

upper lake region, 88.7; Tennessee and the Ohio valley, 90.7; upper Mississippi valley, 90.0; lower Missouri valley, 86.5; northern Pacific coast region, 83.3; middle Pacific coast region, 90.3; southern Pacific coast region, 90.3.

There were 50 omissions to predict (13 being due to the absence of reports from the Pacific coast) out of 3,813, or 1.31 per cent. Of the 3,763 predictions that have been made, 29, or 0.77 per cent., are considered to have entirely failed; 64, or 1.70 per cent., were one-fourth verified; 232, or 6.17 per cent., were one-half verified; 645, or 17.14 per cent., were three-fourths verified; 2,793, or 74.22 per cent., were fully verified, so far as can be ascertained from the tri-daily reports.

CAUTIONARY SIGNALS.

Seven cautionary signals were displayed during the month of July, of which the total number, or 100 per cent, were justified by winds of twenty-five miles per hour, at or within one hundred miles of the station. No off-shore signals were displayed.

One-hundred and fifteen winds of twenty-five miles, or more, per hour, were reported, for which no signals were ordered; many of these were local storms or strong sea-breezes, for which no signals were required. One Signal was reported late.

NAVIGATION.

STAGE OF WATER IN RIVERS.

In the table on the right-hand of chart number iii., are given the highest and lowest stages of water observed at Signal Service stations during the month of July, 1882. In the first column of this table are given the heights of water on the gauge, which have been dangerous to property at stations.

The upper Mississippi river, from Keokuk to Cairo, reached its highest stage between the 1st and 9th. At the former station, on the 1st, the water rose to fifteen feet and seven inches, or thirteen inches above the danger line. At Saint Louis, the highest water, thirty-two feet and five inches, or twenty-five inches above the danger line, occurred on the 5th. On the 8th and 9th, at Cairo, the water rose to within fourteen inches of the danger line. At Vicksburg, the river continued falling throughout the month. The water remained at the danger line on the 1st and 2d; and at the close of the month was five feet and nine inches below the danger line. The highest water in the Missouri river occurred from the 1st to the 3d; and in the Ohio river, from the 1st to the 8th.

FLOODS.

Missouri: Kansas City, 2d, the Missouri river overflowed its banks and completely flooded the surrounding country, doing severe damage to crops. In many places farmers left their homes, fearing a general washout. The damage to crops is estimated at \$50,000. Protom, 3d, heavy rains caused an overflow in Bear and Bee creeks, Boone county. A thickly settled farming region was flooded; fields of corn and cotton were destroyed, fences swept away, and a quantity of shocked wheat was seriously damaged. 8th, a creek about twenty miles south of Protom overflowed from the effects of a heavy rain; horses, cattle and crops were swept away and lost.

Saint Louis, during the 3d, 4th and 5th the Mississippi river was from one foot, six inches to two feet, five inches above the danger-line. Large tracts of bottom-lands were submerged, and lumber-yards and other property along the river suffered considerable damage. The damage to crops is estimated at \$20,000.

Saint Joseph, 18th, heavy rains caused damaging floods, which swept away many small buildings, and caused damage to sewers and other city property to the amount of \$5,000. Much damage also occurred to shocked wheat and to the oat crop, which was ready to harvest.

Ohio: Lebanon, 10th, a flood in Turtle creek caused damage to four houses situated on the banks of the creek, and the furniture was swept away and lost. Columbus, 10th, during a

heavy rain-storm cellars in the northern part of the city were flooded.

Illinois: Alton, 1st, a rise in the Mississippi river caused floods in bottom lands, and ruined many fields of wheat. Several buildings near the river front were damaged.

New York: New York City, 5th, a heavy rain storm flooded the streets and cellars in some sections of the city.

Massachusetts: Boston, 19th, the basements of many houses were flooded during a very heavy rain storm on the afternoon of the above date.

Texas: Coleman City, 9th, a heavy rain caused the creek to rise fifteen feet; bottom-lands were flooded and fences carried away; vegetable crops were much damaged.

TEMPERATURE OF WATER.

The temperature of water as observed in rivers and harbors at Signal Service stations, with the average depth at which observations were taken, is given in the table on the right-hand of chart number ii. In the first column of the table is given the maximum temperature observed during the month; and in the second column the minimum temperature observed during the same period.

The following table gives the highest and lowest temperature of water at the several stations, with the range of water temperature, mean temperature of the air at the station, and the depth of water at which the observations were taken. It will be seen that the greatest ranges are as follows: 18° at Chincoteague; 17°.3 at New Haven; 15°.7 at Newport; 15° at Duluth. The smallest are: 3° at Port Eads; 4° at Smithville; 4°.4 at Savannah; 5° at Baltimore:

Temperature of Water for July, 1882.

STATION.	Temperature at bottom.		Range.	Average depth in feet and inches.	Mean temperature of the air at station.
	Max.	Min.			
Atlantic City.....	74.5	64.8	9.7	6 9	73.3
Alpena.....	71.8	60.8	11.0	12 0	63.9
Augusta.....	87.5	73.6	9.0	6 0	79.2
Baltimore.....	80.5	75.5	5.0	9 10	76.6
Block Island.....	67.9	67.9	10.0	8 9	69.9
Boston.....	69.	60.6	8.5	25 0	71.7
Buffalo.....	74.7	64.7	10.0	10 0	67.3
Burlington.....	76.	61.3	14.7	19 0
Cedar Keys.....	86.	80.	6.0	10 1	81.5
Charleston.....	84.9	78.7	6.2	40 6	81.3
Chicago.....	69.5	61.4	8.1	7 10	68.6
Chincoteague.....	86.	68.	18.0	6 0	74.2
Cleveland.....	77.	67.5	9.5	14 0	68.7
Detroit.....	73.	66.	7.0	24 0	70.1
Duluth.....	60.	46.	15.0	14 3	61.9
Delaware Breakwater.....	73.3	61.5	11.8	6 6	72.6
Eastport.....	48.2	42.9	5.3	18 2	61.6
Escañaba.....	69.	59.5	9.5	15 0	64.6
Galveston.....	86.	78.	8.0	14 6	82.9
Grand Haven.....	78.5	66.6	7.0	18 0	66.5
Indianola.....	66.8	52.4	4.4	9 3	83.0
Jacksonville.....	88.	82.	6.0	18 0	80.9
Key West.....	90.2	82.8	7.4	15 9	85.0
Marquette.....	67.8	51.9	5.9	10 6	62.9
Milwaukee.....	69.5	49.5	14.0	8 0	66.0
Mobile.....	86.3	79.	7.3	15 9	78.6
New Haven.....	79.8	62.5	17.3	15 2	71.6
New London.....	71.	59.	12.0	12 4	71.2
Newport.....	72.4	56.7	15.7	12 0	70.0
New York.....	76.5	65.	11.5	21 7	78.8
Norfolk.....	84.	75.	9.0	16 11	77.9
Pensacola.....	83.	79.8	3.2	17 9	78.5
Portland, Me.....	61.5	61.	10.5	18 10	71.4
Portland, Oreg.....	71.5	62.2	9.3	74 8	65.3
Port Eads.....	82.	79.	3.0	9 7	80.4
Provincetown.....
Punta Rasa.....	80.	53.	7.0	11 10	80.4
Sandusky.....	76.8	68.	8.8	10 0	70.2
Sandy Hook.....	74.3	65.3	9.0	1 7	75.0
San Francisco.....	63.5	57.5	6.0	30 7	68.4
Savannah.....	86.2	81.8	4.4	13 1	81.5
Smithville.....	84.	80.	4.0	10 0	79.3
Thatcher's Island.....	68.7	56.	12.7	7 0	68.3
Toledo.....	78.5	69.5	9.0	11 11	71.8
Wilmington.....	86.5	80.5	6.0	13 0	78.0

*Observations wanting, from 1st to 26th, inclusive.

ATMOSPHERIC ELECTRICITY.

AUORAS.

The most important display of the month occurred on the evening of the 16th. It was observed from Eastport Maine,

southward to Delaware Breakwater and westward to stations in Montana. The following reports of this display have been received:

Eastport, Maine: From 8:40 to 11:40 p. m., a brilliant auroral arch was observed, extending from northwest to northeast, with several streamers shooting upward and reaching nearly to the zenith.

Gardiner, Maine: From 9:00 p. m. to midnight, aurora reaching an altitude of 30°. Observation interfered with by cloudiness.

Burlington, Vermont: Aurora of pale yellow color, with a few streamers, was observed from 9:00 to 11:40 p. m.

Newport, Vermont: Auroral display during the evening.

Grafton, New Hampshire: Aurora observed at 9:00 p. m.

Springfield, Massachusetts: Aurora visible from 9:00 p. m. to midnight, extending from northeast to northwest and to an altitude of 25°. At the beginning of the display bright streamers were observed; later a bright band of light surmounted a dark segment which was irregular in outline and resembled a cloud.

Cambridge, Massachusetts: At 9:45 p. m., a diffused auroral light was observed in the northern sky among and above the clouds. Streamers were suspected at times.

Westborough, Massachusetts: Aurora observed during the evening.

Fall River, Massachusetts: Bright aurora observed from 10:00 p. m. to midnight.

Rowe, Massachusetts: Faint aurora at 9:00 p. m.

Albany, New York: Aurora extending from 135° to 235° azimuth, of pale yellow color, with well-defined dark segment. The display continued without perceptible change from 11:00 p. m. to daylight of the 17th.

Freehold, New Jersey: Aurora observed in the northern sky, consisting of a white glow with obscure outlines.

Barnegat, New Jersey: Fine auroral display from 8:45 to 11:30 p. m., extending to an altitude of 32°.

Atlantic City, New Jersey: At 9:00 p. m. an aurora consisting of an arch of pale yellow color, about 5° in width, extending to an altitude of 15° and from 10° west to 20° east of north. At 10:00 p. m. a few faint streamers extended upward to a height of 30°, lasting about ten minutes. The display ended at 11:20 p. m.

Delaware Breakwater: Faint aurora observed in the northern sky from 10:00 p. m. to midnight.

Buffalo: Faint aurora consisting of a diffused white light, extending from north-northeast to northwest and to an altitude of 20°; the lower edge rested on a bank of haze about 8° above the horizon. The display continued from 10:50 p. m. to 1:35 a. m., of the 17th.

Rochester: Aurora consisting of a few faint slender beams projecting upward to a height of 20° from a dark segment. The display was not brilliant. It was first observed at 9:45 p. m. and disappeared before midnight.

Oswego: From 9:00 p. m. to midnight an aurora of varying brilliancy was observed. It extended to an altitude of 15° and covered 70° of azimuth.

Erie: Auroral display from 9:40 to 11:20 p. m.; beams reaching an altitude of 60°, appeared and disappeared at intervals.

Ithaca, New York: Faint aurora, of 20° altitude, observed during the evening.

North Volney, New York: Auroral display during the evening.

Meadville, Pennsylvania: Auroral display during the evening.

Cleveland: From 9:30 to 11:00 p. m., faint aurora consisting of a diffuse straw colored light, with a shading of pale green, extending from 160° to 220° azimuth, and to an altitude of 25°.

Grand Haven, Michigan: Faint aurora in northern sky, resembling the morning dawn, extending from 10° east to 10° west of north and to an altitude of 5°; display began at 9:30 and ended at 11:30 p. m.

Marquette, Michigan: Faint auroral display, from 10:50 to 11:45 p. m.

Franklin, Wisconsin: Aurora, consisting of a white arch, extending from northwest to northeast.

Embarras, Wisconsin: Auroral display observed during the evening.

Dubuque, Iowa: Faint auroral light, from 9:10 to 11:30 p. m.

Madison, Wisconsin: A faint, but well-defined auroral arch, visible at 10 p. m.

La Crosse: Faint aurora, of whitish light, visible from 9:00 p. m. to midnight; an arch was formed shortly before its disappearance.

Cresco, Iowa: Faint aurora, consisting of a low arch, with dark cloud beneath, and a few short beams; it extended from north to northeast.

Northfield, Minnesota: Auroral display observed during the evening.

Clear Creek, Nebraska: Faint aurora during the evening.

Alexandria, Dakota: Aurora, with slender luminous beams, increasing in brilliancy as the evening advanced.

Saint Vincent, Minnesota: From 9:20 to 11:30 p. m. aurora, consisting of a well-defined arch, making the dark segment distinctly visible. Brilliant streamers were seen at intervals.

Fort Stevenson, Dakota: Aurora, visible in the northeastern sky, from 9:30 to 11:00 p. m.

Bismarek, Dakota: Aurora visible from 9:00 p. m. to midnight. It appeared as a nebulous light about 10° in height.

Fort Keogh, Montana: A few faint auroral beams were observed in the northern sky from 9:45 p. m. until obscured by clouds at 10:30 p. m.

Terry's Landing, Montana: Aurora observed from 10:30 p. m. to 2:00 a. m. of the 17th.

Other auroral displays were less extensively observed on various dates, as follows:

On the 2d, 3d, 4th, 8th, 10th, 13th and 14th, displays, varying in extent and brilliancy, are reported to have been observed at Clear Creek, Nebraska, which were not observed at any other point.

5th: New Athens, Ohio, faint auroral arch observed at 9 p. m.

6th: Huron, Dakota, faint aurora from 9 p. m. until after midnight.

Hatteras, North Carolina: Faint aurora, consisting of a diffuse light of pale straw color, was observed from 10:15 to 11:30 p. m.

7th: Yankton, Dakota, faint auroral arch observed along the northern horizon from 10:10 to 11:25 p. m.

Clear Creek, Nebraska: Faint aurora observed during the evening.

9th: Burlington, Vermont, aurora, of pale yellow color, with a few streamers, observed in the northern sky from 11:00 to 11:45 p. m.

11th: Burlington, Vermont, aurora, consisting of pale yellow light, from 11:00 to 11:45 p. m.

New Corydon, Indiana: Strong auroral light observed from 10:00 p. m. to 2:00 a. m. of the 12th.

Alpena, Michigan: Aurora, consisting of a few small streamers extending to an altitude of 10° or 15°, with a motion from east to west, was observed from 8:55 p. m. to 1:10 a. m. of the 12th.

12th: Alpena, Michigan, aurora observed at 8:50 p. m., consisting of a diffuse light without streamers.

New Corydon, Indiana: Auroral display at 10:00 p. m.

Clear Creek, Nebraska: Faint aurora during the evening.

Yates Centre, Kansas: Faint auroral display from 9:00 to 10:30 p. m.

15th: Cape May, New Jersey, very faint aurora, extending from north-northwest to northeast, observed from 10:00 to 11:00 p. m.

17th: Alpena, Michigan, from 9:00 to 11:20 p. m., diffuse auroral light, without streamers.

Saint Vincent, Minnesota: Aurora from 9:00 to 11:30 p. m.

18th: Clear Creek, Nebraska, faint aurora during the evening. Yates Centre, Kansas, faint aurora, consisting of parallel arches extending from northwest to east-northeast and to an altitude of about 30°.

19th: Burlington, Vermont, aurora of faint green color observed from 10:00 to 11:45 p. m. New Corydon, Indiana, aurora consisting of white segment and small arch, extending to an altitude of 15°, was observed from 9:00 to 11:00 p. m. Alpena, Michigan, diffuse auroral light observed from 9:00 p. m. to 12:35 a. m. of 20th. Saint Vincent, Minnesota, pale yellow auroral light from 9:00 to 11:30 p. m.

20th: Burlington, Vermont, aurora of faint green color from 10:00 to 11:40 p. m. Swanwick, Illinois, aurora consisting of whitish light over a bank of clouds, observed at 9:00 p. m. Saint Vincent, Minnesota, diffuse yellow auroral light observed from 9:30 to 11:30 p. m. Moorhead, Minnesota, faint aurora of diffuse yellow color.

21st: Burlington, Vermont, aurora of faint green and yellow colors.

23d: Fort Madison, Iowa, aurora during the eveing.

26th: Tobacco Garden, Dakota, faint aurora observed at 10.20 p. m.

30th: Burlington, Vermont, brilliant auroral display from 10:30 to 11:30 p. m. No arch was visible; bright streamers of pale green were observed.

31st: Burlington, Vermont, from 10:30 to 11:40 p. m., aurora of pale green color. Saint Vincent, Minnesota, auroral arch at 9:00 p. m., of indistinct outlines, reaching an altitude of 30°; beams of pale yellow were observed at intervals. The light of the moon modified the brilliancy of the display.

THUNDER-STORMS.

Thunder-storms were reported in the various districts on the following dates:

New England: 1st, 3d, 8th, 10th, 13th, 14th, 17th to 22d, 26th to 29th.

Middle Atlantic states: 1st, 4th, 6th, 10th to 14th, 18th to 21st, 26th to 31st.

South Atlantic states: 1st to 5th, 9th, 11th to 14th, 16th to 23d, 25th, 26th, 28th to 31st.

Florida peninsula: 3d to 6th, 8th to 15th, 17th to 21st, 23d to 27th, 29th to 31st.

East Gulf states: 1st to 4th, 8th to 23d, 26th to 31st.

West Gulf states: 2d, 3d, 4th, 7th, 9th to 31st.

Rio Grande valley: 1st, 8th, 9th, 10th, 14th, 17th, 22d, 24th, 30th.

Ohio valley and Tennessee: 1st to 5th, 7th, 9th to 14th, 16th to 21st, 26th to 31st.

Lower lake region: 1st, 2d, 10th, 12th to 14th, 16th to 19th, 27th, 28th, 31st.

Upper lake region: 3d, 9th, 11th, 13th, 16th to 18th, 21st, 24th to 27th.

Extreme northwest: 5th to 8th, 12th, 15th, 17th, 22d to 26th, 28th, 29th, 31st.

Upper Mississippi valley: 1st to 4th, 6th, 7th, 9th to 23d, 25th to 31st.

Missouri valley: 1st to 3d, 5th to 9th, 11th, 12th, 14th to 18th, 20th, 22d to 30th.

Northern slope: 1st to 8th, 13th, 14th, 16th to 21st, 23d to 28th, 30th, 31st.

Middle slope: 1st to 8th, 11th, 12th, 14th to 23d, 25th to 29th.

Southern slope: 3d, 4th, 6th to 9th, 11th to 13th, 15th to 21st, 26th, 28th to 30th.

Southern plateau: 1st to 9th, 12th to 29th, 31st.

Middle plateau: 1st to 5th, 7th, 17th to 21st, 23d, 24th, 27th, 30th.

Northern plateau: 3d, 4th, 20th, 22d, 23d, 31st.

North Pacific coast region: 4th, 28th, 31st.

Middle Pacific coast region: 3d, 4th, 18th, 19th, 20th.

South Pacific coast region: 4th, 5th.

During thunder-storms the following instances of damage by lightning have been reported:

Clay Centre, Kansas, 15th: Two men were killed by lightning at 6.00 p. m., about eight miles from station. 28th, house struck by lightning, and one person killed.

Boston, 28th: Two men killed by lightning.

Dodge City, Kansas, 4th: During thunder, a man was killed by lightning in this city.

Roseburg, Oregon, 4th: About twelve miles north of this place, a barn was struck and burned by lightning, together with six horses, farming implements, hay, etc., entailing a loss of \$5,000.

Cincinnati, 10th: Two men killed by lightning.

Omaha, 29th: During a heavy thunder-storm, a dwelling in Platte county was struck by lightning; one person was killed, and another severely injured.

Texarkana, Arkansas, 12th: During a severe storm, (see LOCAL STORMS,) much damage was done at this place by lightning.

Pike's Peak, Colorado, 1st: At 4.31 p. m., during a heavy fall of hail, lightning struck the station building near the southeast corner, having following the course of the telegraph wire a distance of several rods. The fluid passed through the outer and petition walls and entered the office near the stove, tearing up the floor, melting and tearing off the zinc-sheathing around the stove. The self-registering attachment of the anemometer was demolished, and also the clock which hung upon the office wall. The office wires and anemometer dial were completely burned up. The explosion was terrific. All the window-glass in the office was broken. The observer and assistant were severely stunned and bruised.

Creswell, Kansas, 17th: Dwelling struck and burned by lightning, four miles northwest of this place.

Umatilla, Oregon, 23d: During a severe sand storm, the air was so charged with electricity that office wires and stove-pipe emitted sparks, and when touched produced a shock.

OPTICAL PHENOMENA.

SOLAR HALOS.

Solar halos have been observed in the various districts on the following dates:

New England: 3d, 16th, 22d, 29th.

Middle Atlantic states: 18th, 22d, 24th, 25th, 26th, 27th, 29th, 31st.

East Gulf states: 7th, 24th, 29th, 30th.

Ohio valley and Tennessee: 6th, 11th, 13th, 16th, 20th, 21st, 25th, 30th.

Lower lake region: 12th, 16th, 31st.

Upper Mississippi valley: 6th, 11th, 19th, 29th.

Missouri valley: 6th, 8th, 9th, 16th, 18th.

Solar halos were also reported from the following stations not included in the districts named above:

Saint Vincent, Minnesota, 16th.

Yates Center, Kansas, 9th.

Hatteras, North Carolina, 16th.

Palestine, Texas, 21st, 29th.

Fort Keogh, Montana, 19th.

Tobacco Garden, Dakota, 5th, 18th, 20th.

Salt Lake City, Utah, 16th.

San Francisco, California, 31st.

Grand Haven, Michigan, 30th.

Riley, Illinois, 6th.

LUNAR HALOS.

Lunar halos have been observed in the various districts on the following dates:

New England: 3d, 17th, 31st.

Middle Atlantic States: 21st, 23d, to 28th, 31st.

South Atlantic states: 24th, to 29th.

East Gulf States: 22d, 23d, 24th, 26th, 28th, 29th.

West Gulf states: 20th, 23d, 26th, to 30th.

Ohio valley and Tennessee: 2d, 3d, 4th, 7th, 21st, 24th, to 31st.

Lower lake region: 29th, 30th.

Upper lake region: 2d, 24th, 25th, 26th, 28th.

Upper Mississippi valley: 1st, 26th, to 31st.

Missouri valley 1st, 19th, 24th, 26th, 27th.

Extreme northwest: 8th, 11th, 23d, 24th.