

the heavier rainfalls reported for one hour or less in October of preceding years are: 1.20 in six minutes, at Brownsville, Tex., 23d, 1884; 1.80 in twenty minutes, at Fort Scott, Kans., 2d, 1881; 1.50 in twenty-five minutes, at Abilene, Tex., 24th, 1885; 2.12 in twenty-five minutes, at Galveston, Tex., 30th, 1877; 2.30 in thirty minutes, at Des Moines, Iowa, 15th, 1880.

MAXIMUM RAINFALLS IN ONE HOUR OR LESS.

The following table is a record of the heaviest rainfalls during October, 1889, for periods of five and ten minutes and one hour, as reported by regular stations of the Signal Service furnished with self-registering gauges:

Station.	Maximum fall in—					
	5 min.		10 min.		1 hour.	
	Inch.	Date.	Inch.	Date.	Inch.	Date.
Bismarck, Dak.	0.05	27	0.08	27	0.23	27
Boston, Mass.	0.10	12	0.15	12	0.20	25
Cincinnati, Ohio	0.05	30	0.05	30	0.15	30
Chicago, Ill.†	0.08	12	0.12	12	0.35	12
Detroit, Mich.	0.07	7	0.11	7	0.27	7, 13, 14
Dodge City, Kans.	0.35	5	0.65	5	1.10	5
Jupiter, Fla.	0.02	25	0.05	25	0.05	25
Marquette, Mich.	0.04	12, 21	0.07	12, 21	0.21	12, 13
New York City	0.16	5	0.15	19	0.25	19
New Orleans, La.	0.02	26	0.04	26	0.13	26
Savannah, Ga.	0.12	7	0.21	7	0.63	7
San Francisco, Cal.	0.02	23, 27	0.05	23, 27	0.22	23
Saint Louis, Mo.‡						
Washington City						

* Total for month. † Record not complete. ‡ Rain gauge not working.

The table shows that the greatest rate per minute for a five-minute period was .07, at Jupiter, Fla., 5th. The rate per minute for this period at the other stations given was, .024 at San Francisco, Cal., 7th; .02 at Cincinnati, Ohio, 12th; .02 at New Orleans, La., 5th; .016 at Detroit, Mich., 12th; .014 at Dodge City, Kans., 7th; .01 at Boston, Mass., 27th; .01 at Chicago, Ill., 30th; .008 at New York, N. Y., 12th and 21st; .004 at Marquette, Mich., 25th; .004 at Savannah, Ga., 26th; .004 at Washington, D. C., 23d and 27th. The greatest rate per minute for a ten-minute period was .065, at Jupiter, Fla., 5th. The rate per minute for this period at San Francisco, Cal., was .021, on the 7th; at Cincinnati, Ohio, .015, on the 12th; at New Orleans, La., .015, on the 19th; at Detroit, Mich., .012, on the 12th; at Dodge City, Kans., .011, on the 7th; at Boston, Mass., .008, on the 27th; at New York, N. Y., .007, on the 12th and 21st; at Chicago, Ill., .005, on the 30th; at Marquette, Mich., .005, on the 25th; at Washington, D. C., .005, on the 23d and 27th; and at Savannah, Ga., .004, on the 26th. The greatest hourly rainfall registered was 1.10, at Jupiter, Fla., on the 5th. At the other stations given the maximum rainfall for one hour was less than one inch.

SNOW (snowfall in inches and tenths).

Snow fell north of a line traced from extreme southern New Jersey westward to southeastern Ohio, thence northwest to central Michigan, thence southwest to northern Illinois, thence northward to northwestern Michigan, thence to northern Dakota, thence southward to extreme southern Kansas, thence southwest to central New Mexico, thence northward to southern Wyoming, thence to south-central Utah, thence to eastern California in about latitude north thirty-eight, and east of this line continued northward over eastern Oregon. The snowfall was unusually heavy for the season in central Colorado, southeastern Wyoming, and in Plumas Co., Cal., where it equalled or exceeded twenty inches, and amounted to twenty-four inches at Summit, Plumas Co., Cal., and Fort D. A. Russell, Wyo. In New England the snowfall was heaviest in New Hampshire, where it amounted to two inches at Berlin Mills

and Manchester; in the middle Atlantic states the greatest fall reported was two inches at Nineveh, N. Y., and trace fell as far south as Washington, D. C. No snow fell in the Ohio Valley, except over the eastern half of Ohio, where trace was reported. The heaviest fall reported in the lower lake region was two inches at Pendleton Centre, N. Y., and in the upper lake region, 1.4 inches at Port Huron, Mich. No snow was reported in the upper Mississippi valley, and the heaviest fall in Dakota was 1.5 at Spearfish. Trace was reported in New Mexico as far south as Fort Stanton, and 4.2 inches fell at Beaver, Utah.

Snowfalls of one inch, or more, were reported as follows: California—Summit, 24; Cisco, 4.2; Colorado.—Husted, 23; Palmer Lake, 22; Boulder Cañon and Loveland, 18.5; Dolly Varden Mines, Elkhorn, and Fort Logan, 17; Climax, 16; Denver, Magnolia, and Eagle Farm, 14; Colorado Springs, 13.9; Moraine, 13.5; Villa Grove, 13; Georgetown, 12.5; Longmont and Leadville, 12; Aspen, 11.5; Cumbres, 11; Breckenridge, 9.5; Denver, J. College, 8.5; Fort Collins, 8.5; T. S. Ranch, 8; Ranch near Como, 7.9; Agate and Cañon City, 7.5; Byers and Pueblo, 7; Rocky Ford, 6; Burlington, Grand Lake, and Thon, 5; Fraser, 4.5; Apishapa and Greeley, 4; First View, Las Animas, Fort Crawford, and Vilas, 2; Hardin, 1.5; Rifle Falls, 1.3; Aroya, Emma, and Julesburg, 1. Idaho.—Soda Springs, 5.5. Kansas.—Tribune, 8; Richfield, 6; Macksville and Offerle, 3; Bucklin, Bunker Hill, Dodge City, Lincoln, Quinter, and Winona, 2; Cawker City and Victoria, 1. Michigan.—Port Huron, 1.4. Montana.—Helena, 1. Nebraska.—Gering, 6. Nevada.—Fenelon and Halleck, 2.5; Golconda, 1.5; Battle Mountain, Beowawe, Tacoma, and Toano, 1. New Hampshire.—Berlin Mills and Manchester (1), 2; Antrim, Manchester (2), Walpole, and West Milan, 1. New Jersey.—Egg Harbor City, 1. New York.—Nineveh and Pendleton Centre, 2; Alfred Centre and Number Four, 1.5; South Kortright, 1.1; Cooperstown and South Canisteo, 1. Oregon.—Beulah, 2.5; Telocaset and Jordan Valley, 2. Pennsylvania.—Blue Knob, 3.6; Le Roy, 1.9; Coatsville, Gettysburgh, Huntington, Johnstown, and New Bloomfield, 1. Dakota.—Spearfish, 1.5. Utah.—Beaver, 4.2. Vermont.—Jacksonville, 1. Wyoming.—Fort D. A. Russell, 24; Cheyenne, 12; Camp Sheridan, 3.7; Lusk, 3; Camp Pilot Butte, 2.2; Fort Washakie (1), 2.3; Forts Laramie and Washakie (2), 1.5; Evanston, 1.

HAIL.

The more severe hail-storms of the month are referred to under "Local storms." Hail was reported during the month as follows: 1st, Mass., N. J., N. Y., Pa. 2d, Mich., Wis. 6th, Ohio. 7th, Miss., Nev., Ohio. 8th, Miss., Nev., N. Y., Pa. 9th, N. Y. 10th, N. Y., R. I. 11th, Iowa, Kans., Ohio. 12th, Ark., Ill., Ind., Kans., Ohio, Pa. 13th, Colo. 14th, Conn. 15th, N. J., N. Mex., Pa., Tenn., Tex., Va. 16th, Ohio. 18th, Nev., Pa. 21st, Kans., Me., Mass. 22d, Ark., Mo., N. C. 23d, Va. 24th, Mich., Nev. 25th, Ala., Miss., Nev., N. C. 26th, Ala., Cal., Miss. 27th, Ariz., Oregon, Utah. 28th, Miss., N. Mex., Wash. 29th, Ark., Kans., Miss., Oregon. 30th, Kans., Utah, Wis. 31st, Tex.

SLEET.

The more severe sleet storms of the month are referred to under "Local storms." Sleet was reported during the month as follows: 1st, N. Y. 5th, Mich. 6th, Mich., N. Y., Ohio. 7th, Mich. N. Y., Ohio, W. Va. 8th, Pa. 13th, Colo. 14th, Colo., Pa. 15th, Va. 21st, Dak., Mass., Mich. 22d, Dak., Pa., Wis. 23d, D. C., Md., Mich., Pa., Wis. 24th, Wis. 25th, Ala. 27th and 28th, Utah. 29th, Pa. 30th, Pa., Utah. 31st, Dak., Kans., Nebr., Utah.

WINDS.

The prevailing winds during October, 1889, are shown on chart ii by arrows flying with the wind. In New England, the Florida Peninsula, and the upper and lower lake regions northeast to northwest winds prevailed; in the middle Atlan-

tic states and the extreme northwest they were mostly from north to northwest; in the south Atlantic and east Gulf states, the Ohio Valley and Tennessee, and the upper Mississippi valley from the north; in the west Gulf states from northeast to southeast; in the Rio Grande and Missouri valleys from the southeast; on the southeastern slope of the Rocky Mountains from south to southwest; over the northern plateau region and on the middle Pacific coast from southeast to southwest; on the south Pacific coast from west to northwest; on the northeastern and middle-eastern slopes of the Rocky Mountains, the southern and middle plateau regions, and on the north Pacific coast the winds were variable.

HIGH WINDS.
(In miles per hour.)

The highest wind velocity reported was 78, ne., at Block Island, R. I., 14th. Maximum velocities of fifty miles, or more, were reported as follows: Block Island, R. I., 70, ne., 15th; 64, ne., 16th; Fort Canby, Wash., 72, s., 1st; 55, s., 29th; Hatteras, N. C., 76, n., 24th; 52, nw., 15th; 56, n., 16th; 54, n., 23d; Wood's Holl, Mass., 60, w., 10th; Fort Assiniboine, Mont., 57, w., 1st.

LOCAL STORMS.

Hail storms, accompanied by thunder and lightning, were reported at Philadelphia, Pa., 1st; at Green Bay, Wis., 2d; at Lead Hill, Ark., 12th; at Meridian, Miss., 25th; and at Long View, Tex., 30th. In each instance the hail storms occurred in the afternoon. Destructive gales were reported as follows: Port Huron, Mich., 5-6th: maximum velocity forty-two at 7 a. m. of the 6th. The gale was attended by rain, sleet, and snow, and numerous casualties of a minor character occurred. Detroit, Mich., 5-7th: maximum velocity thirty-four at 2.26 a. m. of the 6th. The Signal Service observer at Detroit reports that this was the most destructive storm in that region in years; that all classes of vessels suffered more or less damage, and that heavy and destructive seas occurred along the shores of Lake Huron. From the 13th to the 16th heavy gales prevailed along and off the coast from New England to the Carolinas, the wind attaining hurricane force at sea, and causing considerable loss and damage to shipping. From the 23d to 25th destructive gales prevailed along and off the coast from the Carolinas to New Jersey. The unprecedentedly heavy rains on the middle and south Pacific coasts are referred to under "Precipitation".

INLAND NAVIGATION.

STAGE OF WATER IN RIVERS AND HARBORS.

The following table shows the danger-points at the several stations; the highest and lowest water during October, 1889, with the dates of occurrence and the monthly ranges:

Heights of rivers above low-water mark, Oct., 1889, (in feet and tenths).

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Date.	Height.	Date.	Height.	
<i>Red River:</i>						
Shreveport, La.	29.9	3.4	19.9	31	6.3	13.6
<i>Arkansas River:</i>						
Fort Smith, Ark. ...	22.0	1	1.9	22	1.0	0.9
Little Rock, Ark. ...	23.0	1	4.0	11-16, 22-31	2.8	1.2
<i>Missouri River:</i>						
Fort Buford, Dak.	28	28	-0.2	1, 7, 8, 9	-0.6	0.4
Kansas City, Mo.	21.0	2	4.8	20	3.7	1.1
<i>Mississippi River:</i>						
Saint Paul, Minn.	14.5	1, 2	2.0	20, 27	1.6	0.4
La Crosse, Wis.	24.0	1-6	2.4	27-31	1.7	0.7
Dubuque, Iowa.	16.0	1	2.3	30, 31	1.7	0.6
Davenport, Iowa.	15.0	1, 2	1.3	25-31	0.8	0.5
Keokuk, Iowa.	14.0	1	0.8	28, 29, 30	0.0	0.8
Saint Louis, Mo.	32.0	1, 2	5.0	18	3.0	2.0
Cairo, Ill.	40.0	1, 2, 3	8.0	22, 23	2.5	5.5
Memphis, Tenn.	34.0	4, 5, 6	6.2	25	2.5	3.7
Vicksburg, Miss.	41.0	1	8.0	29, 30, 31	-0.8	8.8
New Orleans, La. ...	13.0	2	4.1	25-28	2.5	1.6
<i>Ohio River:</i>						
Pittsburgh, Pa.	22.0	29	10.3	25	0.9	9.4
Parkersburg, W. Va. ...	38.0	31	9.7	15	2.9	6.8
Cincinnati, Ohio.	50.0	1	12.1	12	5.9	6.2
Louisville, Ky.	25.0	2	6.5	14, 15, 16	4.3	2.2
<i>Cumberland River:</i>						
Nashville, Tenn.	40.0	1	8.8	19	1.6	7.2
<i>Tennessee River:</i>						
Chattanooga, Tenn. ...	33.0	1	4.8	23, 24	2.1	2.7
<i>Monongahela River:</i>						
Pittsburgh, Pa.	29.0	29	10.3	25	0.9	9.4
<i>Savannah River:</i>						
Augusta, Ga.	32.0	28	8.7	19-23	6.3	2.4
<i>Willamette River:</i>						
Portland, Oregon.	15.0	30	4.0	19, 20	0.5	3.5

Navigation was suspended on the Tennessee River at Chattanooga, Tenn., from the 7th to 14th on account of low water. On the Mississippi River, at Dubuque, Iowa, navigation had been almost suspended on the 27th on account of low water; only small boats being able to move. The last packet boat of the season passed down the river at La Crosse, Wis., on the 7th. On the 31st on the Ohio River at Parkersburg, W. Va., navigation was fully resumed, after having been suspended on account of low water since August 20, 1889. The "Post-Express," Rochester, N. Y., of October 23, 1889, states that the Erie Canal, which feeds a number of streams for water-power purposes, was so low that all feeding gates were ordered

closed; that manufacturers were compelled to close down at a loss of hundreds of thousands of dollars; that many canal boats were stranded at Tonawanda, and that navigation on the Welland Canal was considered dangerous on account of low water. The low water was attributed to the continued easterly winds which had been blowing with more or less violence throughout October.

FLOODS.

At Bellows Falls, Vt., a severe rain storm began on the morning of the 6th, and continued until the following morning. The streams in that vicinity rose rapidly, damaging or carrying away a number of bridges. At Augusta, Me., the Kennebec River rose very rapidly on the 12th, and great damage was reported all along that river. The "Morning Call," San Francisco, Cal., of October 15th, states that advices from Encinitas, San Diego, Co., Cal., report a rainfall of 7.58 inches at that place from 10 p. m. of the 12th to 6 a. m. of the 13th, which caused considerable damage; the storage reservoir at Cottonwood Canyon broke, and a large body of water rushed down the valley, washing away the railroad bridge and doing much injury to ranches. The Signal Service observer at Los Angeles, Cal., reports that 3.16 inches of rain fell at that place from 8.15 a. m. to 4.45 p. m. on the 20th, flooding streets and cellars; submerging the engine house of the cable road, and stopping the engines. He further reports that from this date showers occurred daily until the 23d. On this latter date 1.87 inch fell and numerous washouts occurred on the railroads centering in that city; the Santa Monica Line of the Southern Pacific Railroad suffering the severest damage from a reported cloud-burst in the Santa Monica Mountains, which also destroyed a considerable portion of the Los Angeles and Pacific Railroad.

HIGH TIDES.

At Norfolk, Va., high tides, caused by the heavy northeast wind of the 23d and 24th, submerged wharves and piers, and the eastern, southern, and western ends of the city were flooded. At Hatteras, N. C., on these dates the high wind caused the tide to rise higher than ever before known at that place. At New London, Conn., on the 25th, the tide rose higher than noted for several preceding years. The report of Mr. Albert E. Acworth, voluntary observer at Barren Creek Springs, Md., states that on the 27th the tide in the Nanticoke River, at Riverton, rose three feet above the usual mark and was the highest since 1876, and that the tide remained high for ten days.