

stations; the highest and lowest water for September, 1889, with the dates of occurrence and the monthly ranges:

Heights of rivers above low-water mark, Sept., 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	30	18.8	4, 10	4.3	14.5
<i>Arkansas River:</i>						
Fort Smith, Ark.	22.0	14	9.0	8	2.2	6.8
Little Rock, Ark.	23.0	17	10.2	1	4.2	6.0
<i>Missouri River:</i>						
Fort Buford, Dak.	7	0.3	1	-1.0	1.3
Omaha, Nebr.	18.0	1, 2	5.8	29, 30	5.1	0.7
Leavenworth, Kans.	20.0	1	7.0	30	4.8	2.2
Kansas City, Mo.	21.0	17	7.7	30	4.5	3.2
<i>Mississippi River:</i>						
Saint Paul, Minn.	14.5	1, 3	3.2	29, 30	1.9	1.3
La Crosse, Wis.	24.0	2	4.4	30	2.4	2.0
Dubuque, Iowa.	16.0	5	3.9	29	2.2	1.7
Davenport, Iowa.	15.0	5, 6, 7	2.3	23 to 30	1.3	1.0
Keokuk, Iowa.	14.0	14, 15	2.0	28	0.5	1.5
Saint Louis, Mo.	32.0	17, 18	8.2	30	5.2	3.0
Cairo, Ill.	40.0	10	14.4	4	7.1	7.3
Memphis, Tenn.	34.0	12, 13	11.0	5	6.1	4.9
Vicksburg, Miss.	41.0	18	11.7	10	6.8	4.9
New Orleans, La.	13.0	19	5.7	11, 12, 13, 27	3.7	2.0
<i>Ohio River:</i>						
Pittsburgh, Pa.	22.0	19, 24	6.5	2	0.2	6.3

Heights of rivers—Continued.

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Date.	Height.	Date.	Height.	
<i>Ohio River—Cont'd.</i>						
Parkersburg, W. Va.	38.0	24	4.4	8	1.7	2.7
Cincinnati, Ohio.	50.0	30	13.0	13	5.3	7.7
Louisville, Ky.	25.0	30	5.8	15, 16	3.6	2.2
<i>Cumberland River:</i>						
Nashville, Tenn.	40.0	11	13.0	1	3.0	10.0
<i>Tennessee River:</i>						
Chattanooga, Tenn.	33.0	19	8.0	17	2.4	5.6
<i>Monongahela River:</i>						
Pittsburgh, Pa.	29.0	19, 24	6.5	2	0.2	6.3
<i>Savannah River:</i>						
Augusta, Ga.	32.0	25	19.3	17, 18, 19	6.8	12.5
<i>Willamette River:</i>						
Portland, Oregon.	15.0	10	3.9	19	0.2	3.7

Mississippi River.—Saint Paul, Minn.: the steamer "Sidney" left this port for Saint Louis on the 26th. The water in the river is very low, and this is considered the last boat of the season.—*Report of P. F. Lyons, observer, Signal Corps.* Dubuque, Iowa., 29th: the water in the river is so low above this city that navigation will have to be suspended for the season.—*Report of S. C. Emery, observer, Signal Corps.*

ATMOSPHERIC ELECTRICITY.

AURORAS.

Auroras were observed during the month as follows: 3d, Blue Knob, Pa. 4th, Davenport, Iowa. 5th, Lyons, N. Y. 8th, Mount Washington, N. H. 10th, Webster, Dak. 18th, Leech Lake, Dak.; Saint Vincent, Minn. 21st, Carson, Iowa; Bernier Springs, Mich. 22d, Eastport, Me.; Lyons, N. Y.; Clarksburgh, W. Va. 23d, Nashua, N. H. 25th, Webster, Dak.; Manitowoc, Wis. 27th and 28th, Webster, Dak.

Mount Washington, N. H., 8th: the cloudy condition of the sky lifted at 9 p. m., disclosing an auroral arch, having altitude 18°, and azimuth about 75°. The aurora consisted of a band of greenish light about 2° in width, resting on a dark segment, which in turn rested on the horizon. The display ended 11.10 p. m.—*Report of J. W. Bauer, observer, Signal Corps.*

Saint Vincent, Minn.: an auroral arch was observed from 11 p. m. 18th to 5.20 a. m. the following day. The arch rose to altitude 10°, and extended from azimuth 135° to 215°. Its maximum brilliancy occurred at midnight.—*Report of R. J. Boylan, observer, Signal Corps.*

Eastport, Me., 22d: an auroral arch which rose to altitude 15°, and extended from north-northeast to north-northwest, was observed from 9.10 p. m. to 10.30 p. m.—*Report of D. C. Murphy, observer, Signal Corps.*

THUNDER-STORMS.

The more severe thunder-storms of the month are described under "Local storms." Thunder-storms were reported in the greatest number of states and territories, twenty-one, on the 3d, 4th, and 15th; in twenty on the 2d; in from fifteen to eighteen, inclusive, on the 1st, 5th, 14th, and 16th; in from ten to fourteen, inclusive, on 6th to 13th, 17th, 18th, 19th, 21st, to 25th; in seven on the 20th; and in from two to four, inclusive, on the 26th, 28th, 29th, and 30th. The 27th was the only date on which no thunder-storm was reported.

Thunder-storms were reported on the greatest number of dates, twenty-three, in Florida; on twenty-one in Texas; on nineteen in Dakota; on eighteen in Louisiana; on seventeen in Kansas; on from ten to fifteen, inclusive, in Arizona, Arkansas, Georgia, Illinois, Indian Territory, Iowa, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New York, Pennsylvania, and Tennessee; on from five to eight, inclusive, in Alabama, Indiana, Maryland, Massachusetts, New Jersey, North Carolina, Ohio, Virginia, and Wisconsin; on from one to four, inclusive, in California, Colorado, Connecticut, District of Columbia, Kentucky, Maine, Montana, Nevada, New Hampshire, New Mexico, Oregon, Rhode Island, South Carolina, Utah, Vermont, Washington Territory, and Wyoming. No thunder-storms were reported in Delaware, Idaho, and West Virginia.

MISCELLANEOUS PHENOMENA.

DROUGHT.

Dubuque, Iowa: the rain storm on the afternoon of the 4th broke the drought which has prevailed in this section since July.—*Report of S. C. Emery, observer, Signal Corps.*

Fort Sully, Dak., 9th: the corn crop in this section is completely parched by the continued dry weather.—*Report of S. G. Gardiner, observer, Signal Corps.*

Vanceborough, Me., 9th: the eastern part of this state is now passing through one of the most severe droughts known for years. The brooks have entirely run dry, while the lakes and rivers have become low. Forests and vegetation are parched and dry.—*Portland, Me., Press, September 10.*

Montgomery, Ala., 17th: the weather for some days has

been very dry and hot. Through the country there is considerable complaint on account of the scarcity of water. The mills operated by steam and water power are unable to make full time for lack of water. The drought seems to be particularly severe in the country along the Western Railroad, as the passenger trains on the road have been delayed quite frequently, of late, because of the shortage in the water supply.—*The Daily Advertiser, Montgomery, Ala., September 17.*

Thornville, Mich., 30th: the drought which prevailed during the month of August has continued throughout this month. There has been some rain but not enough to make fall pasturage. Wells have failed more than in any previous year.—*Report of Mr. John S. Caulkins, voluntary observer.*

Birmingham, Mich.: the protracted drought still continues, retarding the growth of wheat.—*Report of Mr. S. Alexander, voluntary observer.*

Wauseon, Ohio, 30th: drought has prevailed during the entire month and farmers have not been able to sow wheat, the ground being too dry.—*Report of Mr. Thos. Mikesell, voluntary observer.*

FOREST FIRES.

Rapid City, Dak.: timber fires west of this place prevailed on the 9th, 10th, and 11th. The fires assumed large proportions and have done considerable injury. The rain on the 13th checked the progress of the fires.—*Report of Wm. Norrington, observer, Signal Corps.*

Detroit, Mich., 4th: a report from East Saginaw states that fires are raging in the pine forests, and that some of the lumber camps are in danger. About 1,000,000 feet of standing pine have been consumed. 9th: forest fires are reported in the upper peninsula, doing considerable damage to lumber and hay.—*Report of E. A. Evans, observer, Signal Corps.*

Port Huron, Mich., 9th: forest fires are raging north of the city, and considerable damage has been done to fences and outlying buildings. The fires are also destructive along the Flint and Pere Marquette Railroad.—*Report of H. I. Boyce, observer, Signal Corps.*

Breckenridge, Summit Co., Colo. 10th: severe forest fires have been raging in this county since yesterday. The entire town of Chihuahua, in the northeastern portion of this county, has been consumed by them. 16th: snow to the depth of over an inch has fallen, quenching the fires.—*Report of Dr. B. A. Arbogast, voluntary observer.*

Helena, Mont., 11th: extensive forest fires are reported in the vicinity of Georgetown, Deer Lodge Co. Hundreds of men are fighting the fires, but so far they have been unable to check the flames.—*Denver, Col., Times, September 11.*

Santa Ana, Cal., 26th: the fire which has been burning for the past two days still continues in the cañons. The burned and burning district now extends one hundred miles from north to south, and is from ten to eighteen miles in width. Over \$1,000,000 worth of pasturage and timber has been destroyed. Santa Barbara, 26th: in the upper part of Santa Barbara county it is estimated that \$200,000 worth of property, including timber and feed, has been destroyed during the past week.—*Los Angeles, Cal., Times, September 27.*

Red Bluff, Cal.: forest fires were reported in various parts of the surrounding country on nearly every day during the month.—*Report of John J. McLean, observer, Signal Corps.*

Walla Walla, Wash.: forest fires occurred near this place on the 2d, 5th, 6th, 11th, 19th, 20th, 25th, 26th.

PRAIRIE FIRES.

Rapid City, Dak.: owing to the dry condition of the grass, prairie fires in this section were both numerous and extensive on the 2d and 3d. Several barns, sheds, corrals, and hundreds of tons of hay have been burned near this city. The fires were only prevented from reaching the city by the united efforts of the citizens.—*Report of Wm. Norrington, observer, Signal Corps.*

Fort Buford, Dak.: Prairie fires started on the afternoon of the 8th on the southwest side of the Missouri River. The fires were extinguished during the night of the 8-9th.—*Report of A. Schneider, observer, Signal Corps.*

HALOS.

Solar halos were most frequently reported in Illinois, where they were noted on eleven days; in New York on ten; in Louisiana on seven; in New Jersey on six, and on from one to five, inclusive, in Alabama, California, Connecticut, Dakota, Indiana, Iowa, Kansas, Kentucky, Massachusetts, Michigan, Mississippi, Missouri, Nebraska, Nevada, New Hampshire, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, and Virginia. In states and territories other than those named no solar halos were reported. They were reported in the greatest number of states and territories, eight, on the 23d; in seven on the 24th;

in six on the 5th and 29th; and in from one to five, inclusive, from the 1st to 4th, 6th, 8th to 17th, 19th, 20th, 22d, 25th to 28th. No solar halos were reported on the 7th, 18th, 21st, 30th.

Lunar halos were most frequently reported in Tennessee and Texas, where they were noted on eight days; in New York on seven; in New Jersey on six; on from one to five, inclusive, in Arkansas, Connecticut, Dakota, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Michigan, Minnesota, Mississippi, Nebraska, Nevada, Ohio, Pennsylvania, South Carolina, Virginia, Washington Territory, and Wisconsin. In states and territories other than those named no lunar halos were reported. They were reported in the greatest number of states and territories, twelve, on the 10th; in nine on the 8th and 10th; in seven on the 4th; in six on the 1st and 5th; in from one to five, inclusive, on the 2d, 3d, 6th, 7th, 11th to 16th, 26th, 28th, and 29th. For dates other than those named no lunar halos were reported.

SUN SPOTS.

Mr. John W. James, Riley, Ill.: large spot on sun's meridian 1st, disappearing by the solar rotation 7th. 7th, four new spots, half the size of the large one, formed within twenty-two hours one day from the west edge, disappearing west edge, 8th, then none seen until the 23d, when the large spot reappeared on east edge, on sun's meridian, 29th, and on October 1st it had split into two spots. Mr. C. E. Buzzell, Leaf River, Ill.: the group of August 27th was central on September 2d, and disappeared late on the 7th; marked faculae and changes in this group were noted on the 7th. A variable group first observed on the 27th, was central 29th, and was still seen on October 2d. Both September disturbances corresponded closely in time to group of August 1st, greatly diminished.

Mr. M. A. Veeder, Lyons, N. Y.: the large spot that came into view on August 26th completed its transit September 8th. On September 6th and 7th there was an outbreak of small spots in its vicinity, otherwise it underwent little change. On the 2d a group of faculae appeared and persisted throughout the entire transit, being seen at the western limb on 15th. On the 5th, 8th, 11th, 12th, 15th, and 17th groups of faculae appeared by rotation and remained visible for two or three days in each instance, not being seen subsequently. On the 23d a very large spot, with other smaller ones near by, was seen on the eastern limb. This spot continued with but slight changes of form until the end of the month. The smaller spots varied in number from day to day. Mr. H. D. Govey, North Leeburgh, Ohio: sun spots were observed on the 1st, 6th, 7th, and 27th.

Haverford College Observatory, Pa., (observed by Prof. F. P. Leavenworth):

Date.	Number of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Faculae.	Remarks.	
	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.			
Sept., 1889.											
9, 10 a. m.	0	0	0	0	0	0	0	0	0	0	Definition poor.
14, 10 a. m.	0	0	0	0	0	0	0	0	0	0	Definition fair.
16, 10 a. m.	0	0	0	0	0	0	0	0	0	0	Definition fair.
17, 10 a. m.	0	0	0	0	0	0	0	0	0	0	Definition poor.
18, 10 a. m.	0	0	0	0	0	0	0	0	0	0	Definition poor.
21, 9 a. m.	0	0	0	0	0	0	0	0	0	0	Definition poor.
21, 10 a. m.	0	0	0	0	0	0	0	0	0	0	Definition good.
22, 3 p. m.	0	0	0	0	0	0	0	0	0	0	Definition good.
23, 10 a. m.	1	6	0	0	1	5	1	6	6	6	Definition fair, 1 large spot.
26, 11 a. m.	0	0	0	0	0	0	0	1	6	6	Definition poor.
27, 9 a. m.	0	0	0	0	0	0	0	1	12	12	Definition fair.
28, 10 a. m.	0	3	0	0	0	0	0	1	15	15	Definition good.
29, 9 a. m.	0	0	0	0	0	0	0	1	7	7	Definition good.
30, 10 a. m.	0	0	0	0	0	0	0	1	6	6	Definition poor, large spot breaking up.

METEORS.

The distribution of meteors, by dates, was as follows: 2d,

Whipple Barracks (Prescott), Ariz. 5th, Greeneville, Tenn. 7th, Thornville, Mich. 9th, Lansing, Mich. 11th, Villa City, Fla. 12th, Nashville, Tenn. 13th, Villa City, Fla.; Rugby, Tenn. 14th, East Portland, Oregon. 15th, Rugby, Tenn.; Vashon, Wash. 18th, New Providence, Ind. 19th, Belle Plaine, Iowa. 21st, Rugby, Tenn. 22d, North Sutton, N. H.; Riddleton and Rugby, Tenn.; Weatherfield Centre, Vt. 23d, Berkeley and Hydesville, Cal. 24th, Greensborough, Ala.; Berkeley and Hydesville, Cal.; Lexington, Ky.; Princeton, Mo.; Riddleton, Tenn. 25th, Chattanooga, Tenn. 27th, New Providence, Ind. 28th, Kalamazoo, Mich.; Egg Harbor City and Beverly, N. J. 29th, Mansfield, Mass.; Las Vegas, N. Mex. Chattanooga, Tenn., 25th: a meteor was observed at 9.35

p. m., about 30° east of the zenith, and moving in a south-westerly direction. A bright pinkish light followed in its path, and after it had disappeared about 60° from the zenith, a pale pink color was visible for about three seconds.—*Report of L. M. Pindell, observer, Signal Corps.*

MIRAGE.

Mirage were observed as follows: Kimball and Webster, Dak., 28th; Hampton, Iowa, 10th, 11th, and 12th; Santa Fé, N. Mex., 17th and 19th.

SAND STORMS.

The only sand storms reported during the month occurred at Phoenix and Fort McDowell, Ariz., on the 6th.

VERIFICATIONS.

FORECASTS FOR 24 HOURS IN ADVANCE.

[Verifications made by Assistant Professor C. F. Marvin, assisted by Mr. H. E. Williams, chief clerk of the Forecast Division.]

The forecasts for districts east of the Rocky Mountains for September, 1889, were made by Captain James Allen, 3d Cavalry, Signal Officer, and those for the Pacific coast districts were made at San Francisco, Cal., by 2d Lieutenant J. E. Maxfield, Signal Corps.

Percentages of forecasts verified, September, 1889.

States.		States.	
Maine	80.5	Kentucky	84.6
New Hampshire	83.9	Ohio	80.4
Vermont	84.5	West Virginia	86.3
Massachusetts	87.1	Indiana	83.2
Rhode Island	85.8	Illinois	84.3
Connecticut	83.7	Lower Michigan	81.7
Eastern New York	82.1	Upper Michigan	70.6
Western New York	82.7	Wisconsin	78.7
Eastern Pennsylvania	82.7	Minnesota	82.4
Western Pennsylvania	80.4	Iowa	79.5
New Jersey	77.5	Kansas	85.0
Delaware	74.8	Nebraska	83.1
Maryland	76.0	Missouri	78.7
District of Columbia	76.3	Colorado	83.3
Virginia	80.5	Dakota	82.3
North Carolina	82.1	Southern California*	86.1
South Carolina	84.9	Northern California*	88.9
Georgia	85.3	Oregon*	88.9
Eastern Florida	83.9	Washington Territory*	84.5
Western Florida	89.0	By elements: Weather	85.5
Alabama	89.2	Temperature†	78.1
Mississippi	87.0	Monthly percentage of weather and temperature combined †	82.5
Louisiana	89.3		
Arkansas	77.3		
Tennessee	82.5		

* In determining the monthly percentage of weather and temperature combined, the Pacific coast states are not included. † The monthly percentage of weather and temperature combined is determined by multiplying the percentage of weather by 6, and the percentage of temperature by 4, and dividing their sum by 10. ‡ The forecasts of temperature in districts east of the Rocky Mountains for September, 1889, were made with reference to the maximum temperature alone; that is, a prediction of warmer or cooler indicated that the maximum temperature of the day designated would be higher or lower than the maximum of the previous day.

FORECASTS FOR 48 AND 72 HOURS IN ADVANCE.

Appreciating the great importance that long time predictions possess for the general public, the Chief Signal Officer has authorized forecasts for forty-eight and seventy-two hours, covering the second and third day in advance. Such forecasts are optional with the predicting officer, and are only made when clearly in the public interest, and cover, in all cases, considerable areas of country, and are not confined to localities.

Percentages of verifications of forecasts made for second day in advance. Number of predictions made: weather, 38;

temperature, 44. Percentages of verifications: weather, 73.2; temperature, 83.9. Weather and temperature combined, 78.4.

Percentages of verifications of forecasts made for third day in advance. Number of predictions made: weather, 13; temperature, 7. Percentages of verifications: weather, 97.7; temperature, 35.9. Weather and temperature combined, 81.3.

FORECASTS FOR 48 AND 72 HOURS IN ADVANCE, FOR AUGUST, 1889.

[Made by Capt. H. H. C. Dunwoody.]

Percentages of verifications of forecasts made for second day in advance. Number of predictions made: weather, 24; temperature, 36. Percentages of verifications: weather, 71.7; temperature, 94.4. Weather and temperature combined, 80.8.

Percentage of verifications of forecasts made for third day in advance. Number of predictions made: weather, none; temperature, 8. Percentage of verifications: temperature, 100.

CAUTIONARY SIGNALS FOR SEPTEMBER, 1889.

Statement showing percentages of justifications of wind signals for the month of September, 1889:

Wind signals.—(Ordered by Captain James Allen.) Total number of signals ordered, one hundred and fifty-five; justified as to velocity, wholly, ninety-five, partly, ten; justified as to direction, one hundred and fifty-one. Of the signals ordered, one hundred and fourteen were cautionary, of which seventy-three were wholly, and two partly, justified; and forty-one were storm signals, of which twenty-two were wholly, and eight partly, justified. Seventy-one signals were ordered for easterly winds, of which sixty-seven were justified, and eighty-four were ordered for westerly winds, all of which were justified. Percentage of justifications, 71.6.

Cold-wave signals.—(Ordered by Assistant Prof. T. Russell.) Two cold-wave signals were ordered during the month, neither of which were justified.

Percentages of local verifications of weather and temperature signals reported by directors of the various State Weather Services for September, 1889.

States.	Weather.	Temperature.	States.	Weather.	Temperature.
Illinois	74.6	80.1	Missouri	82.0	85.0
Indiana	80.0	83.0	Nebraska	88.0	85.9
Kansas	92.7	89.8	New Jersey	89.0	92.5
Louisiana, northern	68.0	96.0	New York	79.0	82.0
Louisiana, southern	64.0	92.0	Ohio	79.0	85.0
Michigan	86.1	82.8	Pennsylvania	88.0	89.0
Minnesota	76.0	73.0	South Carolina	86.4	84.6

STATE WEATHER SERVICES.

[Temperature in degrees Fahrenheit; precipitation, including melted snow, in inches and hundredths.]

The following extracts are republished from reports for September, 1889, of the directors of the various state weather services:

ALABAMA.

The temperature was below the normal. Light frost occurred on the 19th, 20th, and 28th, but caused no damage to vegetation.

The rainfall during the month was not uniformly distributed over the state. In north Alabama the precipitation was large and showers were constant during the month; in middle Alabama there was a deficiency of rain, and in