

noon and night of the 18th. The storms of the 17th in Nebraska appear to have been most severe in the Wood River Valley, where many houses were reported destroyed and a number of people were injured. On the morning of the 17th thunderstorms were forecast for the States of the lower Missouri Valley, and observers were advised that severe storms would probably occur in that section.

The storms of the afternoon and night of the 18th were especially disastrous in eastern Iowa, northern Illinois, and Wisconsin, where a number of people were killed, many injured, and property and stock were destroyed to the value of many thousands of dollars. On the morning of the 18th severe thunderstorms were forecast for eastern Iowa, northern Illinois, northern Indiana, and southern Minnesota. Shipping on Lake Michigan was warned of heavy squalls that would attend thunderstorms on the night of the 18th, and the Chicago local forecast also gave warning of severe thunderstorms that night. Exceptionally severe thunderstorms and squalls did occur in Chicago and over southern Lake Michigan in exact fulfillment of the forecasts made.

**FORECASTS ON PACIFIC COAST.**

During the month no wind signals were ordered and there were no storms. The most important work done by the Bureau in the Pacific northwest is through the river forecasts. More property and expense are saved by the river forecasts than by any other work done by this office. The forecasts are practically accurate. They cover the movements of the river for from two to five days. On the morning of May 20 a warning was issued to the effect that water would enter cellars on Front street, Portland, on Sunday. The merchants put many persons to work clearing out cellars, and no goods were injured by water. The river rose as was expected.

The following letter from Mr. F. C. Mathews, a rancher at Scott, Klickitat County, Wash., shows of what value the river service may be. He had written to the office of the Weather Bureau at Portland, Oreg., for information about the river, stating that his hay crop was in danger. He again writes under date of May 29, 1898:

The daily river bulletins, also your letter of the 27th inst., have been duly received. The bulletins are of inestimable value to me and, accompanied by your letter of additional explanation and suggestion, enabled me to save my hay crop and avoid unnecessary work on overflowed land. I disseminated the information received up and down the river and posted the bulletins where they would be seen by other ranchers.

**AREAS OF HIGH AND LOW PRESSURES.**

During the month the paths of nine areas of high and the same number of low pressure have been sufficiently well defined to be traced upon Charts I and II. It should be noted that during the warm months it is often very difficult to follow the motion of a high or low. The conditions are often extremely indefinite and are frequently characterized by a disturbed region covering quite a large area with clouds but with little clearness in the trend of the isobars. Again, there seems to be a transference of these conditions over long distances without any definite motion. The accompanying table gives the principal facts regarding the place of origin and disappearance of these highs and lows, and of their duration and velocity, and the following description is added:

*Highs.*—Three of the highs were first noted on the Pacific coast while all the rest came down from the north of Montana. No. VIII began off the south Pacific coast and appeared to move up the coast for two days, finally entering the country from the Washington coast. Only three of the highs reached the Atlantic, the rest disappearing in the interior or being merged in the rather permanent high pressure over the Gulf of Mexico.

*Lows.*—Two of the lows could be traced from the south Pacific coast to the western Gulf of Mexico. Four were first noted over the northern plateau region and the other three were first seen in the lower Missouri Valley. Six of these lows disappeared off the Atlantic coast, two in the western Gulf, and one in the Ohio Valley. These conditions were very moderate throughout the month and their mean velocity, 19 miles an hour, was considerably less than the normal velocity. The highest winds of the month along the Gulf, Lakes, and Atlantic were reported as follows:

As low No. II moved to the Atlantic, Wilmington reported 38 miles an hour from the southwest on the evening of the 6th, and on the same date Cape Henry had the same velocity from the northeast. As this same low moved very slowly up the coast it caused a northeast wind of 72 miles per hour at Block Island on the afternoon of the 8th. On the afternoon of the 19th as low No. VI moved into the St. Lawrence Valley a southwest wind of 48 miles was experienced at Cleveland, Ohio. On the afternoon of the 21st, as low No. VII moved to the upper Lake region, Chicago reported a south wind of 46 miles an hour.

*Movements of centers of areas of high and low pressure.*

Number.	First observed.			Last observed.			Path.		Average velocities.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long. W.	Length.	Duration.	Daily.	Hourly.
<b>High areas.</b>		o	o		o	o	<i>Miles.</i>	<i>Days.</i>	<i>Miles.</i>	<i>Miles.</i>
I.....	*29, a. m.	54	113	2, a. m.	43	104	1,020	3.0	340	14.2
II.....	2, a. m.	53	112	9, a. m.	29	90	3,660	7.0	521	21.7
III.....	7, a. m.	47	129	11, p. m.	28	95	2,490	4.5	553	23.0
IV.....	11, a. m.	50	114	14, a. m.	39	81	2,040	3.0	690	28.3
V.....	13, a. m.	53	110	19, p. m.	39	75	2,970	6.5	457	19.0
VI.....	19, a. m.	51	100	23, a. m.	47	58	2,550	4.0	638	26.6
VII.....	19, a. m.	43	127	22, a. m.	32	99	1,980	3.0	660	27.5
VIII.....	21, p. m.	34	122	71, p. m.	32	73	5,610	11.0	510	21.3
IX.....	23, p. m.	53	98	26, a. m.	49	83	990	2.5	396	16.5
Total.....							23,310	44.5	4,755	.....
Mean of 9 tracks.....							2,590	.....	528	22.0
Mean of 44.5 days.....							.....	.....	524	21.8
<b>Low areas.</b>										
I.....	1, a. m.	32	119	5, p. m.	26	99	1,880	4.5	407	17.0
II.....	4, p. m.	34	96	8, a. m.	39	73	1,710	3.5	489	20.4
III.....	4, p. m.	48	122	15, p. m.	48	55	4,560	11.0	415	17.3
IV.....	6, a. m.	32	116	10, p. m.	26	96	1,470	4.5	327	13.6
V.....	12, p. m.	41	117	16, p. m.	38	86	1,710	4.0	428	17.8
VI.....	14, p. m.	46	119	20, p. m.	51	65	3,240	6.0	540	22.5
VII.....	18, p. m.	38	100	26, a. m.	34	74	2,910	7.5	388	16.2
VIII.....	25, p. m.	45	101	30, a. m.	48	65	2,220	4.5	498	20.5
IX.....	26, p. m.	47	119	30, p. m.	36	73	2,850	4.0	712	29.7
Total.....							22,500	49.5	4,199	.....
Mean of 9 tracks.....							2,500	.....	467	19.4
Mean of 49.5 days.....							.....	.....	455	18.9

\* April. † June.

**RIVERS AND FLOODS.**

With the exception of a flood in the Arkansas during the first half of the month, the rivers had a tendency to lower stages, which indicates the approach of the usual summer conditions.

General and heavy precipitation during the first few days of the month, in the valleys drained by the Arkansas River and its tributaries, caused a rapid and unusual rise in that stream. The danger line at Little Rock was passed on the 6th and was exceeded on ten consecutive days thereafter.

During this flood the high water record at Fort Smith and Dardanelle, Ark., was broken. At Fort Smith, the highest of record, heretofore, was 30.9 feet, which occurred May 19, 1892, and at Dardanelle the highest of record was 27.9 feet, which occurred May 18, 1892. During the flood of the present year the water at Fort Smith and Dardanelle registered 35.4 and 29.3 feet, respectively.

The highest and lowest water, mean stage, and monthly range at 118 river stations are given in the accompanying table. Hydrographs for typical points on seven principal rivers are shown on Chart No. VII. 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.

For fuller details see Monthly Bulletin of the River and Flood Service for May, 1898.

Heights of rivers referred to zeros of gauges, May, 1898.

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>	<i>Miles.</i>	<i>Feet.</i>	<i>Feet.</i>		<i>Feet.</i>		<i>Feet.</i>	<i>Feet.</i>
St. Paul, Minn.	1,957	14	5.0	30, 31	2.9	13, 14	3.7	2.1
Reeds Landing, Minn.	1,887	12	4.5	31	2.7	18	3.2	1.8
La Crosse, Wis.	1,822	10	4.7	1, 2, 31	3.8	20, 21	4.2	0.9
North McGregor, Iowa.	1,782	18	5.8	1	3.8	22, 25	4.4	2.0
Dubuque, Iowa	1,702	15	5.8	1, 2	3.7	24, 25	4.4	2.1
Leclaire, Iowa	1,612	10	4.0	3	2.6	27	3.2	1.4
Davenport, Iowa	1,475	15	5.0	3	3.4	27	4.0	1.6
Galland, Iowa	1,466	14	6.6	30	3.5	14, 29, 30	4.4	3.1
Keokuk, Iowa	1,405	17	11.7	21	4.8	31	6.6	6.9
Hannibal, Mo	1,307	23	18.1	23	9.2	18, 14	12.3	8.9
Grafton, Ill	1,264	30	27.2	23	14.8	2	20.8	12.4
St. Louis, Mo.	1,189	30	22.2	24	11.4	2	16.4	10.3
Chester, Ill.	1,073	40	35.3	26	27.2	18	30.7	8.1
Cairo, Ill.	843	33	26.3	28, 29	19.9	20	22.6	6.4
Memphis, Tenn	787	44	36.4	30	30.3	21	33.0	6.1
Helena, Ark.	635	42	45.4	1	39.5	8, 9	38.9	5.9
Arkansas City, Ark.	595	40	40.3	1	33.9	9	36.3	6.4
Greenville, Miss	474	41	47.8	1	41.9	13-15, 28-30	43.2	5.9
Vicksburg, Miss	108	16	17.0	1	14.8	23-25, 27, 30, 31	15.5	2.2
<i>Arkansas River.</i>								
Wichita, Kans.	720	10	5.3	2, 3	2.1	18, 25	2.9	3.2
Fort Smith, Ark.	345	22	35.0	7	5.4	1	18.0	29.6
Dardanelle, Ark.	230	21	29.3	10	6.5	1	17.8	22.8
Little Rock, Ark.	170	23	27.2	11	9.5	1	19.9	17.7
<i>White River.</i>								
Newport, Ark.	150	26	32.1	8	14.3	1	22.6	17.8
<i>Des Moines River.</i>								
Des Moines, Iowa	150	19	4.6	26, 29	3.9	10, 11, 16-21	4.1	0.7
<i>Illinois River.</i>								
Peoria, Ill.	135	14	14.2	26	8.8	15	11.1	5.4
<i>Missouri River.</i>								
Bismarck, N. Dak.	1,901	14	9.3	31	3.8	17, 18	5.8	5.5
Pierre, S. Dak.	1,006	14	8.3	30	4.2	19	5.5	4.1
St. Joseph, Iowa	679	19	12.9	30	8.0	11	9.4	4.0
Omaha, Nebr.	561	18	12.1	31	8.2	12, 13	9.2	3.9
St. Joseph, Mo.	373	10	7.3	31	3.4	15	4.7	3.9
Kansas City, Mo.	280	21	16.7	31	10.4	13	13.1	6.3
Boonville, Mo.	191	20	16.9	21	9.8	1	13.5	7.1
Hermann, Mo.	95	24	18.0	22	9.6	1	14.7	8.4
<i>Ohio River.</i>								
Pittsburg, Pa.	966	22	13.5	18	3.2	7	6.6	10.3
Davis Island Dam, Pa.	960	25	13.3	18	5.6	6, 7	8.2	7.7
Wheeling, W. Va.	875	38	16.9	19	6.5	7	10.1	10.4
Parkersburg, W. Va.	785	35	18.9	19	8.4	6	12.0	10.5
Point Pleasant, W. Va.	703	36	21.8	20	7.9	6	14.8	13.9
Catlettsburg, Ky	651	50	25.7	20	11.2	6	19.0	14.5
Portsmouth, Ohio	612	50	26.5	21	12.8	6	20.5	13.7
Cincinnati, Ohio	490	45	28.5	1	16.9	6	23.7	11.6
Louisville, Ky.	367	24	10.6	22	8.6	6	9.7	2.0
Evansville, Ind.	184	30	23.1	25	16.3	20	20.1	8.8
Paducah, Ky.	47	40	23.1	26	16.7	19, 20	20.1	6.4
<i>Allegheny River.</i>								
Warren, Pa.	177	7	4.0	21, 23	1.8	17-19	2.5	2.2
Oil City, Pa.	123	13	5.5	21	2.2	11	3.2	3.3
Parkers Landing, Pa.	73	20	6.2	21	2.0	11	3.3	4.2
Freeport, Pa.	26	20	10.5	21	4.1	6, 7	6.4	6.4
<i>Conemaugh River.</i>								
Johnstown, Pa.	64	7	4.6	16	1.8	3-5	2.6	2.8
<i>Red Bank Creek.</i>								
Brookville, Pa.	35	8	1.7	27, 28	1.0	1-18	1.2	0.7
<i>Beaver River.</i>								
Ellwood Junction, Pa.	10	14	2.8	21	0.6	31	1.4	2.2
<i>Cumberland River.</i>								
Burnside, Ky	434	50	9.5	9	3.5	31	5.8	6.0
Carthage, Tenn.	257	30	8.2	1	3.8	31	6.0	4.4
Nashville, Tenn.	175	40	13.1	1	6.2	20, 21	8.8	6.9
<i>Great Kanawha River.</i>								
Charleston, W. Va.	61	30	14.8	8	4.1	5, 6	6.7	10.7
<i>New River.</i>								
Hinton, W. Va.	95	14	7.0	7	1.8	4, 5	3.0	5.2
<i>Licking River.</i>								
Falmouth, Ky.	30	25	11.1	7	1.6	31	3.6	9.5
<i>Miami River.</i>								
Dayton, Ohio	69	18	5.2	16	1.8	31	2.8	3.4

Heights of rivers above zeros of gauges—Continued.

Stations.	Distance to mouth of river.	Danger line on gauge.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
<i>Monongahela River.</i>	<i>Miles.</i>	<i>Feet.</i>	<i>Feet.</i>		<i>Feet.</i>		<i>Feet.</i>	<i>Feet.</i>
Weston, W. Va.	161	18	3.0	16	-0.6	3-7	0.3	3.6
Fairmont, W. Va.	119	25	15.1	17	0.8	30, 31	3.1	14.3
Greensboro, Pa.	81	18	18.7	17	7.6	31	9.1	11.1
Lock No. 4, Pa.	40	28	19.0	18	7.1	6	9.7	11.9
<i>Cheat River.</i>								
Rowlesburg, W. Va.	38	14	9.0	17	1.9	5	4.0	7.1
<i>Youghiogheny River.</i>								
Confluence, Pa.	59	10	4.7	23	1.1	6	2.3	3.6
West Newton, Pa.	15	23	6.5	17	1.1	7	2.5	5.4
<i>Muskingum River.</i>								
Zanesville, Ohio	70	20	17.7	17	8.2	6	11.5	9.5
<i>Tennessee River.</i>								
Knoxville, Tenn.	614	29						
Kingston, Tenn.	534	25	3.8	27	1.4	24, 25	1.9	2.4
Chattanooga, Tenn.	430	33	6.5	1	3.4	24, 25	4.3	3.1
Bridgeport, Ala.	390	24	5.0	1	1.8	24, 25	7.7	3.2
Florence, Ala.	220	16	5.5	2	1.6	27, 28	2.9	3.9
Johnsonville, Tenn.	94	21	9.0	1	3.0	23, 30	5.1	6.0
<i>Cinch River.</i>								
Speers Ferry, Va.	156	20	6.6	24	0.3	3, 3, 5, 6	1.1	6.3
Clinton, Tenn.	46	25	12.0	26	3.8	6, 7	5.6	8.2
<i>Wabash River.</i>								
Mount Carmel, Ill.	50	15	15.8	30	5.4	30	9.5	10.4
<i>Red River.</i>								
Arthur City, Tex.	638	27	21.1	8	4.0	3	10.3	17.1
Fulton, Ark.	565	28	27.9	11	7.2	3	18.9	20.7
Shreveport, La.	449	29	14.9	21	5.7	5	11.9	9.2
Alexandria, La.	133	33	15.0	26, 27	7.7	2	12.0	7.3
<i>Atchafalaya Bayou.</i>								
Melville, La.	100*	31	33.9	1-4	32.1	29-31	32.9	1.8
<i>Ouachita River.</i>								
Camden, Ark.	340	39	28.9	10	6.8	21	16.5	22.1
Monroe, La.	100	40	20.8	21, 22	18.8	6	19.9	2.0
<i>Yazoo River.</i>								
Yazoo City, Miss.	80	25	24.0	1	16.9	29-31	19.9	7.1
<i>Chattahoochee River.</i>								
Columbus, Ga.	140	20	2.5	1	-0.9	25, 26	0.5	3.4
<i>Flint River.</i>								
Albany, Ga.	80	20	4.3	1	1.0	20-22	1.7	3.3
<i>Cape Fear River.</i>								
Fayetteville, N. C.	100	38	12.0	25	2.9	24	5.8	9.1
<i>Columbia River.</i>								
Umatilla, Ore.	270	25	20.8	31	12.1	3	15.8	8.1
The Dalles, Ore.	166	40	34.4	31	20.8	4	25.7	13.6
<i>Willamette River.</i>								
Albany, Ore.	99	20	4.0	1, 2	2.8	10, 11, 26, 28	3.2	1.2
Portland, Ore.	10	15	18.1	31	11.3	2-4	13.7	6.8
<i>Edisto River.</i>								
Edisto, S. C.	75	6	4.7	3	1.3	24	2.6	3.4
<i>James River.</i>								
Lynchburg, Va.	257	18	7.6	8	0.9	5	2.6	6.7
Richmond, Va.	110	12	10.2	9	0.2	4, 5	2.0	10.0
<i>Alabama River.</i>								
Montgomery, Ala.	265	35	5.4	1	0.1	28, 29	1.7	5.3
Selma, Ala.	212	35	8.9	1	-0.3	29-31	1.9	9.2
<i>Coosa River.</i>								
Rome, Ga.	225	30	2.8	1	1.4	30-31	1.8	1.4
Gadsden, Ala.	144	18	3.6	1	0.4	25, 30, 31	1.3	3.2
<i>Tombigbee River.</i>								
Columbus, Miss.	285	33	2.2	6	-2.3	22	-0.4	4.5
Demopolis, Ala.	155	35	16.5	1	0.0	26	4.5	16.5
<i>Black Warrior River.</i>								
Tuscaloosa, Ala.	90	38	11.3	1	0.3	31	3.3	11.0
<i>Pedee River.</i>								
Cheraw, S. C.	145	27	14.2	25	1.2	22, 23	2.6	13.0
<i>Black River.</i>								