

ice; 13th, teams crossing on the ice. At Le Claire, Iowa, the river was frozen from the 3d to 31st. At Keokuk, Iowa, the river was frozen on the 9th. At Muscatine, Iowa, the river was frozen on the 7th. At Saint Louis, Mo., the river was frozen on the 16th; ice gorge moved some on the 25th; 29th, ice broken up and river full of floating ice. Teams were reported crossing the river on the ice at Cape Girardeau, Mo., on the 15th, and the 19th an ice gorge formed at that place. At Cairo, Ill., heavy ice commenced running on the 7th, and all boats from Saint Louis bound south were tied up; 8th and 9th, ice running; 12th, river frozen over; 13th to 15th, heavy slush running in the Ohio River; 20th, navigation in the Ohio River difficult on account of floating ice; ice damaged the "Cotton Belt" incline at Birds Point; 22d, ice in the Ohio River ran out; 31st, ice gorge in the Mississippi River broke up and the ice ran out rapidly.

The Missouri River at Saint Pierre, S. Dak., was frozen throughout the month. At Sioux City, Iowa, teams crossed on the ice on the 16th. At Hermann, Mo., floating ice was reported on the 7th; heavy floating ice on the 9th; river gorged with ice on the 11th; ice gorge broken on the 29th.

At Fort Smith, Ark., the Arkansas River was covered for a short time with a thin sheet of ice on the 20th. At Little Rock, Ark., the river was frozen, except in the channel, on the 14th. On the 23d the river was open.

At Manhattan, Kans., the Big Blue River was frozen on the 8th and 12th.

At New Haven, Conn., the harbor was frozen on the 27th. At Erie, Pa., the bay was frozen on the 4th, and on the 7th the ice on the bay was 4 inches in thickness. The river was frozen at Cleveland, Ohio, on the 7th. At Grand Haven, Mich., the harbor was almost blocked by slush ice at the mouth of the river on the 8th; on the 9th steamers forced their way through the slush ice with great difficulty; on the 10th the slush ice was carried into the lake by easterly winds, and navigation was unobstructed; 28th, navigation again obstructed by an accumulation of slush ice. At Milwaukee, Wis., the lake was frozen  $\frac{1}{2}$  to  $\frac{3}{4}$  mile from shore on the 3d; reports of the 6th and 10th stated that the lake continued frozen.

FLOODS.

In the middle of the month freshets occurred in the streams of New Hampshire, eastern New York, eastern Pennsylvania, and eastern Virginia.

From the 15th to 20th rivers in South Carolina, Georgia, and Alabama rose rapidly. On the 20th the Congaree River was 24.05 feet, 9.05 feet above the danger-line, at Columbia, S. C. At Augusta, Ga., the Savannah River rose to 31 feet by the morning of the 20th, and at 10 p. m., that date, reached 32.8 feet, 0.8 foot above the danger-line, without causing material damage. At Montgomery, Ala., the Alabama River reached 54 feet, 6 feet above the danger-line, on the 16th; no material damage was caused, save to railroads, which were submerged above the city.

The Ohio, Cumberland, and Tennessee rivers rose rapidly the middle part of the month. The rivers rose rapidly at Pittsburg, Pa., and at 6 p. m., 13th, the false work of the Herra Island bridge was washed away. On the 15th the river reached

22.9 feet at Pittsburg, after which the water subsided. At Cincinnati, Ohio, the river reached 33.5 feet the morning of the 16th, a rise of 13.4 feet in 24 hours. During the next 24 hours it rose to 40.5 feet, and the morning of the 18th stood at 41.6 feet on the gauge, after which it began to fall.

At Chattanooga, Tenn., the Tennessee River was rising at the rate of 4 inches per hour on the 13th. The morning of the 14th the stage of water was 22.9 feet, a rise of 11.7 feet in 24 hours. Heavy drift was observed. The tracks of the Richmond and Danville, and Western and Atlantic Railroads were partially under water. At Charleston, Tenn., the river was 3.5 feet above the danger-line, and at Loudon, Clinton, and Rockwood it was approaching the danger-line. By the morning of the 15th there was a further rise of 10 feet at Chattanooga, and the river rose steadily at the rate of about 0.2 foot per hour. The water at 6 p. m. began to cover the tracks of the Richmond and Danville Railroad at Rossville Avenue; the dummy trains on the Union Belt Line to Look-out Mountain were stopped in the evening, and residents were forced to move from low-lying parts of the city. The morning of the 16th the stage of water was 37.1 feet, a rise of 4.2 feet in 24 hours, and the morning of the 19th it reached 37.9 feet, 4.9 feet above the danger-line, after which the water subsided slowly. The rise at Chattanooga from the 11th to the 17th was 29.8 feet.

Heights of rivers above low-water mark, January, 1892 (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	25, 26	8-5	17	3-5	5-0
<i>Arkansas River.</i>						
Fort Smith, Ark. ....	22-0	4	3-9	21, 22, 23	1-8	2-1
Little Rock, Ark. * ..	23-0	4	10-3	18	4-4	5-9
<i>Missouri River.</i>						
Fort Buford, N. Dak. † ..						9
Sioux City, Iowa .....	18-7					
Kansas City, Mo. ....	21-0	3†	7-7	10	1-5	6-2
<i>Mississippi River.</i>						
Saint Paul, Minn. † ..	14-0					
La Crosse, Wis. † .....	11-8					
Dubuque, Iowa † .....	16-0					
Davenport, Iowa † .....	15-0					
Keokuk, Iowa † .....	14-0					
Saint Louis, Mo. † .....	30-0	28	10-4	11	2-9	7-5
Cairo, Ill. ....	40-0	24	30-3	15	14-7	15-6
Memphis, Tenn. ....	33-0	26, 27	22-0	18	10-4	11-6
Vicksburg, Miss. ....	41-0	31	28-9	1	16-6	12-3
New Orleans, La. ....	13-0	3†	8-0	1	4-2	3-8
<i>Ohio River.</i>						
Parkersburgh, W. Va. ....	38-0	17	27-0	3†	6-6	20-4
Cincinnati, Ohio .....	45-0	18	41-6	14	14-0	27-6
Louisville, Ky. ....	24-0	19	16-5	15	7-7	8-8
<i>Cumberland River.</i>						
Nashville, Tenn. ....	40-0	20	30-2	3†	9-3	20-9
<i>Tennessee River.</i>						
Chattanooga, Tenn. ....	33-0	17	37-9	1, 2	6-6	31-3
Knoxville, Tenn. ....	29-0	15	23-3	1	2-1	21-2
<i>Monongahela River.</i>						
Pittsburg, Pa. ....	29-0	15	22-9	11	2-5	20-4
<i>Savannah River.</i>						
Augusta, Ga. ....	32-0	20	32-8	2	7-8	25-0
<i>Willamette River.</i>						
Portland, Oregon. ....	15-0	5	12-1	24, 25	2-3	9-8
<i>Susquehanna River.</i>						
Harrisburg, Pa. ....	17-0	16	13-2	29	2-1	11-1
<i>Alabama River.</i>						
Montgomery, Ala. ....	48-0	16	54-0	1	4-6	49-4

\* For 27 days.

† River frozen.

‡ For 20 days.

ATMOSPHERIC ELECTRICITY.

AURORAS.

The auroral displays of the month were numerous and brilliant. On the 5th auroras were reported in the northern tier of states from Maine to Washington, and in the western central valleys as far south as the north part of Oklahoma Territory. On the 29th they were observed from Montana to the middle Atlantic and New England states and southward in the central valleys to the 37th parallel, and on the 30th from the Dakotas to the New England coast. Auroras were also reported in northern New England on the 10th; in New York on the 3d,

4th, and 27th; in Michigan on the 27th and 28th; in Wisconsin on the 1st and 28th; in Minnesota on the 23d, 25th, and 28th; in Iowa on the 2d, 3d, 4th, 15th, and 28th; and in the Dakotas on the 12th, 25th, and 28th.

On the 5th the display was one of the most brilliant ever observed at Eastport, Me., and continued from 6.20 p. m. until midnight. It consisted of an arch of 30° to 35° altitude, with great beams of light shooting upward, some of which passed the zenith and almost reached the southern horizon. At Portland, Me., the aurora was observed from 9.15 to 11.45 p. m.

It extended over 270° of azimuth, and at 10.15 p. m. was very brilliant, with streamers reaching to the zenith. At Manchester, N. H., the display continued from 7 to 11 p. m. It consisted of an arch of a bright yellow color, about 10° in width, which extended from northwest over the northern horizon and to altitude 30°. At 8 p. m. streamers and "merry dancers" appeared, some of which shot upward to altitude 60° to 70°. The time of greatest brilliancy was 9.15 to 10 p. m., when the arch had disappeared, and the entire northern half of the sky was filled with beams and streamers of a bright yellow and green, with wavy circles of color in the zenith. After 10 p. m. the display began to fade.

At Northfield, Vt., an auroral arch of a whitish color, extending from east to west and to altitude 45°, was observed from 7.45 to 11 p. m. A brilliant aurora was observed at Boston, Mass., from 8 p. m. until midnight. It first appeared as a band of white light extending over 120° of azimuth and to altitude 40°. At 8.10 p. m. streamers were observed beginning in the northeast and moving westward; they were first visible below the arch, and thence extended upward and through it. From 10 to 11 p. m. brilliant streamers and waves of light flashed from the horizon to the zenith. At Woods Holl., Mass., the display was observed at 6.50 p. m. as a clearly defined white light, extending from east to west, and rising toward the zenith. It increased in brilliancy, with vertical bars of rose color. Later, waves of light moved back and forth and rose nearly to the zenith. The display began to fade 10.40 p. m. At New Haven, Conn., the aurora began 7.45 p. m. as a band of light about 2° in width, extending over 80° of azimuth, and to 30° altitude. At 8.20 p. m. streamers extended from the arch 20° to 30° towards the zenith. The time of greatest brilliancy was about 8.30 p. m.

At Oswego, N. Y., an arch of dim light reaching 30° altitude was observed at 6.40 p. m. At 6.55 p. m. the light was a yellowish white, with a rosy tint in the northwest. At 8.30 p. m. the arch extended to within about 5° of the zenith, with waves or flashes of light on the east and west sides and below the arch. The display was last observed 12.45 a. m., 6th, as a dim arch of 15° to 20° altitude resting on a very dark segment. At South Canisteo, N. Y., a light aurora extended from northwest to northeast and to altitude 35° at 8 p. m. It began to fade at 8.50 and disappeared at 9 p. m. At Red Wing, Minn., an aurora was observed from 10 p. m. until midnight; it was brightest at 11.40 p. m., when "merry dancers" extended from 150° to 200° azimuth, and rose to altitude about 25°.

At Bismarck, N. Dak., an aurora, consisting of bright, irregular beams, extending to altitude 40° to 50°, was observed from 7.30 to 9.50 p. m. At Fort Buford, N. Dak., a brilliant aurora consisting of 2 streamers of a bluish color in the northwest, extending about 30° above the horizon, was observed at 8.15 p. m. At 8.45 p. m. a band extended from northwest to east with many streamers, two of which were in the northeast and nearly reached the zenith. At this time the color changed gradually to a rosy hue, which was more pronounced 60° above the horizon. At 11 p. m. the display began to fade, and at 11.30 p. m. it had disappeared. At Miles City, Mont., a pale but plainly visible aurora consisting of a diffused light without motion, but with pale columns moving from the horizon

to an arch of altitude about 30°, was observed from 8 to 11.45 p. m.

At Fort Assinaboine, Mont., an aurora consisting of luminous beams of a pale yellow and reddish color rising to the zenith appeared 9 p. m. At 9.30 p. m. the display consisted of 3 arches, the upper one of which extended across the sky from west to east, and at 9.40 p. m. the arches assumed a serpentine shape, with beams of light. At 10.10 p. m., the arches were about 40° altitude and appeared as a brilliant curtain with a variety of colors. The display disappeared 10.30 p. m. At Olympia, Wash., an aurora consisting of 2 streamers of a rosy color reaching altitude 20° to 40°, and shorter streamers on either side, was observed 9.10 p. m. The display was last seen 11.15 p. m.

On the 28th an aurora was observed at Detroit, Mich., in the early morning. It was first seen at 5.20 a. m., when it extended from northwest to northeast and to altitude about 80°. It was a deep crimson color near the base, and rested on a bank of dark clouds; broad shafts of light rose to the zenith; the red color at the base faded into yellow and finally assumed a greenish tinge as the display waned; and at 7.30 a. m. (75th meridian time) the aurora disappeared.

On the 29th, at 3.40 a. m., a brilliant aurora was observed in the northern sky at Red Wing, Minn. "Merry dancers" appeared and finally formed into 4 distinct columns, which rose gradually to the zenith at 5.20 a. m. The display disappeared 5.45 a. m. On this date a brilliant aurora, extending from 100° to 250° of azimuth, was observed from 2 to 7 a. m. at Huron, S. Dak. It consisted of waving beams, some of which reached the zenith; at times the beams would disappear for several seconds; and at such times a bright purple arch was visible in the north. On the same date a brilliant aurora, extending from 175° to 225° of azimuth, was observed at Topeka, Kans., at 6.30 a. m. Streamers of great brilliancy extended to altitude 20° to 35°. The aurora had an apparent motion from west to east, and faded with the advancing daylight.

#### THUNDERSTORMS.

Description of the more severe thunderstorms reported for the month is given under "Local storms."

Thunderstorms were reported as follows: East of the Rocky Mountains they were reported in the greatest number of states, 11, on the 1st; in 7 on the 2d and 5th; in 6 on the 4th and 12th; in 5 on the 11th and 13th; in 3 on the 18th; in 2 on the 9th, 10th, 14th, 19th, 25th, and 30th; and in 1 on the 3d, 7th, 8th, and 31st. No thunderstorms were reported on the 4th, 15th to 17th, 20th to 24th, and 26th to 29th.

East of the Rocky Mountains thunderstorms were reported on the greatest number of dates, 10, in Louisiana; on 7 in Mississippi; on 6 in Alabama and Florida; on 5 in Georgia and Texas; on 3 in North Carolina and Tennessee; on 2 in Kansas, Massachusetts, Missouri, New York, Ohio, Pennsylvania, and South Carolina; and on 1 in Arkansas, Connecticut, Iowa, Maryland, Nebraska, New Jersey, and Wisconsin.

West of the Rocky Mountains thunderstorms were reported in Arizona on the 21st, and 28th to 30th; in Colorado on the 30th; and in New Mexico on the 28th, 30th, and 31st. In states and territories other than those named no thunderstorms were reported.

#### MISCELLANEOUS PHENOMENA.

##### MINERAL MATTER DEPOSITED WITH SNOW IN NORTHERN INDIANA, JANUARY 8, 1892.

Mr. Arthur Goss, of the Chemical Department of Purdue University, La Fayette, Ind., furnishes the following as the result of a chemical analysis of a sample of dark-colored mineral matter in the form of fine powder received at the University from Mr. N. W. Garman, of Rolling Prairie, Ind., who

stated that it fell with the snow of January 8th over an extended area in northern Indiana:

"Loss on ignition (water and other volatile matter)....	15.04
Silica (SiO <sub>2</sub> ).....	65.64
Aluminium (Al <sub>2</sub> O <sub>3</sub> ) } .....	15.50
Iron (Fe <sub>2</sub> O <sub>3</sub> )..... } .....	
Lime (CaO) .....	2.19