

to the growing sugar crop. From the 11th to 15th the stage of the river at Memphis, Tenn., was 33.9 feet, 0.9 foot above the danger-line. Large quantities of driftwood were reported in the Red River at Shreveport, La., from the 25th to 29th. Melting snow in the mountains in north-central New Mexico and south Colorado caused the Rio Grande Del Norte River

and other streams in that region to rise rapidly at the end of the month. At El Paso, Tex., the Rio Grande River was the highest ever known at that season of the year. High water was also reported in the Brazos River in Texas. Serious damage was reported in the Chaudiere Valley, Que., by a rise in the Chaudiere River on the 18th.

MISCELLANEOUS PHENOMENA.

☉ DROUGHT.

Very dry weather prevailed in the south Atlantic and east Gulf states. In west Maryland, and over a great part of North Carolina, the month was too dry for farming operations. In Mississippi cotton was injured, and in Louisiana all crops suffered from drought.

🔥 FOREST FIRES.

At the close of the month fires were raging in the mountains near Cumberland, Md., and extensive forest fires prevailed near Blue Knob, Reading, and Ashland, Pa., and Egg Harbor City, May's Landing, and Tom's River, N. J. Extensive forest fires near East Hampton, Long Island, had been subdued.

☀ SUN SPOTS.

Haverford College Observatory, Pa. (observed by Prof. F. P. Leavenworth):

Date.	Number of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Faculae.	Remarks.
	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.		
April, 1891.										
5, 9 a. m.	0	0	0	0	0	0	1	15	2	Definition fair; 1 large spot.
6, 10 a. m.	0	0	0	0	0	0	1	1	1	Definition fair.
7, 10 a. m.	1	4	0	0	0	0	2	6	2	Definition good; 1 large spot.
8, 12 m.	0	0	0	0	0	0	1	1	1	Definition good.
9, 12 m.	1	8	0	0	0	0	2	9	1	Definition fair.
12, 3 p. m.	1	10	1	1	0	0	2	18	1	Definition fair.
13, 9 a. m.	2	5	0	0	0	0	3	14	2	Definition fair.
14, 9 a. m.	1	5	0	0	0	0	3	32	1	Definition good.
15, 9 a. m.	0	9	0	0	0	0	3	37	2	Definition good.
16, 9 a. m.	2	8	0	0	0	0	4	29	2	Definition poor.
17, 9 a. m.	0	18	0	0	0	0	3	40	2	Definition good.
19, 9 a. m.	1	2	0	0	0	0	5	32	3	Definition good.
20, 11 a. m.	0	0	1	7	0	0	3	22	1	Definition poor.
21, 10 a. m.	1	23	0	0	0	0	4	32	1	Definition good; 1 large spot.
22, 10 a. m.	1	6	0	0	0	0	5	36	2	Definition good; 2 large spots.
23, 10 a. m.	0	59	0	0	0	0	3	92	1	Definition fine; 1 large spot.
24, 10 a. m.	0	0	0	0	0	0	3	62	1	Definition fair.
25, 10 a. m.	0	0	0	6	0	0	3	41	3	Definition good.
26, 10 a. m.	2	4	1	3	0	0	4	34	4	Definition fair.
27, 10 a. m.	1	8	1	10	0	0	4	52	...	Definition fine; 2 large spots.
28, 9 a. m.	0	11	0	0	0	0	4	58	1	Definition fine; 1 large spot.
29, 9 a. m.	0	0	0	0	0	0	3	25	1	Definition fair.
30, 10 a. m.	0	0	0	0	0	0	3	26	1	Definition fine.

Mr. D. E. Hadden, Alta, Iowa: 4th, 1 group, 4 spots; large spot with umbra and penumbra on meridian; faculae by rotation on e. limb. 5th, 1 group, 2 spots. 6th, 1 group, 1 spot. 7th, 1 group, 1 spot; aurora in evening (area by rotation e. limb of faculae of 12th of March). 8th, 1 group, 1 spot. 10th, 1 group, 12 spots; group s. latitude, about 1 day w. of meridian; group faculae by rotation se. limb. 11th, 1 group, 8 spots; small group of faculae by rotation e. limb. 12th, 1 group 6? spots; small group of faculae by rotation se. limb. 14th, 1 group, 9 spots. 15th, 1 group, 10 spots; small group faculae by rotation; faculae on nw. and w. limbs disappearing by rotation. 16th, 1 group, 9 spots; faculae by rotation e. limb. 17th, 2 groups, 14 spots; new group se. 18th, 2 groups, 8 spots?; group on nw. limb disappearing by rotation. 19th, 2 groups. 22d, 3 groups, 18 spots; new group 2 days in on e. limb in large area faculae; 2 large spots, with umbra and penumbra; faculae ne. by rotation 1 day in. 23d, 3 groups, 28 spots; large spot had "bridge" across it. 24th, 3 groups, 30 spots; a group disappearing by solar rotation w. 25th, 2 groups, 24 spots; group faculae by rotation on e. limb; large group very elongated. 26th, 3 groups, 23 spots; new group near meridian, n. latitude; the umbra in large spot in group s. latitude had divided into 2 portions; group with faculae on w. limb disappearing by rotation; large area faculae on e. limb. 27th, 4 groups, 26 spots; faculae by rotation on e. limb. 28th, 4 groups, 12 spots; large spot s. latitude; umbra again united. 30th, 2 groups, 6 spots.

Mr. John W. James, Riley, Ill.: 1st, 1 small spot 2 days w. of meridian in n. latitude; 1 small group 2 days w. of meridian in s. latitude. 4th to 8th and 10th, only the large spot of March 29th seen; this disappeared on w. edge, 10th. 10th, 1 new spot and 1 new group near sun's centre. 16th, 2 new groups 2 days from w. edge. 19th and 20th, none seen. 21st, 2 new spots on e. edge. 23d, 2 new groups 3 days from w. edge. 24th, immense areas of faculae near w. limb; counted 30 spots in all. 26th, part of the group of the 21st formed into 1 large spot on sun's meridian, estimated 26,450 miles in diameter. 27th, 1 new group; 1 of its spots 13,000 miles in diameter; it formed in 21 hours 3 days from w. edge, and disappeared by solar rotation on the 30th, leaving only 1 large spot visible.

Mr. H. D. Gowey, North Lewisburgh, Ohio: sun spots were reported on the 1st, 5th, 7th, 8th, 12th, 16th, 17th, 21st, and 25th to 30th.

☁ ATMOSPHERIC ELECTRICITY.

☀ AURORAS.

Auroras were reported as follows: 1st, Bar Harbor and Eastport, Me.; Berlin Mills, N. H. 3d, Somerset, Mass. 6th, Sycamore, Ill.; Glasgow, Wis. 7th, Canton, Conn.; Oswego and Riley, Ill.; Alta, Cresco, Hopeville, and Stilson, Iowa; Caldwell, Lansing, Marquette, Rockland, and Rochester, Mich.; Choteau, Mont.; Hassan, Ohio; Eagle's Mere, Pa.; Webster, S. Dak.; Embarrass, Harvey, Hayward, Meadow Valley, and Medford, Wis. 8th, New Hartford and Southington, Conn.; Amherst, Cambridge, and Florida, Mass.; Detroit, Marquette, and Sault de Ste. Marie, Mich.; Ithaca, N. Y.; Eagle's Mere and Greenville, Pa.; Block Island, R. I.; Harvey, Wis. 9th, Eastport and Kent's Hill, Me.; Hassan, Ohio. 10th, Orono,

Me.; Hassan, Ohio. 11th, Hassan, Ohio; Glasgow, Harvey, and Hayward, Wis. 12th, Leicester, Mass.; Rochester and Sault de Ste. Marie, Mich.; Demos and Hassan, Ohio; Block Island, R. I. 13th, Berlin Mills, N. H.; Grampian Hills, Pa.; Wolsey, S. Dak. 15th, Webster City, Iowa. 18th, Amherst, Mass. 22d, Sandwich, Ill. 23d, Berlin Mills, N. H. 25th, Angola, Ind. 26th, Oregon, Mo. 27th, Greenville, Pa.; Medford, Wis. 28th, Voluntown, Conn.; Sycamore, Ill.; Eastport, Farmington, Kent's Hill, and Portland, Me.; Cambridge, Mass.; Hayward and Peshtigo, Wis. Sanborn, Iowa; Greenville, Pa. On the 7th, 8th, and 28th auroras were reported over the northern part of the country from New England to Wisconsin.

Detroit, Mich., 8th: a well-defined aurora extending over

about 60° azimuth, and consisting of a diffused white light resting upon a dark bank of clouds, was observed in the north at 9.55 p. m. At 10.15 p. m. the display became more active and several broad streamers shot upward toward the zenith, and the color at the base changed to an orange shade. "Merry dancers" were observed at 10.40 p. m.; the aurora began to fade at 11.15 p. m.; and it disappeared at midnight.

Sault de Ste. Marie, Mich., 8th: an aurora consisting of a bright yellow arch, extending from w. to ne. and resting on a dark segment, was observed 8.15 p. m. The arch extended to about 20° altitude, with bright streamers; it attained its maximum brilliancy about 10.35 p. m.; and disappeared about 11.05 p. m.

THUNDER-STORMS.

Thunder-storms were reported as follows: east of the Rocky Mountains thunder-storms were reported in the greatest number of states, 30, on the 18th; in 20 to 25 on the 15th, 16th, 17th, 21st, and 22d; in 15 to 19 on the 9th, 10th, 14th, 19th, 20th, and 23d; in 10 to 14 on the 1st, 8th, 11th, 12th, 13th,

and 30th; in 5 to 9 on the 2d, 7th, 28th, and 29th; and in 1 to 4 on the 3d to 6th and 25th to 27th. There was no date for which thunder-storms were not reported east of the Rocky Mountains.

East of the Rocky Mountains thunder-storms were reported on the greatest number of dates, 23, in Mich.; on 21 in Tex.; on 15 to 20 in Ark., Fla., Ill., Iowa, Kans., Mo., and N. C.; on 10 to 14 in Ind., Minn., Miss., Nebr., N. J., Ohio, Pa., S. Dak., and Tenn.; on 5 to 9 in Ala., Conn., Ga., Ky., La., Md., Mass., N. Y., S. C., Va., Okla. T., and Wis.; and on 1 to 4 in Del., D. C., Me., Mont., N. H., N. Dak., R. I., Vt., and W. Va. West of the Rocky Mountains thunder-storms were reported in Ariz. on the 16th and 27th; in Cal. on the 6th, 7th, 13th, and 24th; in Colo. on the 14th, 18th to 20th, and 26th to 28th; in Idaho on the 16th; in Nev. on the 11th, 16th, and 18th; in N. Mex. on the 6th, 27th, 29th, and 30th; in Oregon on the 7th, 15th, 16th, and 23d; in Utah on the 15th to 20th, and 28th; in Wyo. on the 12th and 15th. In Wash. no thunder-storms were reported.

VERIFICATIONS.

[Verifications made by Assistant Professor C. F. Marvin, assisted by Mr. H. E. Williams, chief clerk of the Forecast Division.]

FORECASTS FOR 24 HOURS IN ADVANCE.

The forecasts for districts east of the Rocky Mountains for April, 1891, were made by Captain James Allen, Signal Corps, and those for the Pacific coast districts were made at San Francisco, Cal., by 2d Lieutenant John P. Finley, 19th Infantry.

Percentages of forecasts verified, April, 1891.

States.	States.
Maine.....	78.3
New Hampshire.....	75.1
Vermont.....	78.9
Massachusetts.....	84.5
Rhode Island.....	80.4
Connecticut.....	78.7
Eastern New York.....	91.5
Western New York.....	85.1
Eastern Pennsylvania.....	86.7
Western Pennsylvania.....	86.3
New Jersey.....	88.1
Delaware.....	83.7
Maryland.....	86.1
District of Columbia.....	86.5
Virginia.....	86.3
North Carolina.....	79.0
South Carolina.....	85.0
Georgia.....	83.8
Eastern Florida.....	82.5
Western Florida.....	86.9
Alabama.....	85.7
Mississippi.....	82.5
Louisiana.....	81.0
Texas.....	81.0
Arkansas.....	78.8
Tennessee.....	76.5
Kentucky.....	79.5
Ohio.....	82.3
West Virginia.....	83.2
Indiana.....	80.5
Illinois.....	82.3
Lower Michigan.....	78.7
Upper Michigan.....	82.5
Wisconsin.....	88.3
Minnesota.....	84.1
Iowa.....	82.5
Kansas.....	83.8
Nebraska.....	87.2
Missouri.....	81.9
Colorado.....	81.5
North Dakota.....	79.0
South Dakota.....	79.3
Southern California*.....	92.7
Northern California*.....	86.7
Oregon*.....	78.9
Washington*.....	81.5
<i>By elements:</i> Weather..... 88.0	
Temperature†..... 74.9	
Monthly percentage of weather and temperature combined‡..... 82.8	

* 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 April, 1891, 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 HOURS IN ADVANCE.

Appreciating the great importance that long time predictions possess for the general public the Chief Signal Officer has authorized forecasts for 48 and 72 hours, covering the 2d

and 3d days in advance. These are optional with the forecast official, 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 made for second day in advance. Number of predictions made: weather, 214; temperature, 115. Percentages of verifications: weather, 93.8; temperature, 87; weather and temperature combined, 92.0.

WIND SIGNALS FOR APRIL, 1891.

Statement showing percentages of justifications of wind signals for the month of April, 1891.

Wind signals—(Ordered by Captain James Allen).—Total number of signals ordered, 91; justified as to velocity, wholly, 53, partly, 7; justified as to direction, 89. Of the signals ordered, 78 were cautionary, of which 44 were wholly and 4 partly justified; and 13 were storm signals, of which 9 were wholly and 3 partly justified. 28 signals were ordered for easterly winds, of which 26 were justified, and 63 were ordered for westerly winds, all of which were justified. Percentage of justifications, 67.0.

TEMPERATURE-FALL WARNINGS.

[Ordered by Assistant Professor T. Russell.]

Number of warnings issued, 16; justified 6. Percentage of justifications, 37.5. No cold-wave signals were ordered during the month.

Percentages of verifications of weather and temperature signals reported by directors of the various State Weather Services for April, 1891.

States.	Weather.	Temperature.	States.	Weather.	Temperature.
Illinois.....	87	71	Nebraska.....	84	94
Indiana.....	86	91	New Jersey.....	87	89
Iowa.....	88	93	New York.....	87	87
Michigan.....	87	91	North and South Dakota.....	84	82
Minnesota.....	82	86	Ohio.....	87	82
Missouri.....	89	85	Pennsylvania.....	84	88

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 April, 1891, of the directors of the various state weather services: