

est was 111°, at Mount Pleasant on the 10th, and the lowest, 35°, at Loa on the 20th. The average precipitation was 0.40, or 0.42 below normal; the greatest monthly amount, 1.56, occurred at Parowan, and the least, trace, at Corinne.—*J. H. Smith.*

Virginia.—The mean temperature was 73.7°, or 1.3° below normal; the highest was 100°, at Farmville on the 3d, and at Petersburg, Bonair, and Nottoway on the 30th, and the lowest, 47°, at Doswell on the 10th, and at Dale Enterprise on the 26th. The average precipitation was 2.42, or 1.17 below normal; the greatest monthly amount, 5.62, occurred at Warsaw, and the least, 0.33, at Farmville.—*E. A. Evans.*

Washington.—The mean temperature was 67.7°, or 2.4° above normal; the highest was 109°, at Fort Simcoe on the 20th, and the lowest, 32°, at Wenatchee Lake on the 25th. The average precipitation was 0.55, or 0.05 below normal; the greatest monthly amount, 2.66, occurred at Tatoosh Island, while none fell at Fort Simcoe.—*G. N. Salisbury.*

West Virginia.—The mean temperature was 70.9°, or 3.0° below normal; the highest was 100°, at New Martinsville on the 4th, and the lowest, 42°, at Beckley on the 27th. The average precipitation was 2.91, or 1.00 below normal; the greatest monthly amount, 5.93, occurred at White Sulphur Springs, and the least, 0.77, at Beckley.—*H. L. Ball.*

Wisconsin.—The mean temperature was 64.9°, or 2.4° below normal; the highest was 97°, at Gratiot on the 28th, and the lowest, 28°, at Crandon on the 19th. The average precipitation was 2.40, or 0.12 below normal; the greatest monthly amount, 5.25, occurred at Citypoint, and the least, 0.55, at Gratiot.—*W. M. Wilson.*

Wyoming.—The mean temperature was 65.6°, or 1.4° below normal; the highest was 101°, at Carbon on the 12th, and the lowest, 31°, at Atlantic City on the 25th. The average precipitation was 1.35, or 0.54 above normal; the greatest monthly amount, 2.60, occurred at Wheatland, and the least, 0.01, at Strong.—*M. G. Renoe.*

RIVER AND FLOOD SERVICE.

By PARK MORRILL, Forecast Official, in charge of River and Flood Service.

The rivers are now very near their lowest, the stage of none exceeding 10 feet at the close of the month. A slight swell occurred in the lower Mississippi during the first half of the month, most marked at Vicksburg.

The highest and lowest water, mean stage, and monthly range at 112 river stations are given in the accompanying table. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are: Keokuk, St. Louis, Cairo, Memphis, and Vicksburg, on the Mississippi; Cincinnati, 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.

The following résumé of river stages and conditions of navigation in the respective streams is compiled from reports by the officials of the Weather Bureau at various river stations and section centers:

Hudson River. (Reported by A. F. Sims, Albany, N. Y.)—The Hudson was at its normal summer level during the first decade of August. During the night of the 10th and 11th heavy rainfall caused the Mohawk and Hudson rivers to rise 2 feet, and by the afternoon of the 11th tugs and steamboats had trouble in making landings. The dam at Boonville, N. Y., was swept away on the 11th, and the mills in that vicinity were badly damaged. The heavy rains in the Normanskill Valley, at the western end of Schenectady County, made the stream bank full, and, during the 11th, five bridges between Duanesburg and South Schenectady, N. Y., were carried away and the meadows covered with a deposit of gravel. The Hudson River reached the lowest point since the opening of navigation by the 22d. The heavy rains of the 23d and 24th on the upper Hudson watershed found its way to the tributaries within twenty-four hours, and caused turbidity in the tide-water portion of the Hudson. Practically no rain fell on the watershed during the last week of August, so that the end of the month finds a low stage of water in the Hudson between Troy and Coxsackie.

Susquehanna River and branches. (Reported by E. R. Demain, Harrisburg, Pa.)—Heavy showers during the latter part of July caused fair stages at the beginning of August in most of the streams of the Susquehanna system, and especially in the lower river, but the waters fell slowly and the month closed with low water throughout the system. Heavy local showers from the 20th to the 25th were followed by a slight rise in the river at Harrisburg and stations above. At Cedar Run and Sinnemahoning, on the west branch, the gauge readings were below zero during the entire month, and at Wilkesbarre, on the north branch, the water fell to a zero stage on the 10th, and ranged from zero to 1 foot below during the remainder of the month. The gauge readings for 14 reporting stations averaged 1.3 foot for the month, and the average rainfall for 17 stations was 3.0 inches.

Rivers of South Atlantic States. (Reported by E. A. Evans, Richmond, Va.; C. F. von Herrmann, Raleigh, N. C.; L. N. Jesunofsky, Charleston, S. C.; D. Fisher, Augusta, Ga.; and J. B. Marbury, Atlanta, Ga.)—The rainfall over the James River basin for the month, though somewhat in excess of the normal, caused no rise in the stream. A low and uniform stage of water prevailed during the entire month. The water was unusually clear all the month and was brackish at lower river points, where it is usually fresh.

During the month the rivers throughout North Carolina remained continuously low, and the ranges were extremely small. The precipitation at many points this year was less than during the remarkable drought of August, 1896, and the principal streams at the end of the

month had fallen to the unusually low stages of last year. The Roanoke at Danville was below the zero of the gauge the greater portion of the month, and navigation did not extend above Hamilton. The lowest stage reached at Fayetteville, on the Cape Fear River, in 1896, was 1.9 foot on August 12, as compared with 2.3 feet on August 5, this year. No interruption of milling in consequence of present low stages has yet been reported.

The frequent and heavy rains over North Barnwell, Orangeburg, Aiken, Lexington, and Edgefield counties from the 14th to 22d produced a severe freshet along the entire length of the Edisto River from Johnston to Jacksonboro, continuing to the end of the month. On the 15th there was a 4.6 foot stage of water at Edisto; following this date, a steady, daily rise of nearly 0.2 foot occurred until the morning observation of the 26th, at which time the gauge registered 6.6 feet, or 0.1 foot above the danger line; by the morning of the 27th, the stream had receded 0.1 foot, and declined very slowly the remaining days of the month. The freshet reached Jacksonboro on the 27th, and proved a great loss to the rice planters on the lower river, coming at a time when the rice was ripening fast, and required the immediate drainage of the plantations for the purpose of harvesting. Thousands of acres of matured rice were spoiling for the want of drainage, which could not be effected because the stream was more elevated than the water in the rice fields. In some few instances on the low margin of the swamp lands, late corn was damaged to a limited extent. The Aiken Manufacturing Company's milldam, at Bath, was washed away on the 21st, and considerable damage was done to the roads in Orangeburg County.

The rainfall throughout the upper Savannah Valley was greater than the average amount, while in the immediate vicinity of Augusta it was more than double; the constant rain in this section from the 14th to the 23d was a source of much apprehension to the river planters. The critical period arrived on the 19th, when the river was beginning to feel the effects of the general rains above, and in consequence rose steadily until the 21st; it then fell 4.5 feet, but before night another rise was on, which culminated in a 20.4 foot river at Augusta on the early morning of the 22d. After this, to the end of the month, its fall was regular, but a few more feet on the 22d would have played havoc with the corn. Navigation was regularly carried on during the month, there being a marked increase in the carrying trade, both down and up stream, over that of last month. The stages have continued low in other Georgia streams, though there were several heavy rains at intervals.

Mobile River and branches. (Reported by F. P. Chaffee, Montgomery, Ala., and W. M. Dudley, Mobile, Ala.)—During the first half of the month, the rains were sufficient and so well distributed as to prevent any rapid decline in the Alabama and its tributaries, and a light draught stage was maintained. From the 16th to the 24th, continuous and, on some dates, heavy rains, caused the rivers to rise to decidedly higher than the average stage at this season, giving good boating stages during the latter half of the month, with a gradual decline in the rivers during the last week.

There was a gradual fall in the Tombigbee and its tributaries from the opening of the month to the 7th, when heavy rains on the 8th and 9th caused a steady rise, making good stages by the 15th. The rains on the 19th to 22d also produced a gradual rise.

Ohio River and branches. (Reported by F. Ridgway, Pittsburg, Pa.; H. L. Ball, Parkersburg, W. Va.; S. S. Bassler, Cincinnati, Ohio; F. Burke, Louisville, Ky.; P. H. Smyth, Cairo, Ill.; L. M. Pindell, Chattanooga, Tenn.; and H. C. Bate, Nashville, Tenn.)—Comparatively low stages of water prevailed in the upper Ohio throughout the entire month, although the larger packets were not forced to entirely suspend operations until the 23d. The lighter packets were not tied up until the last week of the month. The month closed with all navigation suspended on account of low water. The month opened with the wickets

in Davis Island Dam down; they were raised on the 4th, lowered on the 18th, and raised again on the 21st, remaining up for the balance of the month. No coal was shipped for southern ports during the month.

The rainfall over West Virginia during August was light and all the rivers showed slowly falling stages. The Great Kanawha River was, however, freely navigable until about the 25th, when the water became so low that the larger packets went to the bank. Navigation on the Little Kanawha was entirely closed after the 21st, in order that repairs could be made to the locks along the stream.

At Cincinnati, after a rise in the latter part of July, which prolonged the navigable condition of the river, and caused the longest period of uninterrupted navigation for many years, the river steadily fell during August. The month closed with a decidedly low river, lower than at any time during the season, and only the smallest craft could navigate. Menacing snags and sandbars appeared and put an end to navigation, which is now practically suspended.

While the average depth of water at Louisville for the month was only 5.4 feet, 1 foot lower than the month before, there was no interruption to navigation. The highest water was 8.5 feet on the 1st, then there was a steady decline until the 20th, when the lowest for the month, 4.1 feet, was reached. A slight rise occurred from the 21st to the 28th. At the close of the month the river was again falling slowly.

At Cairo the river fell steadily during the entire month. During the first decade the fall averaged 0.8 of a foot daily; during the second and third decades, 0.3 of a foot daily.

The Tennessee River remained navigable at Chattanooga to large boats during the first fifteen days of the month, and from the 18th to the 25th. At Kingston, Knoxville, and Bridgeport the river was low during the entire month, and only navigable to light draught boats. The rainfall during the month did not have much effect on the river, the precipitation being nearly all absorbed by the soil. Over the lower river, as far as Riverton, the stage was below the 3-foot mark for twenty-six days; the highest water was 5.0 feet, on the 1st. On the 31st the river was below the 1-foot mark at Riverton, Bridgeport, and Kingston.

The month opened with water in the Cumberland for navigation as far up as Carthage, but falling steadily. On the 6th, 7th, and 8th rains fell over the territory drained by the Cumberland's tributaries, and a good rise in the river was evident on the 7th at Carthage, and lower points on succeeding dates. Navigation closed above Nashville on the 15th, and, although the river has been open all the month to lower points, its present stage threatens to close it by September 10, at latest.

Mississippi River and minor branches. (Reported by P. F. Lyons, St. Paul, Minn.; M. J. Wright, Jr., La Crosse, Wis.; G. E. Hunt, Davenport, Iowa; F. Z. Gosewisch, Keokuk, Iowa; H. C. Frankfield, St. Louis, Mo.; P. H. Smyth, Cairo, Ill.; S. C. Emery, Memphis, Tenn.; R. J. Hyatt, Vicksburg, Miss.; R. E. Kerkam, New Orleans, La.; and C. Davis, Shreveport, La.)—Although the stage of water in the Mississippi river from St. Paul to La Crosse diminished considerably, still a satisfactory boating stage was maintained during the month, and the very satisfactory river traffic of the preceding month continued. The opinion is expressed by river captains that there has been much filling of the channel as a result of the spring flood.

The Mississippi River in the vicinity of La Crosse maintained a very satisfactory level, in view of the fact that such level was maintained by the natural flow of the river, and without the use of the reservoirs at the headwaters. For a number of years the river has been very low in August; even with the aid of the reservoirs a sufficient stage to make navigation possible was secured with difficulty. It is expected that the Government engineers will not direct the opening of the reservoirs this year until early in September. It will then take eight or ten days for the rise to be felt in St. Paul, and from that time on the reservoirs are expected to discharge sufficient to maintain a navigable stage for the balance of the season.

The month opened at this point with a stage of 8.5 feet on the gauge, the water rising up to the 5th instant, when a maximum stage of 9.0 feet was attained. From the 5th to the last day of the month the river steadily declined, reaching a minimum of 4.1 feet on the 31st. A serious obstacle to navigation developed during the latter part of the month at Rollingstone, a few miles above Winona, Minn. The packet *Quincy*, of the Diamond Joe line, made the discovery that there was scarcely 3.5 feet of water in the channel at Rollingstone. A bar had formed and the packet went aground. There was plenty of water above and below the bar. This bar was caused by the Chippewa River, which last spring washed down large quantities of sand. The Government engineers put a force of men to work on the bar, and by the end of the month it was reduced so as not to impede navigation, the stage of water having been increased to 5 feet.

The river at Keokuk fell almost steadily throughout the month. Navigation of the Des Moines Rapids was practically suspended by the 20th, with a stage of 3.1 feet at the upper end of the rapids, although a steamboat with a raft of logs in tow attempted a passage on the 28th. The logs struck on sunken rocks and the raft was broken up during the passage.

At the close of the month the water between Cairo and St. Louis was too low for steamboating, except in a light way. With a continued falling river it is very likely that by September 10 Cairo will be practically the head of navigation. Steamers up from the south will then

have to transfer passengers and cargoes at this point to the several railroads, to be forwarded to their destination.

During the first three days of the month the river between Cairo and Memphis rose about 1 foot, the reading on the 3d being 16.4 feet at the latter point. On the 4th it began to fall, and the decline continued steadily up to the close of the month, when the stage of water was 10.4 feet lower than at the beginning of the fall. The gauge reading on the 31st was 6.0 feet, which is 2.7 feet below that of the same date in 1896, and 3.0 feet above that of 1895. The rainfall for this section was below the average, and was mostly confined to local showers. In some of the tributaries the water became so low at the close of the month that boating was somewhat difficult, but in the Mississippi a good boating stage was maintained throughout the month.

The rivers between Memphis and Vicksburg were low, as usual during the month of August, being lowest at the close of the month. Nothing of importance was noted in connection with the navigation of the rivers, except the closing of the mouth of the Yazoo by the sandbar which forms at that point during low stages of water, thus closing the lower Yazoo River to traffic until a rise occurs in that river or the Mississippi sufficient to clear the bar at the mouth. River business has been fair during the month, but the principal carrying trade will commence when the cotton season is fully opened later, although some cotton has already been shipped to market.

The fluctuations at New Orleans amounted to only 2 feet during the entire month. The Red and lower Ouachita continued at a low stage during the entire month, navigation being impossible, except for the lightest kind of craft. The stage at Alexandria was below the zero of the gauge during ten of the last fifteen days of the month, and the heavy rains of the week ending the 23d caused a rise of but 4 feet at that point.

Missouri River and branches. (Reported by L. A. Welsh, Omaha, Nebr., and P. Connor, Kansas City, Mo.)—The Missouri River continued to fall slowly and steadily throughout the month. The average stage of water was about 1 foot lower than that for a corresponding period during the past four years. The entire range of water at Omaha during the month was from 9.0 feet to 6.6 feet, or a fall of 2.4 feet. No further complaint has been heard of cutting at Plattsmouth, Nebr., or at Manawa, Iowa, and no information has been received of any unusual conditions of river during the month.

Arkansas River. (Reported by J. J. O'Donnell, Fort Smith, Ark., and F. H. Clarke, Little Rock, Ark.)—The river westward from Fort Smith was below a navigable stage and falling until the 8th; the heavy rain of the 8th and 9th caused a rise from 2.0 to 8.9 feet on the morning of the 10th at Fort Smith. From this date it fell steadily until the end of the month, excepting a rise of 1.2 foot on the morning of the 20th. The river was navigable west of Fort Smith only from the afternoon of the 9th to the 13th.

Navigation of the river was pursued uninterruptedly from Little Rock to the mouth during the entire month, but was suspended between Little Rock and Dardanelle on account of low water from the 1st to 9th, from the 17th to 21st, and from the 26th to the end of the month.

The decline in the river, that set in on July 25, continued until August 8, when the river began rising at Fort Smith; it rose at Dardanelle on the 10th, 11th, and 12th, and at Little Rock on the 11th, 12th, and 13th, the total rise being 6.9 feet at Fort Smith, 6.8 feet at Dardanelle, and 5.5 feet at Little Rock. The river then declined steadily until the 20th, when a slight rise appeared at Fort Smith, which was felt at Dardanelle on the 21st and 22d, and at Little Rock on the 22d to 24th, the river then declining steadily to the end of the month.

Rivers on the Pacific Coast. (Reported by W. H. Hammon, San Francisco, Cal., and J. A. Barwick, Sacramento, Cal.)—The Sacramento River at Sacramento has ranged between 10.0 and 8.6 feet. With the latter stage there is some trouble in navigation a short distance below the city, from the formation of sandbars caused by slickens from the hydraulic mines in the mountains. Usually navigation has not been obstructed until the gauge at this point indicated a stage of from 7 to 7.6 feet, at which time navigation would be obstructed at several points between Sacramento and the mouth of the river. The water has entirely receded from the arable lands in the tule basins, which land is now covered with a good growth of grass, beans, potatoes, corn, and buckwheat. The river at this point usually reaches its lowest stage in September. During dry autumns the low stage continues until the early part of December. The lowest stage in the past twenty years was 6 feet in November, 1879.

Heights of rivers above zeros of gauges, August, 1897.

Stations.	Distance to mouth of river.	Danger line on gauge.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
<i>Mississippi River.</i>	Miles.	Feet.	Feet.		Feet.		Feet.	Feet.
St. Paul, Minn.	1,957	14	8.9	1	4.5	30.31	6.2	4.4
Reeds Landing, Minn.	1,887	12	7.4	1.2	2.9	31	4.9	4.5
La Crosse, Wis.	1,829	10	9.0	4.5	4.1	31	6.5	4.9
North McGregor, Iowa ...	1,763	18	9.2	6-9	3.9	31	6.9	5.3
Dubuque, Iowa ...	1,702	15	8.8	7-11	3.8	31	6.9	5.0

