

in this city, a large number of cellars were flooded, considerable lumber washed away, and crops on low ground destroyed.

El Dorado, Butler Co., Kans., 17th: extensive rains have caused a flood in the valley of the Walnut. Part of the Missouri Pacific track has been washed away. Iola, Allen Co., 17th: this county has suffered severely from floods in the Neosho River and its tributaries. Crops have been badly

damaged. There is a serious washout on the Saint Louis, Wichita, and Western Railroad.—*Buffalo, N. Y., Express*, 18.

HIGH TIDES.

Manatee, Manatee Co., Fla.: the high southeast wind on the 16th and 17th caused the tide to rise higher than it has been since 1848; all wharves on the river were submerged, entailing slight damage.—*Report of Mrs. Mary W. Broberg*.

ATMOSPHERIC ELECTRICITY.

AURORAS.

Auroras were noted at Saint Vincent, Minn., 14th; Parkston, Dak., 15th; and Orono, Me., 20th. The display at Saint Vincent was first observed at about midnight of the 14th, and consisted of an arch extending from azimuth 160° to 205° and to altitude 12°, and had much the appearance of a rainbow, though somewhat broader. The display remained materially unchanged until daybreak of the 15th.

THUNDER-STORMS.

The more severe thunder-storms are described under "Local storms." Thunder-storms were reported in the greatest number of states and territories, thirty-six, on the 15th; in thirty-one on the 14th; in thirty on the 17th; in twenty-eight on the 16th, 20th, and 28th; in twenty-seven on the 29th; in twenty-six on the 21st; in from twenty to twenty-five, inclusive, on the 4th to 6th, 8th to 11th, 13th, 18th, 19th, 26th, 27th, and 30th; in from fifteen to nineteen, inclusive, on the 3d, 7th, 12th, and 25th; in from ten to fourteen, inclusive, on the 22d

to 24th; in eight on the 1st; and in seven on the 2d. There were no dates for which thunder-storms were reported in less than seven states and territories.

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

MISCELLANEOUS PHENOMENA.

FOREST FIRES.

Two Harbors, Lake Co., Minn., 12th: forest fires are raging along the Iron Range Railroad. This city is enveloped in smoke. A strong wind has been blowing all day, and every thing is dry as tinder, which renders the conditions very favorable for the progress of the fires. Ely, Emmet Co., Mich., 12th: the most destructive fires of the season are burning in this section; twelve to fifteen houses have been destroyed, and much damage has been done to railroad property.—*The Palladium, Oswego, N. Y., June 14*.

Superior, Douglas Co., Wis., 13th: a destructive fire is sweeping the forests south and west of here. Already over \$500,000 worth of pine has been destroyed. The districts tributary to Nemadji and Saint Louis rivers, in Wisconsin and Minnesota, are suffering terribly. The smoke from the burning districts obscures the sun and renders it difficult for vessels to enter the harbor. A strong wind is blowing from the southwest and several villages are threatened. The fires are raging from Saint Croix to the Northern Pacific Junction.—*Union and Advertiser, Rochester, N. Y., June 13*.

Ellensburg, Kittitas Co., Wash., 17th: severe forest fires prevail on the east side of the Cascade Mountains. The roar of the flames are heard for miles, and during the night the sky is illuminated with a glow. High wind prevails and the fires are extending.—*Union and Advertiser, Rochester, N. Y., June 17*.

Fort Apache, Ariz., 24th: the heavy rain during the last three days, it is believed, has extinguished the extensive fires which have prevailed near the headwaters of the White Mountain River since the 13th.

Forest fires were also reported as follows: Red Bluff, Cal., 1st, 4th to 7th; Linkville, Oregon, 10th; Fort Klamath, Oregon, 19th to 22d; Los Angeles, Cal., brush fires, 9th.

HALOS.

Solar halos were most frequently reported in Illinois, where they were noted on fifteen days; in Texas on thirteen days;

in Washington on twelve days; in Dakota on eleven days; in California, Idaho, Kansas, Maryland, Massachusetts, Michigan, Minnesota, Nevada, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, Tennessee, and Virginia, on from five to ten days, inclusive; in Alabama, Arizona, Arkansas, Indiana, Indian Territory, Iowa, Louisiana, Maine, Missouri, Nebraska, New Hampshire, and Wisconsin, on from one to four, inclusive. In Colorado, Connecticut, District of Columbia, Florida, Georgia, Kentucky, Mississippi, Montana, New Mexico, Rhode Island, Utah, West Virginia, and Wyoming no solar halos were reported during the month. They were reported in the greatest number of states and territories, fourteen, on the 1st and 3d; in twelve on the 2d; in eleven on the 6th and 17th; in from five to ten, inclusive, on the 4th, 5th, 7th to 9th, 11th, 13th to 16th, 18th, 20th, 24th, 25th, and 29th; and in from one to four, inclusive, on the 10th, 19th, 21st to 23d, 27th, 28th, and 30th. For dates other than those named no solar halos were reported.

Lampasas, Lampasas Co., Tex.: the solar halo observed at noon on the 6th was a remarkably beautiful one; it was very brilliant, and formed a complete circle. All the colors were distinct, the red being next to the sun. The phenomenon lasted about one hour, and the prismatic colors faded some time before the disappearance of the halo. Very light cirrus clouds, seemingly stationary, were evenly distributed in the zenith during the time of the halo, although a moderate southeast wind was blowing below. Rain fell every day during the six days following; that on the sixth day being the heaviest known here for many years, 4.26 inches falling in about twelve hours.—*Report of Dr. C. M. Ramsdell*.

Lunar halos were most frequently reported in South Carolina, where they were noted on eight dates; in Illinois, New Jersey, Ohio, and Tennessee on seven dates; in Dakota and Minnesota on six dates; in Alabama, Arkansas, California, Florida, Georgia, Idaho, Indiana, Iowa, Kansas, Louisiana, Maine, Maryland, Massachusetts, Michigan, Missouri, North Carolina,

Oregon, Pennsylvania, Texas, Virginia, and Washington, on from one to five dates, respectively. In states and territories other than those named no lunar halos were reported. They were reported in the greatest number of states and territories, thirteen, on the 10th; in twelve on the 8th and 9th; in eleven on the 6th; in from five to ten, inclusive, on the 2d, 3d, 7th, 11th to 13th; and in from one to four, inclusive, on the 1st, 4th, 5th, 14th, 15th, 17th, 18th, 20th, 22d, and 25th. For dates other than those named no lunar halos were reported.

METEORS.

The distribution of meteors by dates was as follows: 1st, Villa City, Fla. 2d, Mount Saint Mary's, Md. 5th, Beverly, N. J. 6th, Queensbury, N. Y. 11th, New Haven, Conn. 18th, Keeler, Cal. 19th, Villa City, Fla.; Vevay, Ind. 22d, Albion, Mich. 26th, Barren Creek Springs, Berlin, Bowie, Fallston, Galena, Pocomoke, Salisbury, Snow Hill, Md.; Weldon, N. C.; Cape Henry, Va. 29th, Quakertown, Pa.; Statesburgh, S. C.

The following are descriptions of the more notable meteoric displays reported: Mount Saint Mary's, Frederick Co., Md.: at 11.35 p. m., local time, 3d, a meteor of great size and brilliancy passed over that portion of the heavens between the constellations Corona Borealis and Centaurus. It was first observed near the star Epsilon Borealis; it disappeared behind dense clouds near the star Alpha Centauri. The time of its passage was five seconds. The size of the nucleus when first observed was about one-fourth the apparent diameter of the full moon. It gradually developed into a tail of about three apparent diameters of the full moon. Its color changed from white to a pale blue and purple. Although at the time of observation the heavens were covered with stratus clouds, through which the stars and Venus were but dimly seen, it shone with all the brilliancy of the full moon.—*Report of Prof. James A. Mitchell, Mount Saint Mary's College Observatory.*

New Haven, Conn.: Messrs. William M. and E. W. Abell report that they observed a bright meteor at 9.30 p. m., 11th. The path of the meteor was noted with reference to the stars in the constellation Leo, and found to be nearly parallel to the elliptic. About midway in its course the nucleus elongated, and an instant later separated in two parts of nearly equal brightness, one chasing the other until both disappeared at a point about 10° above the horizon and a little north of west. Both parts were as bright as Venus at her greatest brilliancy, and were nearly a degree apart when they vanished, the altitude of the rear one being a little less than that of the leader.—*The Morning News, New Haven, Conn., June 13.*

Pocomoke City, Worcester Co., Md.: a large meteor fell to the earth in this vicinity at about 8 p. m., 26th. It appeared to be about the size of a flour barrel, and was accompanied by a heavy rumbling noise resembling thunder. It was also reported from Berlin and Snow Hill, this county, that a meteor was observed throughout this county on the evening of the 26th. A singular feature of the display was that all who saw it imagined that the meteor fell close by.—*Baltimore, Md., American, June 28.*

Bowie, Prince George's Co., Md.: two large meteors lodged within a mile of Springfield, this county; the first 8.30 p. m., and the other 9.10 p. m., 26th.—*Baltimore, Md., Sun, June 27.*

Barren Creek Springs, Wicomico Co., Md.: a meteor moving in an easterly direction was observed at 8.30 p. m., 26th. When nearly in the east it burst in four parts, each part being apparently the size of an egg and appeared like falling sparks. Two explosions were heard at long intervals, sounding like distant thunder, attended by coruscations and a cracking noise.—*Report of Mr. A. E. Ackworth.*

Galena, Kent Co., Md.: a brilliant meteor was observed at 8.20 p. m., 26th, moving from southwest to northeast. It resembled a large skyrocket, and burst when apparently four hundred or five hundred yards above the earth.—*Report of Mr. Henry Parr.*

Fallston, Harford Co., Md.: a meteor was observed at 8.21 p. m., 26th. It appeared to be the size of a large dinner plate,

and passed off in a southeasterly direction. The meteor lighted up the sky with a rosy tint for about forty-five seconds.—*Report of Prof. G. G. Curtis.*

MIRAGE.

Mirage were observed at Webster, Dak., on the 1st, 2d, 4th, 11th, 17th, and at Hampton, N. H., on the 17th, 27th, 28th.

SAND STORMS.

Sand storms were reported during the month as follows: Fresno, Cal., 5th, 15th, 22d, 25th, 27th; San Carlos, Ariz., 4th, 11th, 14th; Fort Thomas, Ariz., 21st; Winnemucca, Nev., 4th, 12th, 18th, 22d, 26th, 27th.

DROUGHT.

Savannah, Ga.: the protracted drought in this section was broken by the heavy rain on the 9th.

Boisé City, Idaho, 20th: reports from the surrounding country show that all crops are severely injured by the prevailing drought; no rain, except trace, has fallen since May 18th, and the temperature during the month has been very high. There is not, in most localities, sufficient water for irrigation, because of the light snowfall during the past winter.

Parkston, Hutchinson Co., Dak., 30th: the ground is intensely dry and all vegetation is withering. Such drought has not existed in this section since its settlement.—*Report of Mr. John J. Swartz.*

Spearfish, Lawrence Co., Dak., 30th: the last half of the month has been very hot and dry, and where there was no irrigation, crops of small grain have suffered considerably.—*Report of Mr. J. H. Warren.*

Wolsey, Beadle Co., Dak., 30th: The rainfall for the month is below the average, and vegetation is suffering from drought.—*Report of Mr. G. W. Frink.*

Woonsocket, Sanborn Co., Dak., 30th: continued dry weather has materially damaged the wheat and oats crops.—*Report of Mr. L. O. Libbey.*

Helena, Mont., 30th: the month has been unusually dry; this, with the insufficient rain in the spring, has caused the severest drought ever known in this vicinity. The water supply in the city is short, small streams are running dry, the grass on the ranges is dying, the grain fields are in serious condition, and in some places no crops will be harvested. Unless heavy rain falls in July farmers, stockmen, and miners will suffer great hardship.

SUN SPOTS.

Haverford College Observatory, Pa., (observed by Mr. H. V. Gummere):

Date, June, 1889.	Number of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Faculae.		Remarks.
	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	Faculae.	
3, 11 a. m.	0	0	0	0	0	0	0	0	1	3	Definition poor.
4, 11 a. m.	0	0	0	0	0	0	0	0	0	0	Definition poor.
5, 10 a. m.	0	0	0	0	0	0	0	0	0	0	Definition poor, clouds.
6, 9 a. m.	0	0	0	0	0	0	0	0	0	0	Definition good.
7, 11 a. m.	0	0	0	0	0	0	0	0	0	0	Definition very good.
8, 11 a. m.	0	0	0	0	0	0	0	0	0	0	Definition good, clouds.
10, 11 a. m.	0	0	0	0	0	0	0	0	0	0	Definition good.
11, 11 a. m.	0	0	0	0	0	0	0	0	0	0	Definition poor.
13, 4 p. m.	0	0	0	0	0	0	0	0	5	24	Definition very good.
15, 4 p. m.	0	0	0	0	0	0	0	0	1	1	Definition poor.
16, 5 p. m.	1	9	0	0	0	0	1	9	0	0	Definition very good, large spot.
17, 10 a. m.	0	1	0	0	0	0	1	10	4	27	Definition good.
18, 9 a. m.	0	4	0	0	0	0	1	14	2	5	Definition poor.
20, 11 a. m.	0	6	0	0	0	0	1	20	1	1	Definition poor.
21, 3 p. m.	0	5	0	0	0	0	1	25	0	0	Definition good.
22, 10 a. m.	0	0	0	0	0	0	1	15	0	0	Definition poor.
23, 11 a. m.	0	0	0	0	0	0	1	12	0	0	Definition poor.
27, 10 a. m.	0	0	0	0	0	0	1	2	1	4	Definition very poor.
28, 12 m.	0	0	1	2	0	0	0	0	0	0	Definition very poor.
29, 12 m.	1	2	0	0	0	0	1	2	10	28	Definition good.

Mr. John W. James, Riley, McHenry Co., Ill.: none seen

until the 16th, when a very large and eleven small ones were found near east edge. The large one, estimated 31,360 miles in diameter, was on sun's meridian the 21st and disappeared by solar rotation 28th. The group of small spots was very changeable in appearance, nearly all vanished before reaching west edge. None seen after the 28th. Mr. C. E. Buzzell, Leaf River, Ogle Co., Ill.: clouds prevented solar observations 8th, 14th, and 15th. But one disturbance was observed during June, a large spot, followed by prominent faculae and a group of small variable spots, appeared by rotation on east limb 16th, passed meridian 21st, and west limb 27th. The group advanced perceptibly, while in view, and several spots were "merged." The larger one was about 22,000 miles in diameter,

and exhibited but very little variability. While this spot was passing the meridian on the 21st, there was a marked high electrical tension upon all the telegraph and telephone lines. There was also a severe disturbance on the 29th, during the storm which registered a maximum velocity of sixty miles from the east. Mr. M. A. Veeder, Lyons, Wayne Co., N. Y.: June 1st and 2d, numerous groups of faculae by rotation. This group of faculae occupied the entire sun's disc alone during the entire transit, disappearing by rotation on the 14th. A very large spot appeared by rotation 5.30 p. m., 15th; this spot was attended by many small ones. It began to divide into two parts on the 25th, and disappeared on the 27th. On the 27th, 28th, 29th, and 30th small groups of faculae appeared by rotation.

VERIFICATIONS.

FORECAST 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 April, 1889, were made by Captain James Allen, 3d Cavalry, Signal Officer and Assistant, 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, April, 1889.

States.	States.
Maine.....	81.2
New Hampshire.....	80.0
Vermont.....	75.9
Massachusetts.....	80.9
Rhode Island.....	80.5
Connecticut.....	80.4
Eastern New York.....	79.9
Western New York.....	80.1
Eastern Pennsylvania.....	81.0
Western Pennsylvania.....	78.1
New Jersey.....	81.2
Delaware.....	75.0
Maryland.....	71.4
District of Columbia.....	70.9
Virginia.....	75.5
North Carolina.....	75.7
South Carolina.....	78.4
Georgia.....	78.9
Eastern Florida.....	87.7
Western Florida.....	92.3
Alabama.....	90.7
Mississippi.....	87.5
Louisiana.....	87.1
Texas.....	81.7
Arkansas.....	79.1
Tennessee.....	81.3
Kentucky.....	79.5
Ohio.....	73.4
West Virginia.....	72.4
Indiana.....	82.0
Illinois.....	81.2
Lower Michigan.....	78.7
Upper Michigan.....	78.1
Wisconsin.....	81.9
Minnesota.....	76.1
Iowa.....	83.1
Kansas.....	76.1
Nebraska.....	77.9
Missouri.....	80.5
Colorado.....	78.7
Dakota.....	77.9
Southern California*.....	89.5
Northern California*.....	84.9
Oregon*.....	78.8
Washington Territory*.....	79.7
By elements: Weather.....	84.0
Temperature.....	73.3
Monthly percentage of weather and temperature combined †.....	79.7

The forecasts for districts east of the Rocky Mountains for May, 1889, were made by Captain H. H. C. Dunwoody, 4th Artillery, Signal Officer and Assistant, 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, May, 1889.

States.	States.
Maine.....	74.5
New Hampshire.....	73.5
Vermont.....	80.8
Massachusetts.....	83.2
Rhode Island.....	83.4
Connecticut.....	82.9
Eastern New York.....	79.7
Western New York.....	83.2
Eastern Pennsylvania.....	81.6
Western Pennsylvania.....	83.4
New Jersey.....	82.6
Delaware.....	85.2
Maryland.....	82.7
District of Columbia.....	80.4
Virginia.....	87.0
North Carolina.....	89.7
South Carolina.....	94.2
Georgia.....	92.8
Eastern Florida.....	92.8
Western Florida.....	93.9
Alabama.....	94.5
Mississippi.....	94.3
Louisiana.....	88.9
Texas.....	89.7
Arkansas.....	88.4
Tennessee.....	90.3
Kentucky.....	85.4
Ohio.....	82.5
West Virginia.....	85.5
Indiana.....	80.0
Illinois.....	75.5
Lower Michigan.....	79.7
Upper Michigan.....	73.0
Wisconsin.....	73.3
Minnesota.....	79.4
Iowa.....	80.4
Kansas.....	81.9
Nebraska.....	82.6
Missouri.....	81.0
Colorado.....	79.9
Dakota.....	78.7
Southern California*.....	85.5
Northern California*.....	78.1
Oregon*.....	83.6
Washington Territory*.....	79.7
By elements: Weather.....	86.2
Temperature.....	80.0
Monthly percentage of weather and temperature combined †.....	83.7

The forecasts for districts east of the Rocky Mountains for June, 1889, were made by Assistant Professor H. A. Hazen, 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, June, 1889.

States.	States.
Maine.....	74.5
New Hampshire.....	73.0
Vermont.....	72.1
Massachusetts.....	77.2
Rhode Island.....	72.7
Connecticut.....	75.1
Eastern New York.....	71.7
Western New York.....	73.6
Eastern Pennsylvania.....	78.5
Western Pennsylvania.....	75.9
New Jersey.....	74.7
Delaware.....	78.2
Maryland.....	81.1
District of Columbia.....	77.2
Virginia.....	80.7
North Carolina.....	79.3
South Carolina.....	80.7
Georgia.....	75.4
Eastern Florida.....	81.0
Western Florida.....	82.1
Alabama.....	77.5
Mississippi.....	75.3
Louisiana.....	79.1
Texas.....	77.3
Arkansas.....	75.4
Tennessee.....	72.0
Kentucky.....	69.9
Ohio.....	81.1
West Virginia.....	72.1
Indiana.....	77.6
Illinois.....	78.6
Lower Michigan.....	76.9
Upper Michigan.....	69.3
Wisconsin.....	77.3
Minnesota.....	75.3
Iowa.....	83.7
Kansas.....	76.9
Nebraska.....	79.9
Missouri.....	78.1
Colorado.....	76.9
Dakota.....	78.7
Southern California*.....	93.3
Northern California*.....	90.2
Oregon*.....	88.2
Washington Territory*.....	87.7
By elements: Weather.....	80.6
Temperature.....	70.6
Monthly percentage of weather and temperature combined †.....	76.6

* 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.

Note.—Beginning with April 11, 1889, the verifications have been prepared by Assistant Professor C. F. Marvin, assisted by Mr. H. E. Williams.

CAUTIONARY SIGNALS FOR APRIL, 1889.

Statement showing percentages of justifications of wind signals and cold-wave signals for the month of April, 1889:

Wind signals.—(Ordered by Captain James Allen.) Total number of signals ordered, one hundred and twenty-eight; justified as to velocity, wholly, eighty-seven, partly, ten; justified as to direction, one hundred and twenty. Of the signals ordered, ninety-five were cautionary, of which sixty-two were wholly, and seven partly justified; thirty-three were storm signals, of which twenty-five were wholly, and three partly justified. Number of signals ordered for easterly winds, seventy-seven; justified, sixty-nine. Number of signals ordered for westerly winds, fifty-one; justified, fifty-one. Percentage of justifications, 74.6.

Cold-wave signals.—(Ordered by Assistant Prof. T. Russell.) Total number of signals ordered, seventy-one, of which forty-four were wholly, and three partly justified. Number of severe cold-waves without signals, six. Percentage of justifications, 63.5.

CAUTIONARY SIGNALS FOR MAY, 1889.

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

Wind signals.—(Ordered by Captain H. H. C. Dunwoody.) Total number of signals ordered, one hundred and sixteen; justified as to velocity, wholly, eighty-seven, partly, eight;