

3.40 a. m. a small, well-defined arch of about 5° altitude and 30° azimuth, without streamers, was visible. At $\frac{1}{2}$ a. m. a few streamers without motion were observed, and continued until daylight. The color of the aurora throughout the entire display was a pale yellow, with the exception of a broad streamer at the western extremity, which from 11.30 to 11.40 p. m. was of bright crimson. At Key West, Florida, from 1 to 1.30 a. m. on the 17th, the aurora was observed, consisting of a diffuse light, resembling the morning twilight, extending to an altitude of 10° , and from 134° to 190° azimuth.

Chicago, 16th, Aurora observed at 9.40 p. m., consisting of a hazy segment of 15° altitude, surmounted by an arch of light about 5° broad, extending from about 40° east of north to 30° west of north. The arch slowly ascended and at 10.15 p. m. was of about 40° altitude. During the next ten minutes the arch widened toward both zenith and horizon, and disappeared, leaving only a faint glow. At 10.30 p. m., vertical columns began to shoot upward from near the north point, toward the zenith, which were soon accompanied by similar displays from first the west, and afterward from the east; the aurora meanwhile having extended laterally to about 55° west of north and to about 70° east of north. The shafts gradually extended laterally and finally converged to a point about 15° south of the zenith, changing in color from pale yellow to blue, red and crimson, shooting up and down from horizon to zenith, resembling a ray of sunlight reflected from a rapidly rotated mirror. About 10.45 p. m. it reached its maximum brilliancy. The point of convergence near the zenith, a circular black nucleus presented a decided contrast to the brilliancy of the converging beams, which varied from a deep red at their summits, to a pale blue near the horizon. At this time the display covered two-thirds of the sky. At irregular intervals, a tremulous swinging movement from east to west, and vice-versa, was observed. At 10.55 p. m. it began to fade, and at eleven post-meridian only a faint glow remained, varied by occasional feeble beams shooting from the horizon toward the zenith. The wires of the various telegraph offices were unusually affected. At the Western Union Office, the batteries were detached and the wires worked to both Omaha and New York, the current being very powerful. Wires running north and south were also much affected but not nearly so powerfully as those running east and west. The display continued until daylight of the 17th, and was characterized by recurring fits;—consisting chiefly of vertical shafts shooting upward from the horizon with great rapidity and quickly disappearing, and a faint luminous glow resembling dawn.

At Indianola, Texas, the aurora was observed from 10 to 10.30 p. m. in the northern sky extending 10° east and 10° west of the magnetic meridian and to an altitude of 45° ; no streamers or arch were visible but the aurora consisted of a diffuse pale red light, resembling the light of a distant prairie fire.

At Olympia, Washington Territory, from 12.30 to 12.50 a. m. the aurora was observed through broken clouds, resembling the glow of a distant fire.

At San Francisco, 16th, 8.15 p. m., an unusually brilliant aurora of deep crimson color, spread over the northern sky, extending to an altitude of 35° , with a wavy motion which soon afterwards settled to a dull steady glow and gradually died away at 9.30 p. m. At 11 p. m. it appeared again, consisting of several columns of white to orange color, extending to a height of 75° . The display attracted the attention of a large number of spectators, who imagined it to be the reflection from a large fire. At Visalia, California, the display began at 8.35 p. m. The northern sky from east to west was of a fiery color, with a motion from east to west; its greatest brilliancy occurred between 8.35 and 9 p. m.; altitude 50° ; azimuth 135° ; it remained visible until $\frac{1}{2}$ a. m. of 17th.

The following interesting report furnished from the United States steamer "Vandalia," in lat. $30^{\circ} 10' N.$, long. $78^{\circ} 19' W.$, by Captain R. W. Mead, United States Navy, commanding, is of special interest: A very remarkable aurora-borealis was noticed, beginning at 10 p. m., Sunday, April 16th, and ending

about 4:30 a. m., Monday, April 17th, 1882. It was preceded by an arc of greenish hue, the base of which was about 45° in length, with its centre not more than 10° in height, directly under the Pole star. This lasted about half an hour, when wave-like shafts of light of different shades of pink, blue, yellow and greenish white colors shot up, all converging toward a common point, about 20° directly above the north star. The base increased one point, ending at n.n.e. and the other at w.n.w. Evidently the compass was affected, for when the light at the northern point increased in intensity, the ship, apparently came to windward of the course, (attributed at the time to bad steering,) but when the light at the western end increased in brilliancy, the ship, apparently, fell off to the leeward. The compass course was northeast by east; wind east by north.

The display next in importance to that of the 16th, was observed during the evening of the 19th and early morning of 20th. At many stations it was scarcely less brilliant than that of the 16th. It was observed from stations in New England westward to Umatilla, Oregon, and southward to Nashville, Tennessee, and at Phoenix, Arizona. Displays of less importance and of varying brilliancy, also occurred on the following dates: 5th, 13th to 24th, 28th, 29th.

THUNDER STORMS.

They were reported in the various districts on the following dates:

New England, 2d, 4th, 6th, 7th, 19th, 20th.

Middle Atlantic states, 2d to 4th, 6th, 9th, 10th, 12th, 14th, 19th, 20th, 22d, 23d, 26th, 27th, 28th, 30th.

South Atlantic states, 2d to 5th, 7th to 10th, 12th, 19th, 20th, 22d, 23d, 27th to 29th.

Florida peninsula, 8th, 10th, 15th, 20th.

East Gulf states, 2d, 3d, 5th to 13th, 17th to 20th, 22d, 26th to 29th.

West Gulf states, 2d, 5th to 12th, 18th, 19th, 21st, 22d, 26th to 29th.

Rio Grande valley, 7th, 8th, 26th, 28th, 29th.

Ohio valley and Tennessee, 2d to 4th, 6th to 9th, 18th, 19th, 21st to 23d, 26th to 28th.

Lower lake region, 1st, 2d, 4th, 6th, 7th, 19th, 27th, 28th.

Upper lake region, 1st to 4th, 6th to 9th, 18th, 19th, 22d, 26th, 27th.

Upper Mississippi valley, 1st to 9th, 18th, 21st, 22d, 25th, 26th.

Missouri valley, 1st to 8th, 11th, 17th to 19th, 21st, 22d, 25th, 26th, 28th.

Southern slope, 4th, 5th, 7th, 10th, 11th, 21st, 26th to 30th.

Southern plateau, 1st, 3d, 12th to 14th, 16th, 29th, 30th.

Thunder-storms were also reported from the following stations not included in the districts named above: Bismark, Dakota, on the 7th; Blackfeet Agency, Montana, on 24th; Fort Custer, Montana, 6th; Terry's Landing, Montana, 24th; Fort Washakie, Wyoming, 11th; Fort Collins, Colorado, 17th; Pike's Peak, 4th; North Platte, Nebraska, 4th, 8th, 17th, 25th; Dodge City, Kansas, 7th; Spokane, Washington, 26th; Eagle Rock, Idaho, 3d; Boise City, Idaho, 22d; Fort McDermitt, Nevada, 3d.

During thunder-storms the following instances of damage by lightning occurred: Burlington, Vermont, 6th, at Winooska Falls, during morning, a church was struck by lightning; a cross on the building was thrown down and a quantity of slating was torn off. Chattanooga, 22d, a tree was struck by lightning; a person in vicinity was stunned and a cow killed. Friendship, New York, 2d, 6 a. m., lightning struck an oil-tank and two derricks. Buffalo, 2d, the railroad station at Buffalo Plains was struck by lightning, set on fire and destroyed. Another building was also consumed at the same time.

OPTICAL PHENOMENA.

SOLAR HALOS.

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

New England, 1st, 4th to 6th, 8th, 10th, 19th, 24th, 25th.
Middle Atlantic states, 1st, 3d, 4th, 9th, 18th, 22d to 24th, 26th, 29th.
South Atlantic states, 1st, 13th, 18th, 22d, 26th.
East Gulf states, 17th, 20th, 24th, 25th, 30th.
West Gulf states, 3d, 4th, 6th, 8th, 20th, 24th, 27th.
Tennessee, 5th, 6th, 11th, 18th, 28th.
Ohio valley 1st to 6th, 8th, 11th, 12th, 17th, 18th, 20th, 21st, 24th, 27th, 28th.
Lower Lake region, 1st, 4th, 5th, 7th, 9th, 18th, 19th, 22d, 23d, 25th, 26th, 29th.
Upper Lake region, 10th, 12th, 16th, 17th, 18th, 21st to 26th, 28th.
Upper Mississippi valley, 4th to 7th, 11th, 12th, 21st, 23d, 24th.
Missouri valley, 3d to 6th, 18th, 29th.
North Pacific coast region, 2d, 12th, 13th, 29th, 30th.
Middle Pacific coast region, 4th, 7th, 10th, 11th, 14th, 16th, to 19th, 21st, 22d, 28th to 30th.

Solar halos were also reported from the following stations not included in the districts named above: Key West, 9th, 10th, 16th, 19th; Santa Fé, New Mexico, 2d, 12th; Salt Lake City, 12th, 29th; Umatilla, Oregon, 13th; Dayton, Washington, 29th; Carson City, Nevada, 11th; San Diego, California, 9th; Campo, California, 27th.

LUNAR HALOS.

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

New England, 4th, 26th, 29th.
Middle Atlantic states, 2d, 4th, 8th, 14th, 16th, 23d, 25th, 28th, 29th.
South Atlantic states, 1st, 3d, 5th, 19th, 27th, 28th, 30th.
East Gulf states, 24th, 26th, 27th, 29th, 30th.
West Gulf states, 3d, 4th, 23d to 25th, 27th, 29th; Tennessee, 5th, 21st, 26th; Ohio valley, 3d to 6th, 13th, 23d, 25th, 28th.
Lower lake region, 1st, 3d, 10th, 26th.
Upper lake region, 1st, 3d to 6th, 8th, 16th, 20th, 22d to 26th, 29th.
Upper Mississippi valley, 1st, 3d to 6th, 22d, 23d, 25th, 26th.
Southern slope, 1st to 3d, 23d, 24th, 26th, 30th.
Northern slope, 22d, 25th.
Southern plateau, 1st, 2d, 28th, 29th.
North Pacific coast region, 28th, 29th.
Middle Pacific coast region, 1st, 4th, 22d, 26th, 30th.

Lunar halos were also reported from the following stations not included in the districts named above: Fort Brown, Texas, 3d; Fort Yates, Dakota, 27th; Yankton, Dakota, 20th; Protem, Missouri, 3d, 4th; Fort Washakie, Wyoming, 29th; Pike's Peak, Colorado, 2d; Spokane, Washington, 1st; Winnemucca, Nevada, 8th; Salt Lake City, Nevada, 2d, 22d, 29th; Umatilla, Oregon, 23d, Boise City, Idaho, 29th; Visalia, California, 1st, 28th, 30th.

MIRAGE.

Rio Vista, California, 17th; Alexandria, Dakota, 4th, 15th, 28th, 29th; Indianola, Texas, 23d, 29th.

MISCELLANEOUS PHENOMENA.

SUNSETS.

The characteristics of the sky as indicative of fair or foul weather for the succeeding twenty-four hours, have been observed at all Signal Service stations. Reports from 187 stations show 5,494 observations to have been made, of which 25 were reported doubtful; and of the remainder, 5,469, there were 4,539, or 83.0 per cent., followed by the expected weather.

SUN SPOTS.

The following record of observations has been forwarded by

Mr. D. P. Todd, Director of the Lawrence Observatory, Amherst, Mass.:

DATE— Ap'1, 1882.	No. of new		Disappeared by solar rotation.		Reappear'd by solar rotation.		Total No. visible.		REMARKS.
	Gr'ps	Spots	Gr'ps	Spots	Gr'ps	Spots	Gr'ps	Spots	
1, 1 p. m.	1	2	0	0	0	0	6	30†	Spots probably disappeared by solar rotation.
2, 1 p. m.	2	10†	0	0	0	0	8	40†	
4, 3 p. m.	0	15	2	10	0	0	5	40†	
7, 4 p. m.	3	20†	2	15			6	48†	
9, 1 p. m.	1	5	0	5	1	5	7	45†	
12, 1 p. m.	2	25†	1	5	2	20†	8	53†	
13, 1 p. m.	0	5	1	3	0	5	5	53†	
16, 12 m.	1	30†	0	0	1	2	6	85†	Many of the spots very small.
17, 6 p. m.	1	30†	0	5	1	2	7	125†	
18, 5 p. m.	2	40†	1	2	0	0	8	180†	Many of the spots small. Three large groups of spots probably disappeared by solar rotation.
20, 1 p. m.	0	0	1	10†	0	0	7	125†	
21, 2 p. m.	1	1	1	5	1	1	7	110†	
24, 2 p. m.	0	0			1	0	3	20†	
25, 1 p. m.	0	0	0	6	0	0	3	14	Spots probably disappeared by solar rotation.
28, 4 p. m.	1	8	1	8	0	0	3	12	
30, 12 m.	1	8	2	6			1	8	

†Approximated. Faculae were seen at the time of every observation.

Mr. William Dawson, at Spiceland, Indiana, reports: 1st, eight groups, thirty-three spots; 4th, six groups, fifty-six spots; large group of small spots in northeast quadrant and large spot east of centre; 5th, seven groups, sixty spots; 11th, eight groups, thirty-six spots; large group east of centre; 12th, seven groups, sixty-five spots; several large groups east of centre; five of the spots very large; several others quite prominent; very large spot and prominent penumbra at east edge; air very poor; 13th, five groups, sixty-five spots; the large spot is 1' from east edge; 14th, seven groups, seventy-five spots; one spot quite large; many others quite prominent; air poor; 15th, nine groups, one-hundred and forty spots; one very large group in southwest quadrant; the eastern group easily seen without telescope; 16th, eight groups, one-hundred and sixty spots, twelve of which are large and twelve others quite prominent; 17th, nine groups, one hundred and seventy-five spots; two very large groups south of centre; one easily seen without telescope; six groups, ninety-five spots; one visible without glass; 24th, three groups, thirty-five spots; one large group has disappeared; one large spot west of centre; 25th, three groups, thirty spots; 27th, five groups, twenty-five spots; 28th, three groups, twenty spots, all of which are small; 30th, three groups, eighteen spots. Mr. David Trowbridge, at Waterburg, New York, reports: 3d, six groups, twelve spots; faculae in west; 7th, seven groups, twelve spots; faculae in east; 15th, seven groups, twenty-two spots, several of which are large; one group in east easily seen without telescope; one large group in west; 16th, seven groups, twenty-five spots; one group has disappeared and one appeared by rotation. There are visible ten spots included in one penumbra in the large group which is still plainly visible without telescope; it occupies fully one-fifteenth of the solar diameter; 17th, six groups, twenty-two spots; one group has disappeared and another is very faint; the large group still seen with unassisted eye; 18th, six groups, twenty-six spots; one group has appeared and one has disappeared by rotation; two groups now visible without telescope; 22d, four groups, seven spots; the two large groups near west margin are no longer visible without telescope, one of which was visible for six days without aid of glass; 23d, light groups, twelve spots; 24th, four groups, seven spots; one large group has disappeared by rotation; 25th, three groups, seven spots; faculae near the large group and in the east; 26th, two groups, four spots; large group has disappeared by rotation; 29th, one group, one spot; faculae; 30th, one group, three spots; faculae in east. Mr. H. D. Gowey, at North Lewisburg, Ohio, reports: Sunspots were observed on every clear day during the month; they were largest and most active from fifteenth to twenty-first; smallest and least numerous on twenty ninth and thirtieth; the groups and spots were exceedingly large from seventeenth to nineteenth.

The following record of observations has been forwarded by