

Lowville, N. Y., and Webster, S. Dak. 7th, Greenwood, Wis. 12th and 13th, Saint Vincent, Minn. 15th, Sheldon, Minn.; Fort Buford, N. Dak.; Queensbury, N. Y.; Scranton, S. Dak.; Manitowoc, Wis. 16th, Saint Vincent, Minn. 17th, Riley, Ill.; Cornish, Me.; Hanover, N. H.; Leech Farm, N. Dak. 18th, South Canisteo, N. Y. 19th, Glendive, Mont.; Eagle's Mere, Pa. 22d, Saint Vincent, Minn.

THUNDER-STORMS.

The more severe thunder-storms of the month are described under "Local storms". East of the Rocky Mountains thunder-storms were reported in the greatest number of states and territories, twenty-one, on the 22d; in twenty on the 21st, 27th, and 28th; in fifteen on the 20th; in thirteen on the 18th; in from six to twelve, inclusive, on the 6th, 10th, 11th, 12th, 19th, 24th, 25th, 26th, 30th, and 31st; and in from one to five, inclusive, on the 1st, 2d, 4th, 5th, 9th, 13th, 14th, 17th, 23d, and

29th. On the 3d, 7th, 8th, 15th, and 16th no thunder-storms were reported east of the Rocky Mountains.

East of the Rocky Mountains thunder-storms were reported on the greatest number of dates, eighteen, in Texas; on thirteen dates in Alabama; on eleven dates in Arkansas and Illinois; on from five to ten dates in Florida, Georgia, Indiana, Kansas, Kentucky, Louisiana, Maryland, Mississippi, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, and Virginia; and on from one to four, inclusive, in Connecticut, Indian Territory, Iowa, Massachusetts, Michigan, Minnesota, Montana, Nebraska, New Hampshire, Rhode Island, South Dakota, West Virginia, and Wisconsin. In states and territories east of the Rocky Mountains other than those named, no thunder-storms were reported. The only states and territories west of the Rocky Mountains reporting thunder-storms were: California, 25th and 28th; Colorado, 30th; Utah, 23d and 29th; and Wyoming, 26th.

MISCELLANEOUS PHENOMENA.

DROUGHT.

Long and damaging drought was reported in the lower Rio Grande Valley; stock perished from need of water; the Rio Grande River was the lowest ever known at Brownsville, Tex.

HALOS.

Solar or lunar halos were reported in New England and the middle Atlantic states on twenty-three dates; 83 per cent. of the halos were attended on the first day, 65 per cent. were followed on the second day, and 61 per cent. were followed on the third day by rain or snow. In the south Atlantic states halos were reported on twelve dates; 50 per cent. of the halos were attended on the first day, 50 per cent. were followed on the second day, and 42 per cent. were followed on the third day by rain or snow. In the Gulf States halos were reported on fourteen dates; 57 per cent. of the halos were attended on the first day, 43 per cent. were followed on the second day, and 50 per cent. were followed on the third day by rain. In the Lake region halos were reported on sixteen dates; 75 per cent. of the halos were attended on the first day, 38 per cent. were followed on the second day, and 44 per cent. were followed on the third day by rain or snow. In the Mississippi and Ohio valleys halos were reported on twenty-nine dates; 73 per cent. of the halos were attended on the first day, and 63 per cent. were followed on the second and third days by rain or snow. In the Missouri Valley halos were reported on eighteen dates; 61 per cent. of the halos were attended on the first day, 67 per cent. were followed on the second day, and 55 per cent. were followed on the third day by rain or snow. In the Rocky Mountain and plateau regions halos were reported on seventeen dates; 47 per cent. of the halos were attended on the first day, 53 per cent. were followed on the second day, and 60 per cent. were followed on the third day by rain or snow. On the Pacific coast halos were reported on nineteen dates; 68 per cent. of the halos were attended on the first day, 74 per cent. were followed on the second day, and 63 per cent. were followed on the third day by rain or snow. In New England and the middle Atlantic states 48 per cent. of the halos occurred in the eastern quadrants, and 52 per cent. in the western quadrants of low pressure storms. In the south Atlantic states 58 per cent. of the halos occurred in the eastern, and 42 per cent. in the western quadrants of low pressure storms. In the Gulf States 64 per cent. of the halos occurred in the eastern, and 36 per cent. in the western quadrants of low pressure storms. In the Lake region 40 per cent. of the halos occurred in the eastern, and 60 per cent. in the western quadrants of low pressure storms. In the Mississippi and Ohio Valleys 40 per cent. of the halos occurred in the eastern, and 60 per cent. in the western quadrants of low pressure storms. In the Missouri Valley 71 per cent. of the halos occurred in the eastern,

and 29 per cent. in the western quadrants of low pressure storms. In the Rocky Mountain and plateau regions 53 per cent. of the halos occurred in the eastern, and 47 per cent. in the western quadrants of low pressure storms. On the Pacific coast 33 per cent. of the halos occurred in the eastern, and 67 per cent. in the western quadrants of low pressure storms.

Unusually well-defined and brilliant solar halos and parhelia were noted on the 2d at University and Pontotoc, Miss., Brodnax and Shreveport, La., Carrollton, Ala., Fort Smith, Ark., Peekskill, N. Y., Fulton, Wis., and Gallatin, N. Dak.; on the 4th at Fort Adams, R. I., and on the 31st at New Haven, Conn. Remarkably bright lunar halos were reported at Lawrenceburgh, Tenn., on the 2d, and at Trenton, on the 3d. The remarkable and extensively observed solar halos of the 2d occurred with high barometer, unusually low temperature, and heavy frost in the west Gulf states and the Mississippi Valley. The barometer continued high over the Gulf States during the 3d, and a low pressure storm moved southeastward over the upper lake region. On the 4th and 5th rain fell in the Gulf States, attending the presence of an area of low pressure in the Rio Grande Valley, and the development of a low pressure storm over the Gulf States.

METEORS.

Brilliant meteors were reported as follows: 3d, Nashville, Tenn.; 20th, Greensborough, Ala.; 30th, Cedar Keys, Fla. Meteors were also reported as follows: 4th, Leicester, Mass.; 6th, Butlerville, Ind.; 9th, State College, Pa.; 12th and 13th, Barren Creek Springs, Md.; 14th, Monticello, Iowa; 15th, Villa City, Fla.; Beverly, N. J.; Oregon, Mo.; 22d, Weeping Water, Nebr.; 29th, Heppner, Oregon.

MIRAGE.

Mirage were observed during the month as follows: 1st, Clinton, Mich.; 5th, Woonsocket, S. Dak.; 10th, Hampton, Iowa; 11th, Webster, S. Dak.

PRAIRIE AND FOREST FIRES.

Prairie fires were reported at Lexington, Nebr., on the 23d; at Fort Sully, S. Dak., on the 23d, 24th, 25th, and 26th; at Fort Sill, Ind. T., on the 1st to 5th, 7th, 8th, 11th to 29th; at Fort Custer, Mont., on the 22d and 23d; in Kit Carson, Colo., on the 23d and 24th; in Rooks, Lincoln, Sedgwick, and Kingman counties, Kans., on the 23d and 24th; and forest fires were reported at Egg Harbor City, N. J., on the 27th.

SUN SPOTS.

Mr. C. E. Buzzell, Leaf River, Ill.: solar observations during the month were made as follows: 4th, a good sized group of spots came into view by rotation, in high north latitude $32^{\circ} 33'$; the group was surrounded by prominent faculae, and remained unchanged until the 8th, when it

began to break up, and disappeared in faculæ on the 13th. None others seen.

Mr. M. A. Veeder, Lyons, N. Y.: on March 4th a large spot, unusually far north on the sun's surface, appeared by rotation. On succeeding days it divided into several parts, and by March 13th had nearly faded out. Faculæ in its location reappeared by rotation on March 31st. On March 7th faculæ appeared by rotation and made the entire transit, being seen at the western limb on March 20th. On March 19th a group of faculæ was about two days removed from the eastern limb. The groups of faculæ of March 7th and 19th were in the location of areas that have long been much disturbed, and whose

return at the eastern limb have been attended by the chief magnetic storms of recent years, manifesting at times for months together a very exact twenty-seven day periodicity. There has been a similar reoccurrence of magnetic perturbations associated with the area occupied by the spot of March 4th continuing however since August, 1889, only.

Mr. John W. James, Riley, Ill.: a small group surrounded by very prominent faculæ, on the eastern edge of the sun, 4th, very changeable in appearance, daily, and vanished 13th, before reaching the western edge. None others seen.

Mr. H. D. Gowey, North Lewisburgh, Ohio: sun spots were observed on the 9th.

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 March, 1890, 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, March, 1890.

States.	States.
Maine.....	81.4
New Hampshire.....	83.5
Vermont.....	84.2
Massachusetts.....	84.8
Rhode Island.....	82.4
Connecticut.....	84.1
Eastern New York.....	83.4
Western New York.....	75.2
Eastern Pennsylvania.....	81.5
Western Pennsylvania.....	73.9
New Jersey.....	84.4
Delaware.....	91.5
Maryland.....	90.6
District of Columbia.....	89.0
Virginia.....	86.0
North Carolina.....	85.9
South Carolina.....	82.2
Georgia.....	83.7
Eastern Florida.....	78.1
Western Florida.....	86.3
Alabama.....	84.8
Mississippi.....	81.9
Louisiana.....	80.8
Texas.....	81.1
Arkansas.....	82.3
Tennessee.....	86.2
Kentucky.....	83.9
Ohio.....	74.5
West Virginia.....	79.7
Indiana.....	77.4
Illinois.....	82.8
Lower Michigan.....	82.1
Upper Michigan.....	79.5
Wisconsin.....	82.1
Minnesota.....	79.4
Iowa.....	78.6
Kansas.....	75.2
Nebraska.....	80.5
Missouri.....	82.6
Colorado.....	71.7
North Dakota.....	77.4
South Dakota.....	81.4
Southern California*.....	82.1
Northern California*.....	82.8
Oregon*.....	75.9
Washington*.....	78.4
By elements: Weather.....	82.1
Temperature†.....	81.5
Monthly percentage of weather and temperature combined †.....	81.9

* In determining the monthly percentage of weather and temperature combined, the Pacific coast states are not included. † The forecasts of temperature in districts east of the Rocky Mountains for March, 1890, 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. ‡ 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.

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 days 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, 195; temperature, 132. Percentages of verifications: weather, 78.5; temperature, 94.2. Weather and temperature combined, 83.3. For third day in advance. Number of predictions made: weather, 7; temperature, 34. Percentages of verifications: weather, 82.9; temperature, 86.5; weather and temperature combined, 85.6.

CAUTIONARY SIGNALS FOR MARCH, 1890.

Statement showing percentages of justifications of wind signals for the month of March, 1890:

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

Gold-wave signals.—(Ordered by Assistant Professor T. Russell.) Total number of signals ordered, seventy-four; justified, twenty-nine. Percentage of justifications, 39.2.

Percentages of verifications of weather and temperature signals reported by directors of the various State Weather Services for March, 1890.

States.	Weather.	Temperature.	States.	Weather.	Temperature.
Illinois.....	81.0	78.2	New Jersey.....	84.7	92.3
Indiana.....	85.0	88.0	New York.....	84.3	87.3
Kansas.....	82.7	86.6	North and South Dakota...	82.0	84.0
Michigan.....	84.4	82.9	Ohio.....	80.0	85.0
Minnesota.....	69.0	82.0	Pennsylvania.....	82.0	85.0
Missouri.....	80.0	85.0	South Carolina.....	83.6	91.4
Nebraska.....	79.9	86.6	Tennessee.....	84.7	86.6

STATE WEATHER SERVICES.

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

The following extracts and summaries are republished from reports for March, 1890, of the directors of the various state weather services:

ALABAMA.

Temperature.—The average temperature was 1.08 below the normal; highest monthly mean, 58.4, at Citronelle; lowest monthly mean, 47.8, at Valley Head; maximum, 84, at Citronelle, 19th, Montgomery, 21st, and at Wiggins, 20th and 26th; minimum, 10, at Valley Head, 2d; greatest local monthly range, 64, at Uniontown, Valley Head, and Wiggins; least local monthly range, 50, at Union Springs.

Precipitation.—The average was 0.66 below the normal; greatest monthly, 9.67, at Carrollton; least monthly, 2.09, at Bermuda.

Wind.—Prevailing direction, north.—P. H. Mell, Signal Corps, Auburn, director.

ARKANSAS.

Temperature.—The mean temperature was about 2 above the normal; highest monthly mean, 54.7, at Pine Bluff; lowest monthly mean, 44.9, at Wins-