to 18, inclusive, and considerable damage to crops resulted therefrom. At Buchanan, Va., the crest stage of 15.6 feet was reached on June 14; at Columbia, Va., a stage of 26.0 feet, 8 feet above flood stage, occurred at 9 p. m., June 16, and at Richmond, Va., the highest point reached was 14.1 feet, 4.1 feet above the flood stage, on June 18. Warnings were issued in ample time for precautions to be taken and portable property and live stock were removed to places of safety. It is estimated that about \$35,000 was saved in this manner.

Weather conditions very similar to those over Virginia prevailed over the Carolinas from about June 5 to 17, inclusive, and continuous showers, interspersed with heavy downpours, gradually raised the Cape Fear, the Tar, and the lower Roanoke rivers to heights above the flood stage. Timely warnings issued by the Weather Bureau permitted the removal of stock, etc., likely to be endangered, and it is estimated that about \$50,000 worth of property was saved through the proper observance of these advices. Damage to crops to the extent of about

\$200,000 was caused by the floods, chiefly in the Tar River lowlands.

Similar conditions prevailed in the Pedee, Wateree, and Santee rivers of South Carolina. At Cheraw, S. C., on the Pedee River, the crest stage was 31.8 feet, 4.8 feet above the flood stage, on June 16, and at Smiths Mills, S. C., 14.2 feet, 1.8 foot below the flood stage, on June 24. There was no damage of consequence, and the flood was really very beneficial to lumber interests, as it enabled them to float to market large quantities of logs that had been lying dry since the summer of 1909.

The Wateree River rose to 27.4 feet at Camden, S. C., 3.4 feet above the flood stage, on June 15, and crops along the river to the value of about \$14,000 were destroyed. Losses from other sources were minimized by warnings issued by the Weather Bureau, and it is estimated that property to the value of \$26,000 was saved through their proper observance.

The Santee River was also above flood stage without damage of consequence.

At Blue Rapids, Kans., the Blue River rose 14.7 feet in 24 hours, reaching a stage of 21.5 feet, or 7.5 feet above the flood stage, on June 9. This rise was caused by excessive local rains on June 7 and 8, and was not so pronounced over other portions of the river, although for a short time conditions were somewhat alarming in the vicinity of Marysville, Kans.

Along the Osage River the heavy rains were more general and flood stages were slightly exceeded.

The Arkansas River was low for the season, and at Wichita, Kans., the stage of 3.3 feet below zero on June 30, was the lowest stage of record.

Owing to the dry season in that section, the Mississippi River above the mouth of the Missouri was low throughout the month, but below Alton, Ill., the stages were more in keeping with the time of year. Good stages also prevailed in the Ohio River, and in the Missouri River east of the State of Montana.

Heavy showers occurred during the early evening of June 17, in the lower Paradise Valley, 18 miles northeast of Phoenix, Ariz. The area affected was probably not over 25 square miles in extent, but the amount of rainfall was estimated at between 2.50 and 3.50 inches, of which at least 1.50 inch fell between 4:30 and 6:00 p. m. The Arizona Canal at Indian Head, on the Pima Indian Reservation, was washed out in 21 places, and there was a rise of 2.3 feet in the Salt River at Tempe, Ariz., during the early morning of June 28. There was no loss of life, but a number of horses and cattle were lost. Notice of the rise was sent out to all interested.

The rivers of the Pacific were low as had been previously forecast, and at some places along the Sacramento River the stages were the lowest of record for the season of the year.

Hydrographs for typical points on several principal rivers as shown on Chart I. The stations elected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.