

U. S. DEPARTMENT OF AGRICULTURE.

REPORT

OF THE

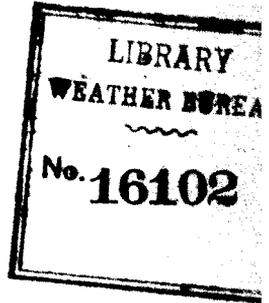
CHIEF OF THE WEATHER BUREAU

FOR

1892.

BY

MARK W. HARRINGTON.



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FROM THE REPORT OF THE SECRETARY OF AGRICULTURE FOR 1892.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1893.

National Oceanic and Atmospheric Administration Report of the Chief of the Weather Bureau

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REPORT OF THE CHIEF OF THE WEATHER BUREAU.

SIR: I have the honor of transmitting herewith a report on the work of the Weather Bureau during the year 1892.

MARK W. HARRINGTON,
Chief.

Hon. J. M. RUSK,
Secretary.

WORK OF THE YEAR.

IMPROVEMENT OF FORECASTS AND THEIR DISTRIBUTION.

In my annual report for 1891 I said:

The value of the work of the Weather Bureau to the country depends largely upon its ability to distribute promptly the information collected at central points from its system of telegraph stations. The daily weather forecasts issued by the Bureau have always been recognized as of sufficient importance to be telegraphed by the Associated Press as items of news, and they are therefore distributed without expense to the service to the centers of population, and have appeared regularly in the daily journals of the country. Many efforts have been made to reach the more thinly settled portions of the country, and with the transfer of the Weather Bureau to the Agricultural Department renewed efforts are being made to extend the weather forecasts to agricultural communities. The most thorough distribution of the forecasts possible would be by telegraph daily to every telegraph office in the country, where means should be provided for the display of reports in bulletin form. Such a system can not at present be utilized, owing to the small appropriations made for telegraph purposes, although it has been strongly urged by agricultural organizations throughout the country, and Congress has been petitioned repeatedly for appropriations to bear the expense attending such telegraph service. Those most interested in agriculture will not be satisfied without additional appropriations for this feature of Weather Bureau work, and it will be in the interest of the general public, including all classes, if arrangements can be made which will place the daily weather bulletin at every telegraph office in the country.

I am happy to be able to say, at the end of this first year, that this our first care—the improvement of the forecasts and their extended distribution—has met some measure of success. The yearly percentages of verifications for all stations east of the Rocky Mountains are: For twenty-four-hour forecasts, weather, 83.6; temperature, 81.9; weather and temperature combined, 82.9. Beginning with January, 1892, the percentages of forecasts have in addition to the groupings by States and elements heretofore followed been determined by classes of forecasts, *i. e.*, predictions of “fair weather,” “rain,” or “snow;” “warmer” or “colder” and “stationary” temperature have been grouped together and the percentages of verifications of each class computed. The result shows that of the total number of twenty-four-hour forecasts of weather made during the period considered, for the districts east of the Rocky Mountains, 71.3 per cent were for fair weather; and of these 88.8 per cent were verified. Of rain or snow forecasts 70.5 per cent were verified. Of the temperature forecasts 62.0 per cent were for warmer or colder; and 82.8 per cent of these were verified. Of the stationary forecasts, 79.2 per cent were verified.

Percentages of verifications of 8 p. m. 24-hour forecasts of weather and temperature for the six months ending December 31, 1891.

[The percentages of verification for the first half of 1891 will be found in the annual report of the Secretary of War, 1892, Volume IV, page 53.]

States.	1891.															Yearly average.			
	July.			August.			September.			October.			November.				December.		
	Weather.	Temperature.	Weather and temperature combined.	Weather.	Temperature.	Weather and temperature combined.	Weather.	Temperature.	Weather and temperature combined.	Weather.	Temperature.	Weather and temperature combined.	Weather.	Temperature.	Weather and temperature combined.		Weather.	Temperature.	Weather and temperature combined.
Maine.....	88.7	68.4	80.6	84.2	65.2	76.6	84.3	85.3	84.7	93.9	88.7	91.8	90.7	84.7	88.3	88.4	87.1	87.9	83.5
New Hampshire.....	83.9	76.8	81.1	83.5	67.7	77.2	87.3	82.0	85.2	91.3	88.4	90.1	92.3	82.7	88.5	85.8	86.8	86.2	82.6
Vermont.....	86.5	69.0	79.5	80.6	65.2	74.4	89.7	85.3	87.9	85.8	90.6	87.7	92.7	86.0	90.0	86.1	91.9	88.4	82.0
Massachusetts.....	11.3	73.9	81.3	82.3	68.4	76.7	88.3	87.0	87.8	90.0	89.0	89.6	92.3	80.3	87.5	87.7	90.6	88.9	81.6
Rhode Island.....	91.3	76.8	85.5	82.3	84.8	83.3	94.3	79.0	88.2	88.1	88.4	88.2	93.7	78.0	87.4	89.0	94.5	91.2	85.8
Connecticut.....	86.8	71.6	80.7	80.6	77.7	79.4	92.7	83.3	88.9	86.5	86.5	86.5	91.7	77.0	85.8	87.7	87.7	87.7	81.9
Eastern New York.....	87.7	69.0	80.2	85.8	74.2	81.2	92.7	83.3	88.9	90.0	84.8	87.9	89.7	87.0	88.6	86.8	91.9	88.8	85.4
Western New York.....	82.6	71.3	78.1	87.7	80.6	84.9	91.7	94.0	92.6	89.0	85.8	87.7	91.0	84.3	88.3	88.4	90.0	89.0	84.3
Eastern Pennsylvania.....	83.2	66.5	76.5	81.0	64.2	74.3	90.3	84.3	87.9	88.1	82.9	86.0	91.7	88.0	90.2	89.4	83.5	87.0	85.2
Western Pennsylvania.....	83.2	80.6	82.2	81.6	81.9	81.7	88.3	87.0	87.8	90.0	81.6	86.6	89.0	81.0	83.8	83.9	93.5	87.7	83.6
New Jersey.....	79.7	65.8	74.1	84.2	74.5	80.3	91.3	80.0	86.8	86.1	83.9	85.2	88.7	94.0	90.8	90.3	86.8	88.9	84.8
Delaware.....	80.3	78.1	79.4	83.2	72.3	78.8	92.7	79.3	87.3	87.4	90.6	88.7	88.7	88.3	88.5	88.7	85.5	87.4	85.5
Maryland.....	82.0	73.5	78.6	82.9	75.2	79.8	89.0	76.7	84.1	87.7	88.1	87.9	85.7	85.7	85.7	85.1	86.5	87.5	84.9
District of Columbia.....	77.7	77.4	77.6	73.5	71.9	72.9	89.3	71.7	82.3	85.8	87.1	86.3	86.0	83.3	84.9	88.4	85.5	87.2	83.5
Virginia.....	83.9	77.4	81.3	80.3	73.5	77.6	89.3	80.3	85.7	92.3	73.2	84.7	88.3	87.3	87.9	89.4	89.4	89.4	84.4
North Carolina.....	80.6	79.4	80.1	78.7	74.2	76.9	97.3	83.3	91.7	94.8	68.4	84.2	89.7	85.7	86.1	87.7	87.7	90.5	83.9
South Carolina.....	88.8	78.1	83.3	77.1	82.6	79.3	93.7	86.7	90.9	92.6	73.9	85.2	88.7	81.0	85.2	87.7	91.0	89.0	88.0
Georgia.....	91.6	88.7	90.4	85.2	88.7	86.6	90.0	85.0	88.0	97.1	70.6	86.5	89.0	81.0	85.2	87.7	91.0	89.0	88.0
Eastern Florida.....	75.8	92.3	82.4	87.1	92.3	89.2	90.7	86.7	93.1	92.3	83.8	89.7	88.0	81.0	85.2	87.7	91.0	89.0	88.0
Western Florida.....	85.2	94.5	88.9	80.3	90.3	84.3	87.0	87.3	91.1	95.5	86.5	91.9	89.3	80.7	85.9	85.2	94.5	88.9	87.8
Alabama.....	90.0	88.4	89.4	91.9	85.5	89.3	93.7	84.7	90.1	97.1	77.4	89.7	90.3	89.7	90.1	90.0	93.2	91.3	87.6
Mississippi.....	88.4	89.4	88.8	90.6	89.4	90.1	93.3	85.0	90.0	96.8	78.7	89.0	88.3	85.7	87.8	87.4	91.6	89.1	86.5
Louisiana.....	83.2	83.5	83.3	92.6	85.8	83.9	90.7	91.0	90.8	95.5	91.6	93.9	85.7	78.3	82.7	89.0	91.0	89.8	85.9
Eastern Texas.....	88.7	83.9	87.1	90.3	96.1	92.6	89.0	91.3	89.9	95.8	83.5	90.9	91.7	81.3	87.5	93.9	91.0	92.7	86.5
Arkansas.....	83.2	74.5	79.7	86.8	87.1	86.9	90.3	93.3	91.5	97.1	85.8	92.6	81.7	89.0	84.6	92.9	89.7	91.6	85.3
Tennessee.....	84.2	79.7	82.4	88.4	89.4	88.8	95.0	90.0	93.0	97.4	87.4	93.4	91.0	82.0	87.4	92.3	82.9	88.5	85.3
Kentucky.....	90.6	82.9	87.5	88.1	91.3	89.4	96.3	92.3	94.7	97.7	90.3	94.7	90.3	78.7	85.7	91.3	83.2	88.1	86.2
Ohio.....	91.6	81.9	87.7	81.9	79.7	81.0	95.3	87.7	92.3	93.2	85.2	90.0	88.0	81.3	85.3	88.7	85.2	87.3	84.6
West Virginia.....	92.9	75.2	86.4	77.7	78.4	78.0	92.7	70.3	83.7	93.9	81.6	89.0	88.0	77.7	83.9	92.3	89.7	91.3	84.4
Indiana.....	94.2	81.9	89.3	88.1	78.1	84.1	95.0	88.3	92.3	94.2	82.9	89.7	88.7	78.0	84.4	92.9	91.9	92.5	86.5
Illinois.....	89.4	80.6	85.6	79.4	73.5	77.0	95.0	91.7	93.7	92.6	84.2	89.2	87.3	76.0	82.8	88.1	85.2	86.9	85.7
Lower Michigan.....	86.8	81.0	84.5	80.3	74.5	78.0	91.3	88.0	90.0	87.1	81.3	84.8	84.0	87.7	91.5	88.4	91.3	89.6	84.3
Upper Michigan.....	81.9	72.6	78.2	81.6	68.7	76.4	85.7	83.3	84.7	84.8	77.7	82.0	86.0	80.3	83.7	91.6	78.1	86.2	81.6
Wisconsin.....	86.5	75.2	82.0	82.9	75.8	80.1	92.7	86.3	90.1	93.2	83.5	89.3	91.0	85.3	89.7	89.4	85.8	88.0	83.2
Minnesota.....	90.3	70.0	82.2	88.7	81.3	85.7	88.0	75.0	82.8	94.2	85.5	90.7	83.0	78.7	81.3	92.5	91.9	92.9	84.5
Iowa.....	89.7	81.6	86.5	83.2	80.6	82.2	97.3	84.0	92.0	95.5	79.4	89.1	83.3	80.0	82.0	89.0	87.1	88.3	85.3
Kansas.....	83.2	73.5	79.3	90.0	73.2	83.3	96.3	87.2	92.7	96.1	83.2	90.9	87.0	79.0	83.8	86.1	75.2	81.7	83.8
Nebraska.....	87.4	78.4	83.8	84.5	75.2	80.8	96.0	74.7	87.5	96.1	79.4	89.4	85.3	76.3	81.7	91.6	77.4	85.9	84.3
Missouri.....	90.3	78.4	85.5	89.7	82.6	86.9	96.7	88.7	93.5	94.5	85.5	90.9	82.7	79.7	81.5	91.0	77.4	85.6	86.3
Colorado.....	89.4	81.6	78.3	93.2	71.0	84.3	85.0	74.3	80.7	98.4	82.3	92.3	93.0	75.3	85.9	86.8	81.0	84.5	82.4
North Dakota.....	88.1	82.9	85.0	89.0	73.9	81.0	92.3	71.7	84.1	92.6	81.3	88.1	84.7	64.7	76.7	84.8	86.8	85.6	82.2
South Dakota.....	88.4	77.1	83.9	82.3	76.1	79.8	93.3	73.0	85.2	93.2	81.3	88.4	83.7	71.7	78.9	90.6	83.5	87.8	82.8
Monthly average.....	86.4	77.7	82.9	84.4	78.7	82.1	91.7	84.3	88.7	92.4	83.4	88.8	88.6	81.7	85.8	89.1	87.3	88.4	84.9

* Includes the twelve months of 1891.

Percentages of verifications of 8 p. m. 24-hour forecasts of weather and temperature for the year ending December 31, 1892.

States.	1892.																	
	January.			February.			March.			April.			May.			June.		
	Weather.	Temperature.	Weather and temperature combined.	Weather.	Temperature.	Weather and temperature combined.	Weather.	Temperature.	Weather and temperature combined.	Weather.	Temperature.	Weather and temperature combined.	Weather.	Temperature.	Weather and temperature combined.	Weather.	Temperature.	Weather and temperature combined.
Maine	70.3	77.7	73.3	81.7	77.6	80.1	84.8	91.3	87.4	81.0	73.7	78.1	80.3	72.3	77.1	76.0	76.0	76.0
New Hampshire	65.2	81.3	71.6	87.9	81.0	85.1	89.0	89.7	89.3	74.3	73.0	73.8	90.3	61.9	78.9	72.3	75.3	73.5
Vermont	64.8	79.4	70.6	90.3	81.7	86.9	91.0	82.6	87.6	75.3	73.3	74.5	71.9	67.7	70.2	71.0	79.3	74.3
Massachusetts	69.0	82.9	74.6	87.6	87.2	87.4	90.0	93.9	91.6	70.3	73.3	71.5	87.7	72.3	81.5	73.0	81.3	76.3
Rhode Island	62.3	77.7	68.5	85.2	92.4	88.1	91.9	98.4	94.5	75.0	62.7	70.1	87.1	73.2	81.5	78.3	67.3	70.9
Connecticut	63.5	82.3	71.0	86.6	91.7	88.6	91.3	93.5	92.2	75.0	71.0	73.4	90.0	66.1	80.4	74.3	74.7	74.5
Eastern New York	81.0	81.0	81.0	85.2	78.6	82.6	85.8	87.7	86.6	75.7	79.7	77.3	82.9	65.2	75.8	68.3	77.0	71.8
Western New York	90.0	84.5	87.0	89.3	84.5	86.9	85.2	91.9	87.9	79.0	86.3	81.9	69.7	66.8	68.5	82.0	68.7	75.7
Eastern Pennsylvania	87.4	84.2	86.1	86.3	76.6	83.6	88.4	87.7	88.1	85.0	80.3	83.1	83.5	79.7	82.0	77.0	92.7	83.3
Western Pennsylvania	88.4	97.7	92.1	87.6	80.0	84.6	88.4	96.1	91.5	74.7	82.3	77.7	90.6	64.2	71.0	84.7	69.0	78.4
New Jersey	89.0	90.6	89.6	87.6	75.2	82.6	86.1	91.6	88.3	82.0	67.3	76.1	81.3	75.2	78.9	73.3	82.7	77.1
Delaware	86.5	96.8	90.6	81.0	71.7	77.3	81.9	93.5	86.5	84.0	76.0	80.8	85.2	77.4	82.1	79.0	85.0	81.4
Maryland	85.5	96.1	89.7	83.4	73.1	79.3	83.9	85.5	84.5	85.0	80.7	83.3	77.4	75.5	76.6	78.0	89.3	82.5
District of Columbia	86.5	91.9	88.7	80.3	75.9	78.5	83.9	83.9	83.9	83.3	73.3	79.3	82.3	77.4	80.3	68.3	90.0	77.0
Virginia	86.8	91.0	88.5	81.7	75.5	79.2	88.1	85.2	86.9	82.0	71.3	77.7	82.3	66.5	76.0	77.3	85.7	89.7
North Carolina	90.3	80.0	86.2	81.0	75.9	79.0	89.4	87.7	88.7	77.3	73.0	75.6	82.3	79.4	81.1	84.3	78.7	82.1
South Carolina	86.8	77.1	82.9	86.2	82.8	84.8	85.5	83.9	89.9	81.7	70.3	77.1	85.2	82.9	84.3	80.0	80.3	80.1
Georgia	84.5	80.6	82.9	90.0	79.0	85.6	85.5	80.6	89.5	80.7	72.3	77.3	82.3	78.1	80.6	74.3	82.7	77.7
Eastern Florida	81.6	85.5	83.2	82.8	82.4	82.6	86.5	86.8	86.6	89.7	89.0	85.4	89.7	94.2	91.5	90.3	95.0	90.2
Western Florida	91.6	89.9	88.5	96.3	95.9	97.3	98.5	90.6	88.9	84.0	90.7	86.7	87.1	96.1	90.7	76.7	90.3	82.1
Alabama	82.9	85.5	89.9	92.4	84.1	89.1	91.3	83.5	88.2	80.0	76.7	78.7	79.0	83.9	81.0	78.7	92.3	84.1
Mississippi	92.6	85.2	89.6	89.7	86.6	88.5	86.8	85.5	86.3	77.3	74.7	76.3	81.9	80.0	81.1	84.0	89.0	86.0
Louisiana	91.3	90.6	91.0	87.6	92.4	89.5	90.3	89.4	89.9	71.3	83.3	76.1	86.5	91.0	88.3	92.7	92.7	92.7
Arkansas	81.3	81.9	81.5	82.1	77.2	80.1	86.1	85.5	85.9	83.0	77.3	80.7	83.2	80.3	82.0	91.3	93.0	92.0
Tennessee	86.1	88.7	87.1	82.8	80.0	81.7	85.5	82.3	84.2	80.3	78.7	79.7	78.7	79.0	77.3	80.0	84.3	81.7
Kentucky	85.5	84.5	85.1	91.4	71.4	83.4	94.5	78.4	88.1	81.0	74.3	78.3	65.8	76.8	70.2	74.0	78.0	75.6
Ohio	81.0	91.9	85.4	84.8	75.5	81.1	92.3	80.3	87.5	78.0	82.0	79.6	74.5	74.2	74.1	76.7	78.3	77.3
West Virginia	82.9	93.5	87.1	85.2	84.1	84.8	80.3	86.5	82.8	78.7	73.0	76.4	74.8	66.1	71.3	82.3	81.0	81.8
Indiana	81.3	93.2	86.1	85.9	83.8	85.1	84.8	83.2	84.2	75.7	79.0	77.0	78.7	63.9	72.8	68.3	85.7	75.3
Illinois	77.7	84.8	80.5	86.6	86.3	86.4	82.9	81.3	82.3	80.3	67.7	75.3	80.0	60.0	72.0	82.0	82.0	82.0
Lower Michigan	76.1	88.1	80.9	81.4	89.0	85.6	84.5	91.0	87.1	84.3	77.0	81.4	84.2	72.9	79.7	75.7	82.3	78.3
Upper Michigan	79.7	90.3	83.9	96.6	89.3	93.7	81.3	83.5	82.2	82.3	71.7	78.1	71.6	57.7	66.0	72.7	76.3	74.1
Wisconsin	77.4	79.7	78.3	84.1	76.9	85.2	68.4	90.3	77.2	79.7	64.3	73.5	67.7	64.8	66.5	73.7	66.7	68.9
Minnesota	82.3	84.8	83.3	82.1	83.4	82.6	84.2	82.6	87.6	78.0	75.7	77.1	66.5	65.5	64.1	71.7	78.0	74.2
Monthly average	79.7	82.6	80.9	84.8	72.1	79.7	77.7	81.9	79.4	86.7	79.0	83.6	76.1	68.7	73.1	68.7	75.3	71.3
Iowa	83.5	86.8	84.8	82.1	74.1	78.9	81.0	91.9	85.4	78.0	79.3	78.5	81.3	66.5	75.4	70.7	77.8	73.3
Kansas	89.7	81.0	86.2	79.3	79.7	79.5	77.1	85.5	80.5	73.3	70.7	72.3	75.5	60.6	69.5	79.0	73.7	76.9
Nebraska	74.5	77.7	75.8	83.1	69.3	77.6	82.6	81.9	83.1	71.3	63.7	68.3	70.0	60.3	66.1	81.0	79.0	80.2
Missouri	85.2	86.8	85.8	77.9	82.8	79.9	87.1	91.9	89.0	73.3	73.7	73.5	84.5	68.1	77.9	78.0	85.0	80.8
Colorado	82.9	74.2	79.4	83.3	83.1	86.8	78.4	81.3	79.6	76.0	70.3	73.7	73.5	84.5	60.9	83.3	77.7	81.1
North Dakota	81.3	74.8	78.7	83.1	85.5	84.1	81.6	80.3	81.1	92.3	79.7	87.3	71.9	66.5	69.7	62.7	65.0	75.6
South Dakota	78.7	81.0	79.6	91.4	81.7	87.5	86.8	88.1	87.3	78.7	72.7	76.3	68.1	60.6	65.1	79.7	66.3	74.3
Monthly average	81.8	85.0	83.1	85.9	81.1	84.0	86.1	86.9	86.4	79.6	75.3	77.9	79.3	72.0	76.4	77.3	80.5	78.6

Percentages of verifications of 8 p. m. 24-hour forecasts of weather and temperature for the year ending December 31, 1892—Continued.

States.	July.			August.			September.			October.			November.			December.			Yearly average.		
	Weather.	Temperature.	Combined.	Weather.	Temperature.	Combined.	Weather.	Temperature.	Combined.	Weather.	Temperature.	Combined.	Weather.	Temperature.	Combined.	Weather.	Temperature.	Combined.	Weather.	Temperature.	Combined.
Maine.....	85.8	70.3	80.6	80.6	82.6	81.4	84.3	90.0	86.0	78.1	89.7	82.7	87.7	93.3	80.9	76.8	82.9	79.2	80.6	81.4	80.9
New Hampshire.....	81.9	76.1	79.6	84.8	87.7	86.0	81.0	91.3	85.1	79.0	91.6	84.0	85.3	90.0	87.2	76.1	82.6	78.7	80.6	81.8	91.1
Vermont.....	79.4	73.5	77.0	83.2	86.1	84.4	84.3	89.3	86.3	85.8	82.9	84.6	88.3	89.3	88.7	70.3	88.4	77.5	79.6	81.1	80.4
Massachusetts.....	79.0	77.1	78.2	88.4	93.2	90.3	91.3	89.3	90.5	88.4	94.5	90.8	96.0	92.7	94.7	77.1	81.0	78.7	83.2	84.9	83.9
Rhode Island.....	77.0	73.7	78.1	88.1	86.5	87.5	94.0	88.3	91.7	87.1	96.5	90.9	91.3	96.3	93.3	74.2	78.7	76.0	82.6	83.1	82.8
Connecticut.....	84.2	81.6	83.2	91.0	89.0	90.2	93.3	87.7	91.1	90.3	92.9	91.3	94.7	95.0	94.8	76.5	85.8	80.2	84.2	84.3	84.2
Eastern New York.....	77.4	81.3	79.0	88.4	90.3	89.2	91.0	82.0	87.4	91.6	82.6	88.0	91.3	94.0	92.4	86.5	85.2	86.0	83.8	82.0	83.1
Western New York.....	79.0	84.2	81.1	75.8	71.6	74.1	84.0	79.3	82.1	87.4	92.2	89.4	91.3	81.0	87.2	88.7	81.3	85.7	83.4	81.0	82.4
Eastern Pennsylvania.....	80.3	81.3	80.7	87.4	91.3	87.0	92.7	85.3	89.7	94.2	88.7	92.0	93.3	84.0	89.6	85.5	85.5	85.5	86.8	84.8	86.0
Western Pennsylvania.....	80.0	78.1	79.2	77.4	79.4	78.2	82.7	79.3	81.1	91.9	90.6	91.4	81.3	79.0	80.4	75.2	86.1	79.6	82.7	81.8	82.1
New Jersey.....	82.9	77.1	80.6	89.0	85.5	87.6	95.0	81.7	89.7	95.5	79.7	89.2	88.7	86.0	87.6	86.1	85.2	85.7	86.4	81.3	84.4
Delaware.....	75.2	90.3	79.2	90.3	88.7	89.7	95.0	81.7	89.7	98.4	87.1	93.9	86.3	85.0	85.8	90.3	82.3	87.1	86.1	84.6	85.5
Maryland.....	85.5	87.1	86.1	85.2	91.9	87.9	89.7	85.0	87.8	98.4	95.8	97.4	87.3	86.7	87.1	88.1	85.5	87.1	85.6	86.0	85.8
District of Columbia.....	79.0	83.9	81.0	83.9	80.6	82.6	88.3	86.7	87.7	98.4	96.8	97.8	85.0	86.7	85.7	79.0	83.9	81.0	83.2	84.2	83.6
Virginia.....	84.8	86.8	85.6	83.5	81.3	82.6	88.7	89.3	88.9	97.1	90.6	94.5	92.3	81.3	87.9	87.4	84.8	86.4	86.0	82.4	84.6
North Carolina.....	80.6	82.3	81.3	71.6	77.7	74.0	86.3	91.0	88.2	93.9	86.5	90.9	88.7	94.0	80.8	85.2	86.8	85.8	84.2	82.8	83.6
South Carolina.....	74.2	82.3	77.4	69.7	71.9	70.6	93.3	95.7	94.3	96.5	92.9	95.1	92.0	95.7	93.5	85.5	89.4	87.1	85.5	83.8	84.8
Georgia.....	88.1	87.1	87.7	89.7	86.1	88.3	90.3	87.0	89.0	95.8	92.3	94.4	92.3	89.7	91.3	78.4	85.5	81.2	86.8	83.4	85.4
Eastern Florida.....	74.5	96.5	83.3	88.1	86.5	87.5	89.3	99.7	93.5	85.8	95.2	89.6	97.3	90.7	94.7	77.1	87.4	81.2	86.9	90.7	88.4
Western Florida.....	73.9	97.4	83.3	88.1	88.1	76.1	73.3	94.3	81.7	95.2	93.9	94.7	91.3	90.0	94.4	82.3	79.4	81.1	84.7	90.8	87.1
Alabama.....	84.8	86.8	85.6	85.5	79.4	83.1	92.0	93.7	92.7	90.0	88.1	89.2	89.0	85.3	87.5	88.1	80.0	84.9	87.0	84.9	86.2
Mississippi.....	85.2	82.3	84.0	87.1	78.7	83.7	84.3	92.7	87.7	90.3	89.7	90.1	89.3	81.3	86.1	86.1	81.9	84.4	86.2	84.0	85.3
Louisiana.....	78.4	87.4	82.0	78.7	75.8	79.2	87.7	95.3	90.7	85.5	87.4	86.3	92.0	88.3	84.0	81.6	88.4	84.3	85.3	88.6	86.6
Eastern Texas.....	84.2	91.3	87.0	82.6	74.2	79.2	90.3	94.3	91.9	84.8	91.6	87.5	85.0	84.0	90.6	81.3	78.8	79.5	84.6	84.0	84.4
Arkansas.....	84.5	87.4	85.7	84.2	68.8	77.2	96.0	81.3	92.1	85.8	88.4	86.8	91.3	87.7	89.9	71.6	80.0	75.0	83.7	82.0	83.0
Tennessee.....	81.0	80.0	80.6	84.8	68.7	78.4	92.3	88.7	90.9	93.2	91.9	92.7	86.0	74.7	81.5	80.6	89.7	84.2	84.2	79.8	82.4
Kentucky.....	86.8	82.9	85.2	87.4	70.0	80.4	93.7	87.0	91.0	91.3	89.4	90.5	88.7	87.3	84.1	80.3	89.4	83.9	84.6	81.5	83.4
Ohio.....	78.7	79.0	78.8	85.2	80.6	81.4	90.0	79.0	85.6	88.7	92.9	90.4	81.7	85.3	81.9	81.9	84.1	82.8	81.9	82.4	82.4
West Virginia.....	80.3	87.7	83.3	86.1	71.0	80.1	86.0	83.7	85.1	89.4	91.0	86.0	75.3	84.3	78.9	71.6	86.1	77.4	80.3	81.9	80.9
Indiana.....	75.5	76.5	75.9	88.4	72.6	82.1	88.3	77.0	83.8	92.6	88.1	90.8	84.0	76.7	81.1	81.3	87.1	80.6	84.1	78.3	81.8
Illinois.....	83.9	77.7	81.4	76.1	77.4	76.6	88.7	78.7	84.7	95.5	87.4	92.3	92.7	68.3	82.9	88.4	81.3	85.6	84.5	80.9	83.1
Lower Michigan.....	87.7	84.2	86.3	80.0	74.8	77.9	86.7	82.3	84.9	89.4	89.0	89.2	86.7	88.0	87.2	86.1	79.7	83.5	83.4	80.6	82.3
Upper Michigan.....	84.8	71.6	79.5	83.9	76.5	80.9	81.7	81.3	81.5	81.6	80.0	81.0	87.7	87.7	82.7	89.4	84.2	87.3	80.0	78.0	79.2
Wisconsin.....	84.8	81.6	83.5	78.7	75.2	77.3	85.0	80.7	83.3	87.7	73.5	82.0	92.0	80.3	87.3	81.9	83.2	82.4	81.2	79.5	80.5
Minnesota.....	81.3	77.6	79.6	75.8	66.5	72.1	77.3	80.3	78.5	90.6	75.2	84.4	94.3	80.3	88.7	78.4	80.6	79.3	81.0	75.8	78.9
Iowa.....	86.1	81.6	84.3	76.5	71.0	74.3	80.7	79.7	80.3	92.6	77.7	86.6	99.7	73.3	89.1	85.5	75.5	81.5	83.2	77.9	81.1
Kansas.....	80.0	78.7	79.5	78.7	71.6	75.9	90.3	85.3	88.3	89.7	85.8	83.1	93.0	80.7	88.1	76.5	78.4	77.3	81.8	77.6	80.1
Nebraska.....	72.3	86.6	75.6	75.8	75.8	75.8	84.0	89.0	86.0	94.2	81.9	89.3	96.7	65.3	84.1	76.5	78.7	77.4	80.2	75.4	78.3
Missouri.....	82.6	84.8	83.5	79.4	73.2	76.9	83.7	85.7	84.5	83.2	88.1	85.2	95.3	71.0	85.6	78.4	75.2	77.1	82.4	80.5	81.6
Colorado.....	82.9	77.7	80.8	78.4	63.9	72.6	91.7	90.0	91.0	94.2	76.8	87.2	97.0	86.3	92.7	68.7	73.9	70.8	83.0	76.8	86.5
North Dakota.....	84.2	82.6	83.6	75.8	79.7	77.4	87.7	80.0	84.6	89.7	77.7	84.9	89.3	77.7	84.7	78.4	77.4	78.0	81.5	77.3	79.8
South Dakota.....	86.1	79.7	83.5	81.0	71.6	77.2	77.3	79.0	78.0	80.7	80.0	85.8	98.3	72.0	87.8	83.5	77.4	81.1	83.3	76.7	86.7
Monthly average.....	81.4	82.2	81.7	82.2	78.8	80.8	87.7	86.1	87.1	90.4	87.5	89.3	90.2	84.4	87.9	81.3	82.7	81.9	83.6	81.9	82.9

LOCAL FORECAST OFFICIALS.

1892
Up to a comparatively recent date the authority to issue official predictions was restricted entirely to the officials on duty at Washington. With some little uncertainty as to the immediate results of the experiment, a radical departure from the established policy of the Bureau, a number of competent observers were directed to make forecasts for their stations and immediate vicinity. In the first appropriation for the Weather Bureau provision was made for twenty local forecast officials. The favor with which this movement is looked upon is evidenced by the fact that there have been the most urgent applications for the assignment of such officials at cities which could not be provided for. The last Congress appropriated for six additional officials and the number will doubtless have to be increased to meet the demand. These local forecast officials have the advantage of a personal knowledge of the topography, climatology, etc., of their districts and ought to be able to make more accurate predictions for their individual districts than has been possible for the officials at this office who have had but a limited time for all the States and Territories. With each year's experience there should be increased knowledge of the meteorological conditions. No efforts have been spared to give these forecast officials a sufficiently great number of reports for the purpose in hand and to encourage in every way systematic study and investigation of local weather problems.

THE WEATHER MAP.

The weather map is based on observations made morning and evening at 8 o'clock, seventy-fifth meridian time, at one hundred and sixty places throughout the United States and the Dominion of Canada, and is issued twice a day. Data as to the condition of the weather are thus gathered from an extent of more than 3,500,000 square miles of the earth's surface, about one-fortieth part of the whole surface of the globe. Information is also received from the West Indies at times when severe storms prevail there, and occasionally also from Bermuda Islands.

The observations taken at a place comprise the pressure of the air; the temperature at time of observation; the highest temperature of the day and the lowest; the moisture; the wind direction; the velocity of wind for five minutes at the time of observation; the depth of rainfall for the preceding twelve hours when the observation is made in the evening, and for the preceding twenty-four hours when the observation is made in the morning; the condition of the weather at the time of observation, whether clear, raining, snowing, foggy, or hazy; the condition of the sky as to clouds and the kind of clouds; the direction of their motion and the proportion of sky covered.

These observations are telegraphed to the central office of the Weather Bureau at Washington, D. C., with the aid of a cipher code designed for the purpose of saving time and expense in the transmission of the messages. As a rule, a message consists of six words. The cipher is so constructed that a person familiar with the key can quickly translate the message without reference to the key and without consulting an index of words. As the cipher messages are received a skilled translator reads each of them in the terms expressed by the cipher. An assistant enters the data upon a map of the country near the location of the particular place. When all the data are entered on

the map, it is generalized by lines representing graphically the various conditions of the air and the changes going on.

This map, made up from observations at 8 o'clock, is issued two hours and a half later in a number of the large cities throughout the country, and is posted in post-offices, custom-houses, boards of trade, and maritime exchanges. In the aggregate, 5,000 copies of the weather map are issued daily, except Sundays, at sixty-three cities.

On the printed weather map issued at Washington the principal data for the various stations are given in figures, in tabular form, on the side of the map.

WEATHER MAPS ISSUED AT STATIONS.

The total number of weather maps issued daily at all stations on June 30, 1891, was 3,100; during the year just ended 6,800 were issued, or more than double. Observers have been required to improve the appearance of the maps by paying greater attention to the mechanical details. By the malleograph process—developed and improved for this special purpose—the stations print and issue within a very short time from the receipt of the reports, maps showing the existing conditions. The maps are posted without delay in conspicuous places, and dispatched to all points which can be reached within twenty-four hours. They contain not only the data necessary, but the forecast for thirty-six hours or longer and a synopsis of the storm movement, etc.

It is hardly necessary to point out that such maps enable those who are students of meteorology to draw their own conclusions as to the probable weather; and that they are the greatest helps to a better understanding by the public, of the real value and significance of the forecasts. The rule is to furnish these maps, which cost the Bureau less than half a cent apiece, to all who will display them for the information of the public; but they are also furnished to many schools and colleges where instruction in meteorology is given. The policy of the Bureau is to be as liberal as possible in their distribution.

An effort has been made during the past year to induce newspapers in all large cities to print a facsimile map (reduced), with the gratifying result that many papers with large circulations now publish the map regularly. Hundreds of thousands are thus reached daily without expense to the Bureau other than the assistance of the men at the several stations in the preparation of the data. An "Explanation of the Weather Chart," including a brief general statement of the laws governing the motions of storms in the United States, for popular reading in connection with the map has been printed and freely distributed.

WIND SIGNALS.

Up to January 1, 1892, authority to direct the hoisting of "Storm," "Cautionary," and "Information" signals was confined to the officials at the Washington office; but on that date the authority was conferred on the local officials and specially selected observers at important stations on the Atlantic and Gulf coasts, and along the Great Lakes. Whenever, in their judgment, winds dangerous to shipping were likely to occur, they were authorized to display signals, advising the central office of their action. All observers on the coasts mentioned have been instructed to notify the officials on duty at Washington by telegraph whenever local conditions seem to indicate the likelihood of dangerous winds.

SPECIAL WIND-SIGNAL STATIONS.

Around many of the regular stations are grouped subsidiary ones called special display stations. When directed by the observer in charge of the regular station, the officially designated displaymen hoist signals. The compensation for this service is very small, but during the past year it has been impracticable to establish stations of this class at all of the places at which they were needed, except under agreement that the signals be displayed without pay. Fourteen stations have been thus established at which no compensation is given the displayman.

COTTON REGION SERVICE.

The Bureau has continued to render important information to cotton-growers. After consultation with the observers in charge of the several centers and upon the urgent requests of the commercial exchanges, the time for taking and reporting the observations was extended, and these are now made from April 16 to November 30 of each year. Many requests for the establishment of new stations have been received, but it has been practicable to open but two. In order to establish nine stations of a somewhat similar character in the sugar and rice growing districts, and to keep within the appropriation, it was necessary to discontinue nine of the less important cotton region stations.

WEATHER REPORTS FROM THE WEST INDIES.

We have continued to receive reports from the paid observers at San Domingo, Kingston, St. Thomas, and Santiago de Cuba; and from P. Benito Viñes, s. j., Belen College Observatory, Havana, and General Russell Hastings, voluntary observer at Bermuda, during the hurricane season, *i. e.*, from July 1 to October 1. But in order to reduce telegraphic expenses, the instructions previously issued requiring daily telegraphic reports have been modified so that while observations are taken twice daily and a record kept and monthly reports forwarded by mail to this office, the observations are not telegraphed to the observer at Key West, Fla., unless an unusual meteorological condition prevails, or information is received of an approaching storm, either at the time of the regular observation or during the interval between the two observations.

By an arrangement with the governor of the Bahama Islands, daily reports from Nassau are telegraphed to Jupiter without expense to the Weather Bureau; and in return the Jupiter office transmits reports once a day to Nassau, giving the observations at ten Weather Bureau stations, and also telegraphs warning of storms likely to prove dangerous to shipping.

FLOOD PREDICTIONS.

There are now in active operation 166 special river stations and 59 special rainfall stations. These are arranged in groups or sections under the supervision of central stations. The river observers record the rainfall also. River bulletins are issued at 22 places. Stage predictions of some of the principal rivers are made daily at Washington. The observer at Chattanooga is authorized to predict for the river there.

The special bulletin of April 21 in relation to an expected flood along the Lower Mississippi was of great value, and was verified in all details. Small maps showing the location of certain river gauges have been issued with the river bulletins, for the better understanding of the warnings. A beginning has been made in the measurement of river discharges. Our purpose at present is to improve the predictions for Cairo, Ill., by measurements of the discharge there. Cairo is the key to the situation in the Lower Mississippi Valley, and any improvement at that point will be followed by improvements at all places below.

Measurements have been made at Parkersburg, Cincinnati, and Henderson, on the Ohio River; at Nashville, on the Cumberland; at Chattanooga and Johnsonville, on the Tennessee; at Mount Carmel, on the Wabash; Charleston, on the Kanawha; Louisa, on the Big Sandy; Frankfort, on the Kentucky; and Roekport, on the Green River. Apparatus for velocity measurement has been procured, and the investigation will be carried on as opportunity permits.

Some study has been made of the relation of rainfall in the river basin above Pittsburg to the height of the water at Pittsburg. The result for this particular case seems to be that rainfall observations are of small value in estimating river rise. A somewhat similar study made for St. Louis shows that in this case the rainfall can be advantageously used with the changes of the up-river gauges in forecasting the river rise.

ADVANCED SCIENTIFIC WORK—PUBLICATIONS.

During the past four or five months, something like 400,000 Annual Reports and extracts from the same, professional papers, and other publications, including weather maps, have been sent out by the Publications Section. Four Bureau bulletins have been published and widely distributed. Others are in preparation. Bulletin No. 1 has for its title "Notes on the Climate and Meteorology of Death Valley, California," by Mark W. Harrington, Chief of the Weather Bureau. This bulletin has 50 pages, and treats of (1) physical features of the valley; (2) station and instruments; (3) discussion of observations; (4) the weather in the valley; (5) the automatic registers; (6) deductions, with tables of the daily pressure, temperature, relative humidity, wind directions and velocities, five-day means, and hourly wind velocities, temperature, and pressure. The principal features of popular interest in Death Valley are its excessive heat and dryness. The temperature rises occasionally in the shade to 122°, rarely falls at any time in the five hot months below 70°, and averages 94°. It is not only hot in summer, but consistently hot, and the heat is increased by occasional hot blasts from the desert to the south. The air is not stagnant, but in unusually active motion. Gales of a few hours' duration are very common, and sometimes they produce sand whirls and sand storms. Rains may fall frequently in the mountains and occasionally in the valley; clouds are by no means lacking, and water can probably always be found in the soil at the depth of a few feet, yet the heat and wind together keep the surface very dry and the relative humidity low. Animal and plant forms are comparatively few, and the former are usually nocturnal to avoid the heat.

Both heat and aridity are increased by the character of the valley. It is narrow and deep, apparently the bed of an old sea, inclosed by high and dry mountains. The white and shifting sands become much heated under the noonday sun; the rest of the surface is in part salt

and alkali, in part pebbly wash from the mountains and in part a loose spongy earth over which it is difficult to move. With the exception of a few springs, the water is bitter and unwholesome.

The meteorological features of interest lie for the most part in those modifications of diurnal changes which are due to the topography. The range of temperature is unusually great; the hourly progress of the winds show curious changes in speed, in direction, and in temperature. The diurnal change in the barometer is the most characteristic of the form found in continental valleys. It is of the purest single-maximum type and has the largest amplitude known. With these features go those sharp thunderstorms, limited to certain hours of the day, and daily gales and hot blasts.

It is also noteworthy that the absolute humidity here is fairly constant and is that belonging to that part of the world. The air in the valley is part of the general aerial ocean, and this shows no sharp contrasts in its moisture contents, except where wind prevails across a mountain ridge. Here the prevailing winds are up and down the valley, and its relative aridity is due to its higher temperature.

A few words may be given to the winter climate, concerning which there are no recorded observations. The physical conditions of the valley, however, supported by the statements of those who have prospected there in the winter, and of those who have resided there in connection with borax works, enables us to reach a fair idea of this season. For five years, beginning in 1883, about 40 men were employed there. The season began with September and ended in June. By them the climate was considered healthy. Ducks and other migrating birds, jack rabbits, and cottontails were reported as abundant, and the neighboring Pi-Utes extended their migrations into the valley. Snowfalls occurred on the mountains, sometimes to the depth of several feet. Ice forms in, and extreme cold has been reported from, the neighboring but higher valleys. In fact, the relatively clear sky and bare soil make this region a favorable spot for the fall of winter temperatures. At Yuma the lowest temperature often reaches 27° , and once descended to $22^{\circ}.5$.

In short, following the year through, and accepting the guidance of the observations, of the physical conditions, and of the reports of those who have lived there, it is safe to conclude that the winter must be cool and salubrious, with an inch or two of rain. The early spring and late autumn must be of moderate temperature, with clear, delightful air and little rain; the autumn very dry; the summer, with May and September, as we know, hot and arid. While the diurnal changes are great, the annual must be very much greater. The winter mean temperature may be between 35° and 40° , and that of the year 58° or 60° .

Bulletin No. 2: "Notes on a New Method for the Discussion of Magnetic Observations," by Prof. Frank H. Bigelow. In this bulletin a general account of the relations thought to exist between terrestrial and cosmic magnetism and certain meteorological phenomena is given. The plan pursued is to subdivide the resultant deflecting force disturbing the normal terrestrial magnetic system at any instant into its several components and then trying to unravel these. The residuals derived from the observations, showing variations about a mean, are changed to a system of rectangular coordinates, which are transformed to equivalent polar coordinates, which, in turn, are transferred to a model in an attempt to classify the very complex systems that give rise to them. The result has been to give the following

components: (1) The annual solar, due to the orbital motion of the earth; (2) the diurnal solar, due to the rotation of the earth on its axis; (3) the coronal, due to the rotation of the sun on its axis; (4) the disturbance, probably due to spasmodic actions in the body of the sun; and (5) the meteorological, probably due to variations in the terrestrial atmosphere as a conductor to magnetic-ether waves. The research has been conducted along three principal lines, and enough has already been accomplished to make sure the main lines of the development, giving at the same time the promise of very interesting conclusions, which it is hoped can be definitely announced before the end of another year. In order to clear the ground for the final object to be attained by the investigation, namely, the development of the meteorological term, the other components had to be studied with some care; and a full treatment of the magnetic needle in the annual and diurnal periods was undertaken. The records of thirty stations, where hourly observations have been conducted for at least a year, have been fully reduced and transferred to a 10-inch model. These stations are distributed in latitude (magnetic) from Kingua-Fjord to Hobarton; and in time from 1840 to 1890, including the British colonial stations, the international polar stations and the modern permanent observatories. The result is that the radiant field of sunlight is to be regarded as a magnetic field in which a spherical conducting magnet is rotating in the known astronomical conditions; that the earth is thus acted upon by a couple, tending to pull the north magnetic hemisphere toward and to push the south magnetic hemisphere away from the sun; that the plane of symmetry passing through the center of the earth, and thus not affecting its axial rotation, is itself turned westward by about 23° in the northern hemisphere and by about 8° in the southern from the meridian of the sun; that the lines of force are absorbed by the earth, as a better conductor of magnetic waves than the surrounding medium, and indicate by their peculiar curvature that magnetic refraction is the simple law of the complex resultant formula; that the polar fields pass into the mid-latitude fields through a belt which is to a certain extent discontinuous, and which is the region occupied generally by auroral manifestations, which must therefore be the result of a combination of magnetic wave vibrations increased sufficiently in frequency to become just visible as light; that among the many important conclusions in physics to be drawn from these premises is the confirmation of Maxwell's electro-magnetic theory of light.

The second step was the discussion of the magnetic and meteorological data. For this purpose the Washington observations of 1889, 1890, 1891 were reduced, and some persistent relations that can not be considered coincidences were found. Owing to the lack of material for the United States the records of European observatories were taken. The year 1887 was selected, because this is the only complete year of International Weather Maps. These were supplemented by the "Wetterkarte u. Wetterbericht d. Kgl. Bayer. Meteor. Centralstation Munchen, 1887." The computations were made for Los Angeles, Toronto, Greenwich, Paris, Pola, Prague, Vienna, Pawlowsk, Tiflis, Zi-ka-wel, and Batavia. What was at first supposed to be a simple meteorological term has been divided into two parts—(1) a term that can be properly ascribed to the motion of the sun on its axis, and which gives the individual dates on which the southern and the northern poles of the solar coronal system pass synodically in front of the earth, confirming remarkably the results hitherto obtained by Prof. Bigelow regarding the location of these coronal poles; (2) a proper meteorological term showing absorption of magnetic waves during periods of rain.

It may be said, in a preliminary way, that the weather conditions show a type of fluctuations related to these two terms that gives ground for hope that some interesting conclusions may be obtained. It has been decided to extend the computations into the years adjacent to 1887 to verify the results. Quite a large amount of material for the discussion of the "disturbances" has been collected and is already partially reduced, but not enough yet to show that additional knowledge is to be gained. All the large disturbances registered at Washington for 1889, 1890, 1891 are being discussed for the recurrence of the phenomena at a single station, and the disturbances of January 3, January 28, and February 13, 1892, as recorded at widely distributed stations, are also to be treated.

Two cosmical fields in the neighborhood of the earth seem to be clearly made out—(1) the radiant or electro-magnetic field parallel to the plane of the ecliptic; (2) the coronal field perpendicular to the same plane at the earth, consisting of longer and therefore invisible magnetic waves. When these other waves penetrate the atmosphere and come in contact with its oxygen and aqueous vapor, they pass through a series of transformations, by which some of the wave lengths are increased so as to give the heat vibrations; some are absorbed and broken up in the air, and others at the earth itself.

Bulletin No. 3 is a "Report on the Relations of Soil to Climate," by Prof. E. W. Hilgard, of the University of California. This treats of the processes of soil formation—(1) through mechanical agencies, changes of temperature, freezing water, moving or flowing ice, flowing water; (2) chemical agencies, solution by water alone, carbonic acid, the oxygen of the atmosphere, water in combination; and (3) weathering or fallowing.

Following a classification of the soils, Prof. Hilgard gives a synopsis of the climatic factors that modify soils, such as the influence of rainfall, temperature, and sunshine. Conjointly with the study of soils, that of climatic conditions is of the utmost practical and theoretical importance. Meteorological stations must be more numerous, and located largely with reference to the agricultural problems to be determined in connection with them. "Actual field surveys to define the agricultural subdivisions," says Prof. Hilgard, "should be made by parties covering not only the agricultural, but also the meteorological, geological, and botanical aspects of the several problems. This will be but simple and tardy justice to the fundamental industry upon which the very existence of nations depends.

Bulletin No. 4 is "Some Physical Properties of Soils in their Relation to Moisture and Crop Distribution," by Prof. Milton Whitney, of the Maryland Agricultural College. This report is based partly on the author's original work and partly on a generalization of the work of others in this line, as reported in the literature of the day. The limits of the report do not permit of the presentation of even the main facts from which these generalizations have been drawn, which are well known, however, through the admirable writings of Johnson and Storer, or of the views generally held by agricultural chemists as to the cause of the local distribution of plants.

Bulletins in course of preparation are: "Variation of Barometer," by Dr. F. N. Cole, of Ann Arbor, Mich.; "Fluctuations of Ground Water," by Prof. Franklin H. King, of Madison, Wis.; and probably papers on "Average Wind Velocities in the United States," by Prof. Frank Waldo; and on "Rainfall Laws," by Prof. Gustavus Hinrichs.

For exhibition at the World's Fair, at Chicago, a set of normal charts has been prepared, as follows:

- Normal pressure and wind for January, April, July, October, and the year (5).
- Normal temperature for January and July (2).
- Difference between the maximum and minimum (6).
- Normal precipitation for the seasons and the year (5).
- Snowfall chart (1).
- Grains of moisture per cubic foot, January and July (2).
- Clouds for January and July (2).
- Rain and wind, January and July (2).
- Number of days on which .01 inch precipitation fell, January, July, and the year (3).
- Number of days on which maximum temperature was above 90, June, July, and August (3).
- Number of days on which minimum temperature was below 32, December, January, February, and March (4).
- Mean hourly temperature departures, Chicago and Yuma (2).
- Diurnal range of wind velocity at Chicago (1).
- Diurnal range of wind direction at Chicago (1).
- Typical weather map.

SEVERE LOCAL STORMS.

Some study has been made of the most destructive storms and a list of casualties has been prepared by Prof. Hazen. These storms have been grouped as follows: (1) Where the loss did not exceed \$3,000; (2) where the loss was in the neighborhood of \$20,000; and (3) where the amount was \$100,000 or more. Of 1,207 storms considered, 71 per cent are storms that were not especially dangerous to either life or property. Only 70 storms, or about 5 per cent of the total number reported, were destructive to the amount of \$10,000 or more.

DEATHS BY VIOLENT WINDS AND LIGHTNING.

Whenever deaths were reported a circular was sent to the nearest voluntary observer, or to the postmaster, asking for names, etc.

Months.	Wind.			Lightning.		
	1890.	1891.	1892.	1890.	1891.	1892.
January		2				
February		1				
March	180	10	20	2		
April	6	9	38	6	13	5
May	26	9	60	8	23	26
June	27	35	34	37	77	102
July	29	30	31	55	62	95
August	25	11	7	12	53	62
September		1			8	2
October						
November						
December						
Total	273	108	190	120	236	292
	571			648		

RECORDS OF THE WEATHER BUREAU.

I can only repeat the statement of last year relative to utilizing the records now in the possession of this office. The policy of the Bureau is to afford an opportunity to everyone interested in climatology to have the benefit of the enormous accumulation of meteorological records.

We have now the observations for the twenty years during which the meteorological work was in charge of the Signal Service, and also those for many years before, when in charge of the Smithsonian Institution. I propose to utilize these data by special studies by the proper officers of the Bureau. Several studies of this sort are now under way and others are being organized. But I believe that we should

pursue no exclusive policy in the treatment of our records. They should be thrown open to all students of meteorology who are competent to use them, subject only to such restrictions as will preserve them from injury. I recommend that meteorologists be invited to make use of them in the Bureau. Space can be found for a limited number of such students and the necessary guidance and oversight given them.

A brief statement of the records embraced in the files of the Weather Bureau follows:

(1) The records of Weather Bureau stations which have been in operation since November, 1870. Of such stations, 373 have been in operation at one time or another. Main dependence is of course placed upon these observations.

(2) The records of the Medical Department of the Army from 1860 to date, and the reports of voluntary cooperating observers from December, 1873, to date.

(3) As a special deposit, the records collected by the Smithsonian Institution from 1847 to 1873. This collection embraces original registers or monthly values of temperature and precipitation secured through the cooperation of the United States Lake Survey, under the Engineer Corps, U. S. Army; the U. S. Coast Survey, under the Treasury Department; the compilations of Dr. F. B. Hough from observations made under the direction of the regents of the University of the State of New York; the records made in Pennsylvania under the direction of the Franklin Institute of Philadelphia, the transactions of various societies, and periodical publications.

(4) Abstracts of monthly registers forwarded by directors of State weather services and meteorological societies.

(5) Abstracts of reports made by the Central and Southern Pacific Railway agents.

(6) Records of observations at stations of the Canadian meteorological service, furnished through the courtesy of the director.

(7) Copies of many private series of observations, the originals remaining in the custody of the owners.

The duties of the Records Division of the Bureau have been so fully described in previous reports that no extended comment is needed here. Meteorological forms and reports as shown in the following table have been received from all classes of observers in the United States. The gain over 1891 is 6,978.

No. of form.	Description.	Received.
1001	Original monthly record of observations	1,752
1002	Annual meteorological summary	150
1003	Annual meteorological summary abridged	303
1004	Monthly meteorological record of third-order stations	194
1004	Monthly meteorological record of special rainfall stations	790
1005	Monthly meteorological record of cotton region stations	856
1005	Monthly meteorological record of sugar and rice stations	21
1006	Monthly meteorological record of river stations	2,076
1006	Monthly meteorological record of voluntary observers	} 12,421
1009	Monthly meteorological record of voluntary observers abridged	
1011	Monthly meteorological summary (State weather services)	103
1012	Monthly meteorological summary of voluntary observers' records (temperature and precipitation)	375
1014	Abstract of daily journal	1,776
1015	Anemometer record sheet	33,000
1015	Self-recording rain-gauge record	144
1016	Anemometer and anemoscope record sheets	1,020
1017	Anemometer, anemoscope, and rainfall record sheets	19,260
1021	Prevailing hourly wind direction	349
1022	Hourly wind movement	1,708
1026	Hourly barograph record	648
1026	Hourly thermograph record	909
1026	Hourly hygrometer record	10
1029	Annual report of stations (observers)	151
1031	Monthly record of wind signals	600
1032	Monthly record of cold-wave signals	1,116
1033	Monthly record of wind signals, special display	642
1055	Records of observations of Piche evaporimeter	18
1061	Cipher report (telegraphic) of observations	100,580
1064	Record of radiation	24
1065	Record of sun-shine	242
1066	Monthly verification of weather and temperature forecasts	334
	Trace sheets, barograph	2,808
	Trace sheets, hygrometer	43
	Trace sheets, thermograph	4,108
	Total	195,238

In addition to the foregoing numerous special reports of severe local storms, thunderstorms, tornadoes, etc., have been received and acknowledged.

The promptness and efficiency of regular and special observers in forwarding the reports required of them is especially commendable. It is almost incredible that out of nearly 200,000 reports there should be but 113 delinquent cases, and yet such is the fact. The loss in transit through the mails was limited to but one record of value (original thermograph trace).

FOREIGN METEOROLOGICAL REPORTS.

On July 1, 1891, reports of simultaneous meteorological observations were received from Canada, Denmark, France, Germany, Italy, Netherlands, Spain, and Turkey, through the courtesy of meteorological services and individual observers in those countries. The following circular letter was sent to each of the meteorological services and cooperating observers on November 1, 1891:

U. S. DEPARTMENT OF AGRICULTURE, WEATHER BUREAU,
Washington, D. C., November 1, 1891.

Owing to the inability of this Bureau to bear the labor and expense incidental to a proper continuation of the International Meteorological publications issued by the United States Weather Service since 1875, the Chief of the Bureau deems it advisable to formally discontinue this work, on the part of the United States, after December 31, 1891.

The series of simultaneous meteorological observations, upon which these publications were based, was inaugurated as a result of the Vienna Meteorological Conference of September, 1873. In accordance with the promises of the Chief Signal Officer these observations were arranged, reduced, and published at the expense of the United States, and the publications were distributed to cooperating observers throughout the world.

Continued reductions in the funds available for carrying on the work, however, led the Chief Signal Officer to issue a circular letter, dated August 1, 1887, in which he announced that after December, 1887, this work would be discontinued by the United States. This letter resulted in a discontinuance of the simultaneous observations by many of the more important foreign services. In a subsequent circular the Chief Signal Officer stated that he would publish a monthly summary of observations furnished by cooperating observers who desired to continue the work. This monthly summary, which contains less than 200 foreign reports from observers irregularly distributed over the Northern Hemisphere, was published from January, 1888, to June, 1889.

In finally discontinuing the international work on the part of the United States, the Chief of the Weather Bureau desires to thank the chiefs of weather services and the voluntary observers for the cordial cooperation which has so largely contributed to the success of this work in the past. He also desires to state that it is the intention of this Bureau to publish a summary, with charts, of the general meteorological conditions over the Northern Hemisphere, based upon international simultaneous observations for ten years, copies of which publication will be furnished to each observer who has cooperated in the work of international observation.

I have the honor to be, very respectfully, your obedient servant,

MARK W. HARRINGTON,
Chief of Weather Bureau.

There still remain, however, a few countries and individual observers who continue to forward reports of observations to this Bureau.

The number of reports received from points outside of the United States during the year was 3,014.

Acknowledgment is due and is hereby made to all foreign meteorological services and individual observers for the care and attention given to the preparation of their respective reports, and for their generous cooperation without which the prosecution of the international work of the Bureau would have been impossible.

EXAMINATION OF RECORDS.

The following table shows the number of forms and record sheets examined during the year:

Serial number of form.	Designation.	Number examined.	Error letters prepared.
1001	Original monthly record of observations.....	1,752	1,708
1015	Anemometer record sheet (daily).....	33,060	
1016	Anemometer and anemoscope record sheet (daily).....	1,020	
1017	Anemometer, anemoscope, and rainfall record sheet (daily).....	19,200	
1022	Hourly wind movement (monthly).....	1,798	
1002	Annual meteorological summary.....	150	
1003	Annual meteorological summary.....	150	
1004	Monthly meteorological record of third-order and rainfall stations.....	194	
1020	Hourly readings (monthly).....	1,558	
1061	Cipher report (telegraphic) of observations.....	106,580	
1065	Sunshine record (monthly).....	242	200
	Total.....	166,304	4,508

The examination to which the more important forms are subjected consists of an inspection of the report to see that there is agreement among the various entries, that no improbable entries have been made, that the reductions have been correctly made, and, finally, as to the numerical correctness of the monthly sums, averages, etc. Such an examination of the various statistical reports of observers operates not only as a check upon those who may be carelessly inclined, but also as a means of determining the relative accuracy and fitness for advancement of the better class of observers.

Nearly 20,000 more forms and record sheets were examined during the past year than in the preceding year. To accomplish this result it became necessary to shorten the time spent on the less important forms and to adopt shorter methods in others. The greater portion of the time devoted to the examination of meteorological reports is spent upon the original record of observations and other forms containing meteorological and climatological data used in the preparation of the Monthly Weather Review and other statistical reports.

The increase of the number of stations of the first order has been felt in the work of this division, both in the matter of instructing observers as to the preparation of reports from self-registering instruments, and in the greater number of forms to be examined. Purely instrumental records are sent to the official in charge of the instrument room for the correction of any noticeable mechanical defects in the working of the instruments. This plan keeps the official in charge of the instrument room fully informed as to the working of each of the self-registering instruments in the service.

REQUESTS FOR METEOROLOGICAL DATA.

Applications for climatological statistics have been as numerous as in former years and as varied in character. The liberal policy of the Bureau in regard to furnishing climatological information as outlined in previous reports has been followed during the year. All reasonable applications have been met and satisfied without expense to the applicants or detriment to the current work of the division. As illustrating the general use of climatological statistics, the following table showing the number of applications received from each State or Territory has been prepared. The District of Columbia includes, of course, the Executive Departments and both Houses of Congress.

Number of applications for climatological statistics received from each State and Territory.

State.	No.	State.	No.	State.	No.
Alabama.....	4	Louisiana.....	15	Ohio.....	4
Arizona.....	6	Maine.....	2	Oklahoma.....	4
Arkansas.....	2	Maryland.....	14	Oregon.....	3
California.....	13	Massachusetts.....	12	Pennsylvania.....	30
Colorado.....	3	Michigan.....	22	Rhode Island.....	3
Connecticut.....	5	Minnesota.....	10	South Carolina.....	1
Delaware.....	0	Mississippi.....	3	South Dakota.....	1
District of Columbia.....	87	Missouri.....	14	Tennessee.....	4
Florida.....	4	Montana.....	0	Texas.....	5
Georgia.....	4	Nebraska.....	4	Virginia.....	12
Idaho.....	3	Nevada.....	0	Vermont.....	1
Indian Territory.....	0	New Hampshire.....	2	Utah.....	0
Indiana.....	4	New Jersey.....	10	Wisconsin.....	2
Illinois.....	28	New Mexico.....	1	West Virginia.....	5
Iowa.....	3	New York.....	113	Foreign.....	15
Kansas.....	5	North Carolina.....	8		
Kentucky.....	13	North Dakota.....	2		
				Total.....	503

Special reports for the use of the various scientific divisions of the Department were made as follows: For the Division of Ornithology and Mammalogy, a report on the temperature of a number of places in the United States as illustrating the effect of climate on vital phenomena; for the Pomological Division, a series of frost charts showing the average date of last killing frost in the United States, and also the dates of last killing frost in 1889, 1890, and 1891; and for the Division of Vegetable Pathology, a report of the temperature and rainfall of certain years in the peach-growing districts of Delaware and Maryland. Computations, the extent of which can not be stated numerically, have also been made for the officials of the Bureau and for special agents and other investigators.

Copies of the compilations of precipitation and temperature data for Arkansas and New Jersey have been made for use of the Weather Bureau officials of those States. Much of the accumulated data of temperature and precipitation in the files of the division is of great value to the Weather Bureau officials in the several States and Territories and it is recommended that, as soon as other duties will permit, copies be made and sent to the States and Territories having most need of them. Some attention has been given to the preparation of the manuscript for an annual volume of meteorological observations to be printed in accordance with a plan approved by the Chief of the Bureau.

Work has also been done on normal values for use in preparation of charts for exhibition at the World's Columbian Exposition.

THE RECORDS VAULT.

The fireproof vault, in which are stored the original records of observation and other valuable reports, was fitted up with inside shelving during the year. No provisions for properly lighting or ventilating the vault have been made. The lack of ventilation is sorely felt, and has retarded a final classification and arrangement of the contents of the vault, but it is hoped that some action may be taken during the coming year to better the present conditions.

No records were bound during the year by reason of a lack of funds.

WORK OF THE REVIEW ROOM.

In the preparation of the Monthly Weather Review from June, 1891, to May, 1892, reports from 2,031 regular and voluntary observers have been used. Of these, 160 were regular stations of the Weather

Bureau; 1,719 were voluntary and State weather service stations; 98 U. S. Army post surgeons; 422 marine reports, through the Hydrographic Office; 32 Canadian reports; and 200 from the Central Pacific Railway Company. Marine reports, averaging about 75 per month, have also been received from the New York Herald. In addition to the regular contents of the Review, the following articles have appeared: Mean temperature at Nashville for thirty years; Excessive precipitation at Taunton, Mass., 1843 to 1890; Fluctuations of temperature and pressure at base and summit of Mount Washington; Some experiments in atmospheric electricity; Chinook winds; Mineral matter deposited with snow; Cloud work at Blue Hill Observatory; Observations of wind direction in West India cyclones; Precipitation at Washington and New York; Thunderstorms of May 3 in New York.

THE LIBRARY.

The work of the librarian has been of two kinds—(1) the collection and arrangement of the books and magazines proper in a meteorological library; (2) the preparation of a general catalogue. Some 13,000 books and 1,500 pamphlets are now in the library. Special efforts have been made to enrich the library in climatological literature. In conjunction with the Records Division, the Library began the preparation of an index of the foreign meteorological observations on file at this office. In January it had to be discontinued owing to lack of clerical force. Thus far the index is complete for Australia, China, Japan, India, and the East Indies.

The Library is open to all persons interested in meteorology, and it is gratifying to state that of many books loaned not a single volume has been lost or damaged.

About 1,000 titles have been added to the general catalogue of meteorology. It is of great importance to working meteorologists that this bibliography be put in print.

THE STUDY OF METEOROLOGY.

Prof. Abbe has been engaged in condensing and codifying the results of the International Meteorological Congress at Munich. Although a special committee was appointed by the conference to do this, it is thought that Prof. Abbe's paper may be of interest. In October, 1891, the manuscript of his extensive report on "Climate and Crops" was returned to him for condensation and certain changes before submittal for publication. This work has occupied much of his time, and it has been necessary for him to test experimentally certain conclusions which he had drawn from his study. He has also had to review the literature of the subject. Much of his time has also been occupied in answering correspondence on topics more or less intimately related to the work of the Bureau.

It will not be out of place, perhaps, to refer here to the loss which the science of meteorology sustained in the death of Prof. William Ferrel on September 18, 1891. He began his official connection with the Signal Service on August 1, 1882, and remained a faithful, able officer until September, 1886, when, having reached the age of 70, he carried out a resolution formed earlier in life of retiring from active life and resigned his professorship. His various papers contributed while thus connected with the Weather Service of the United States are:

"Recent Mathematical Papers Concerning the Motions of the Atmosphere." Part I—"The Motions of Fluids and Solids on the Earth's

Surface," with notes by Dr. F. Waldo. "Popular Essays on the Movement of the Atmosphere." "Temperature of the Atmosphere and Earth's Surface." "Recent Advances in Meteorology." "Vapor Tension, Dew-Point, and Relative Humidity Tables." "Reduction of Barometric Pressure to Sea Level and to Standard Gravity."

A full list of Prof. Ferrel's papers is published in the American Meteorological Journal, October, 1891. Some valuable papers commemorative of Prof. Ferrel were read at a meeting of the New England Meteorological Society in October, 1891.

TELEGRAPH ROOM.

During the year 1,277,500 words of cipher reports and 100,000 messages have been handled by the operators of the Bureau at Washington. The bills of the various telegraph companies for service are audited here, and during the year 492 bills have been certified to the Accounts Division for settlement. Six hundred and twenty-six miles of seacoast telegraph lines were operated by the Bureau. There are 8 sections in all, 3 on the Pacific coast, with 163 miles of line, and 5 on the Atlantic coast, with 463 miles. Sixty-five miles of submarine cables are included in these figures. The receipts from commercial messages on these lines were \$5,166.07, which amount has been covered into the Treasury as required by law.

The Tatoosh Island line and cable were put in good working order in August, but during December were seriously damaged by a storm of unusual severity. Permanent repairs were not completed until January 20. The line is of great value, both for reporting vessels entering the Strait of Juan de Fuca and for weather reports, but owing to the rough and heavily timbered country it is subject to frequent interruptions. A wagon road is now under construction from Port Angeles to Cape Flattery, and steps have been taken to follow this road. The Fort Canby section also suffered in the storms of December, and particularly on December 7, when the wind averaged 75 miles per hour for fifteen hours and reached a maximum velocity of 98 miles. Temporary repairs were made without delay, followed by further repairs in the spring. The section is now reported to be in good condition. The line between San Francisco and Point Reyes Light, California, was damaged in December, in the heavy timber, near Tocaloma, and arrangements had to be made at once to have the weather and vessel reports from Point Reyes relayed by the Western Union office at Tocaloma, with a view to the ultimate abandonment of the Government line. This move, however, was strenuously opposed by the commercial bodies of San Francisco and others interested, and it was finally decided to improve the line. This was accomplished by July, 1892, and direct telegraphic service with Point Reyes Light resumed, to the great satisfaction of many interested therein. Several instances have occurred where the line has been of great value in reporting vessels and in summoning assistance.

The Nantucket section has been improved by the erection of 100 additional wooden poles on Naushon Island. This line has been instrumental in saving several vessels, notably the bark *Western Belle*, in March, 1892, which with cargo was valued at \$286,000. The Block Island section is in excellent condition and has suffered only a few ordinary interruptions. The cable between Block Island and the mainland (11 miles) has remained unbroken.

The Hatteras section was greatly improved and strengthened by 840 new poles and 70 miles of new wire between Currituck Inlet and Life Sav-

ing Station No. 11. Further improvement will be necessary in another year near the southern terminus of the line, where some 1,300 new poles and 4 miles of new wire are needed. Communication was interrupted, in all, 44 days, a shorter period than during any preceding year; and, considering the exposed position of the line, fairly satisfactory. The cable between Cape Henry and Cape Charles, broken during the previous year, has been repaired. There has been no other cable trouble on this section. The reports of vessels from Cape Henry have been of great value to shipping interests, and have been promptly and accurately made. Several instances occurred during the year where the line was of great help in summoning assistance. The Wilmington section has required no general repairs and has been efficiently maintained at but slight expense. The Jupiter section received a thorough overhauling. Since the extension of the International Telegraph Company's lines to Jupiter, connecting the cable to Nassau, the Government line, so far as the transmission of vessel and weather reports is concerned, can be abandoned, but in view of the very great benefits conferred to the plantations along the Indian River, and which are not reached by the commercial lines as yet, the line has been maintained.

THUNDERSTORMS.

Some special observations were made in New England, New York, Pennsylvania, New Jersey, Ohio, Michigan, Indiana, Illinois, Wisconsin, and Missouri.

The intention was to make a practical study of thunderstorms, to see if it is possible to successfully forecast them. Each observer authorized to make forecasts of these storms received warnings from stations to the west by telegraph whenever storms occurred. The result was not all that might have been anticipated. The telegraphic service did not sufficiently cover the ground, and thunderstorms frequently arrived at stations before warnings were received from the west. These storms appear to be of two types: *a*, those traveling with a low area, with about the same velocity, and occurring in a narrow, elongated belt along the southeast quadrant; and, *b*, those accompanying heated terms, in which case these storms occur over a wide stretch of country. To make a fair test of the methods of telephoning and telegraphing warnings, the lines of the Michigan Bell Telephone Company were leased during the months of June, July, and August. The State was divided into nine sections, and the stations reported directly to the section center. These in turn reported to Detroit the direction of movement and the intensity of the storm. This plan worked very well. Telegraphic warnings from the west, however, were generally so retarded in transmission (it sometimes requiring from one to three hours to get a warning from one station to another) that the warnings were not of much practical use. Of 22 thunderstorms occurring in June in Michigan, 18 were forecasted from 8 to 24 hours in advance, two partially forecasted, and two complete failures.

Briefly, it appears from all this work that thunderstorms can be forecasted with some degree of success from the 8 a. m. and 8 p. m. weather maps; that these storms have a general progressive easterly motion; that they occur in the southeast quadrant of "lows," and have approximately the same velocity; that during heated terms attention is to be directed to the isothermal lines rather than to the position of the low; and that by the agency of the telephone, warnings can be successfully given.

STATE WEATHER SERVICE.

State weather service work, the general features of which have been fully outlined in previous reports, has been carried on to a much greater extent than heretofore, and the results accomplished prove the usefulness and importance of this branch of the Bureau. The entire territory of the United States, with the exception of Alaska, is now covered by local weather services, the last organized being that for Idaho. During the year Iowa, Maryland, New Jersey, and Ohio have, by legislative enactments, provided for the maintenance of their respective State services, and it is probable that their action will be followed in the present year by the legislatures of other States. The work in New England was until March 22, 1892, conducted under the direction of the New England Meteorological Society, with a central station at Cambridge, but on the date named the station was transferred to Boston and the name changed to the New England Weather Service. In Kansas, the director, owing to press of other duties, felt compelled to withdraw in April, 1892, much to the regret of the Chief of the Bureau. The Kentucky service, until August, 1891, was operated under the auspices of the Polytechnic Society of Louisville, when it was placed under the direction of the observer at Louisville. Until August, 1891, the Dakota Weather Service covered both North and South Dakota, when separate services were formed. In California, in addition to the usual work of the service, weekly weather crop bulletins have been issued from Red Bluff, Fresno, and Los Angeles. The regular monthly reports now contain important tables, rendering it possible to obtain the special features of the climate of every section of the country. Thus farmers, immigrants, physicians, invalids, and all others have a means of securing detailed information.

THE WEATHER CROP BULLETIN.

This forms a most important feature of State weather service work. Besides the National Bulletin, all the States and Territories, except Nevada and Idaho, issue local bulletins during the season of planting, cultivation, and harvesting of crops. Such has been the demand for the National Bulletin that the edition has been more than doubled, and yet the demand increases. The text of the bulletin is telegraphed by the press associations, and is reproduced either in whole or in part in many papers.

THE DISTRIBUTION OF FORECASTS, FROST, AND COLD-WAVE WARNINGS.

This branch of the work of the division has greatly increased during the past year, but has been hampered by inadequate appropriations for telegraphic purposes. The increase in the number of stations supplied by telegraph at Government expense with the daily forecasts, as compared with the number supplied on June 30, 1891, is over 200 per cent, and on the 1st of July, 1892, our lists show a total number of 1,888 receiving a daily telegram at the expense of the Weather Bureau.

A large number of applications could not be favorably considered, as the allotment of the telegraph appropriation would not admit of any increase over the number already supplied. One hundred and thirty-six stations have been established under the auspices of the National Grange of the Patrons of Husbandry, many of which were supplied with flags by the Weather Bureau, while others disseminated the forecasts and warnings by means of steam whistles.

There appears to be no abatement in the interest manifested by all classes and conditions in the forecasts and warnings, and hearty cooperation is met with by this office in its endeavors to place the information in the hands of all who would be benefited.

The railroad telegraph and train service, as gratuitous means of distribution, are largely utilized, and nearly 3,000 places receive the forecasts daily in this manner, and over one thousand points are supplied by mail or a free telegraph or telephone service.

The following tabulated statement shows the number of places supplied with forecasts and warnings by paid service and without expense, and is arranged with a view to comparison of the work of distribution in each State and Territory:

Distribution of forecasts, cold-wave, and frost warnings.

States and Territories.	By telegraph or telephone at Government expense.			Without expense to the United States, by—			
	Forecasts and warnings.	Cold-wave warnings only.	Frost warnings only.	Mail.	Tele-graph or tele- phone.	Railroad tele- graph.	Railroad train service.
Alabama	16		3	1	1	2	56
Arizona							
Arkansas	24	1			18	2	3
California	64	1	4	16	7		
Colorado	26	2		2			7
Connecticut	17	3	9		46		156
Delaware	6					5	
District of Columbia	1				2		
Florida	18		18	129	9		
Georgia	40		34				83
Idaho	1						
Illinois	94	11	1	1	10	190	36
Indiana	81	4		2		52	80
Indian Territory	4	1					
Iowa	89	2		60			22
Kansas	39	4		3	23	91	3
Kentucky	44	1	101	1	3	4	
Louisiana	35	5	4	17	14	10	59
Maine	32	2			4	10	77
Maryland	20	1	4	4	1	61	
Massachusetts	27	1	27	13			274
Michigan	98	7		8	19	67	5
Minnesota	91	2			2		
Mississippi	40	4	1	15	26	33	14
Missouri	51	1	100	3	51		137
Montana	3	1			1		
Nebraska	54	3	1	65			
Nevada	5						
New Hampshire	17	1		2	8	3	15
New Jersey	32	5	20	51	13	138	
New Mexico	1						
New York	138	8	26	62	80	23	143
North Carolina	59		16	173	8		
North Dakota	27		11				
Ohio	101	1	32		57	53	
Oklahoma	6	1					
Oregon	32			4			
Pennsylvania	50	11		7	85	356	7
Rhode Island	2			3			28
South Carolina	25	6	2	4	11	19	
South Dakota	61		1	5			
Tennessee	27		43	15	19	15	98
Texas	41	2		15		3	5
Utah	1				6		1
Vermont	12	1				1	
Virginia	26	3		8		18	153
Washington	18		3				
West Virginia	21		2			30	
Wisconsin	163		20		7		
Wyoming		3					
Total	1,888	100	492	639	533	1,204	1,462

Grand total, 6,368.

*Rain warnings.

INSTRUMENT ROOM.

The maintenance of a high standard in the instrumental outfit of the various stations of this Bureau is confided to this division. The character of instrument best adapted to the particular necessities of the service demanded, the accuracy of the instruments themselves, and the questions of exposure and proper care are all matters that call for a high degree of training and ability. Active efforts have been made to improve the former types of apparatus, to devise and develop new ones, and to adopt improvements when convinced of their value. The personnel of the division is well adapted for such work. Among other innovations may be noticed the adoption of ink in recording instruments.

On the 30th of June, 1892, 63 first-order stations were in operation, and at each of these, in addition to eye observations, records for each 24-hour period were obtained of pressure, temperature, wind direction and velocity. At 21 stations a photographic record of sunshine and an automatic record of rainfall were obtained. In addition to these continuous records there were in operation, at other selected stations, 22 thermographs, 6 barographs, 1 hygrometer, 1 recording rain-gauge, and 1 sunshine recorder. The demand for automatic instruments becomes greater and greater as they become better known, and it is the intention of this Bureau to supply each large city therewith, even when near other large cities, in order to meet the frequent and important calls by courts for official records at particular hours. It has not been found practicable as yet in part because of the considerable cost of apparatus to equip all the stations with desirable instruments. The distinction made by this Bureau of first-order and second-order stations is, it will readily be understood, one that has not reference to the size or importance of the city in which the station is located, so much as to the meteorological importance of records.

It is hardly necessary to allude to the system of checking by eye-readings the records of all self-recording instruments. The necessary corrections are, of course, made in all tabular data based thereupon.

SOIL THERMOMETER.

Students of soil physics have long felt the need of improved instruments for the measurement of soil temperatures. The ordinary thermometers, with stems long enough to bring the top of the column of mercury above the ground while the bulb is buried at depths of from a few inches to several feet, are subject to very large and uncertain errors, due to the fact that the stem may be at a different temperature from that of the bulb. The error increases as the stem is lengthened, while the actual changes of soil temperature becomes less and less as we descend. Furthermore, since the long portion of the stem between the bulb and the graduations may have a different sized bore, often larger than the graduated portion, it is difficult to determine the correction to be applied to reduce the reading to a true temperature on the assumption that the entire instrument is at the same temperature.

In a mercurial thermometer of the ordinary construction, suitable for getting temperatures 12 inches below the surface, the error referred to may be 0.13° F when the stem is only 10° different from the bulb. If the internal diameter of the ungraduated portion of the stem is only a small amount larger than that of the graduated portions the error is much greater, being in proportion to the squares of the diameters.

Still greater errors arise if the maker is not careful to avoid the formation of accidental enlargements of the bore of the tubes at points of union, which enlargements act as small secondary bulbs, with temperature that may be widely different from that of the true bulb. For the best results the ungraduated portion of the stem above the bulb should be made of much finer bore than the graduated portion. This construction is not feasible in the ordinary mercurial thermometer, as the graduated portion must be very fine unless very large bulbs are used. A soil thermometer which will register the maximum and minimum temperatures also possesses several advantages, and an effort was made during the past year to construct a desirable form of thermometer for the use of Prof. Whitney in his studies of soil physics. A special form of the old Six maximum and minimum thermometer, with the stem prolonged to carry the bulb to the desired depth, had already been tried by Prof. Whitney, but in his instrument the exposed column was exceptionally long and led to a very large error, which was still greater owing to the high coefficient of expansion of the alcohol with which the bulb and stem were filled. It is apparent from these remarks that ordinary instruments are subject to large error. In the instrument constructed, in addition to the small constriction and spherical portion at the bottom, the bulb is fused to the stem in such a manner that a slender prolongation of the latter extends quite through and well into the spherical bottom portion. The top portion of the thermometer stem differs in no essential respect from the stem of the ordinary thermometer. The bulb is almost wholly filled with alcohol, which acts as the principal thermometric fluid, and presents the advantage of its high coefficient of expansion. The remainder of the bulb and the stem of the thermometer, up to a point convenient for graduation, is filled with mercury. The mercury is retained about the point just above the small sphere, and prevents the entrance of alcohol into the stem when the thermometer is horizontal. In order to register the maximum and minimum temperatures, a short column of alcohol is placed in the upper portion of the stem above the mercury, and within this are arranged two small steel indices, so constructed that they will not slide in the tube of their own weight, but are easily pushed upward by the mercury column, or pulled downward by the top meniscus of the alcohol column. The indices are set by the aid of a small magnet, the one being drawn down upon the top of the mercurial column and the other raised up against the meniscus of the alcohol. The rise of the mercury carries its index upward, leaving it to register the highest point reached, while the alcohol meniscus withdraws the other index and leaves it at a point representing the minimum temperature. It only remains to add that the graduations are fixed in the usual way, having reference only to the positions of the summit of the *mercurial* column. Beyond the highest point supposed to be reached by the mercury, say about 120 degrees, the graduations are extended in an arbitrary manner. The scale numbers represent temperatures by mercurial column, and are continued in regular sequence beyond the 120° point. On this plan the readings for minimum temperatures are on a purely arbitrary scale, and are converted into true degrees of temperature by use of a table prepared for each thermometer, which table embodies as well all the corrections for instrumental error. The use of mercury in the stem of the thermometer not only admits of the use of the index for registering the maximum temperature, but possesses the additional advantage of reducing the error due to uncertain temperature of the stem to about one-sixth what it would be if alcohol

were used. Moreover, if necessary, as in the case with thermometers for greater depths than that figured, the ungraduated portions of the stem can be made of very much finer bore than the graduated portion, the effect of which is to diminish the objectionable error to a comparatively unimportant quantity.

SUBURBAN FIRST-ORDER STATIONS.

A matter of considerable popular interest investigated during the year was the proposed establishment of a number of suburban meteorological stations around large cities with a view to getting at truer records. It appears, however, that, with the shelters now in use and considering the various corrections applied, the readings are substantially the same. The question was submitted to observers at a number of selected stations, and lengthy and valuable reports made thereon. It has long been established in meteorology that the average temperatures observed in large cities are higher than those observed in the country near by. The diurnal and annual maximum and minimum temperatures show a larger range in the country than in the city. If data especially applicable to agriculture and forestry are desired, naturally the observing stations should be located in woods and fields. But, on the other hand, if we are to study rainfall and temperature in their relation to the welfare of cities, the reverse holds. Furthermore, the most important service performed at present by this Bureau is the prediction of coming changes of weather. While, therefore, we are extremely desirous of obtaining data bearing directly upon agricultural matters, it has not been practicable as yet to curtail, in anyway, the work of the present stations. As for the work to be accomplished at agricultural institutions and experiment stations, Bulletin No. 10, issued by the Office of Experiment Stations in March, 1892, treats at some length. The paper is of service in indicating the scope and methods best adapted for successfully investigating the relations of climate to agriculture. Such problems, for example, are the distribution of temperatures within such heights in the air and depths in the soil as are occupied by animal and plant life; the changes of temperature with the hour of the day, with the season, with the weather, and with the topography; the problems of air drainage; the occurrence of frosts and protection from them; the distribution of moisture; the problems of condensation and evaporation of water in the air; the solar and terrestrial radiations and the disposition of them; the action of the meteorological elements on organic life and the reactions of life on them; the actions and reactions of weather, climate, and soil; the precipitation of the moisture of the air and the final disposition of it. Special observations very much desired are the amount of sunshine, the temperature of the soil, the evaporating power of the atmosphere, the chemical effects of sunshine, and other matters of particular value in studying the relation of climate to crops.

GENERAL REMARKS.

The successful prosecution of the work of this Bureau requires not only the systematic arrangement of its climatological data, but the thorough discussion of this material. The discussion is being performed under the supervision of Lieut. B. M. Purssell, and is provided for by a special appropriation. The particular topic at present under investigation is the rainfall of the entire country. We hope that some of the

more prominent results will soon be in such condition that practical use may be made of them.

Another matter of great importance in the work of this Bureau is the determination of the best methods for distributing widely and intelligently the forecasts. This matter has received special attention during the past year, and we feel that the facts in the case warrant the statement that our success has been limited only by the appropriation. This is an expenditure where the money is directly used to benefit the people. None of this goes in any way for the support of the Bureau or its employes, but is returned directly in giving warning of impending changes.

A third subject is that of improvement in the character of the forecasts themselves. This, of course, necessitates the most careful study of general meteorology itself and the application of our knowledge to the special problems of forecasting. This is largely a matter calling for special scientific research, and of the scientific force of the Bureau one member is now devoting his entire time to the fundamental physical laws underlying meteorology and another to the relations between meteorology and general terrestrial phenomena. We must also have now in meteorology observations of the conditions prevailing in the upper air strata. The policy of the Bureau has looked, therefore, to the reestablishment of the high-level stations, and the station at Pikes Peak has been reopened. And yet all the requirements of modern meteorology can not be fully met by mountain stations. We require a certain number of observations made in free air, and for this purpose balloons seem to be the only means at present available. Advantage has been taken of one or two balloon ascensions to make observations of the humidity and temperature, but nothing calling for marked comment has yet been obtained from these observations. With a proper outfit, which need not necessarily be very expensive, doubtless much could be ascertained.

In conclusion, therefore I feel called upon, to recommend that for the coming year the climatological work be continued under a special appropriation, and that the attention of Congress be called to the pressing need of our being enabled to distribute in adequate and speedy manner our forecasts to agricultural communities not now easily reached; and, finally, that an effort be made to extend our knowledge of atmospheric conditions by observations made at high elevations in the air, either by balloons or otherwise.

WEATHER CONDITIONS OF THE CROP OF 1892.

(Prepared by H. H. C. DUNWOODY, Major, Signal Corps.)

As has been stated in previous reports, the Weather Crop Bulletin forms a most important feature of State weather service work. Besides the National Weather Crop Bulletin all States and Territories, except Idaho and Nevada, issue local bulletins during the season of planting, cultivation, and harvesting of crops. The character of these bulletins has been much improved, more attention having been given summarizing and discussing the reports and treating the general crop and weather conditions in editorial form. The circulation of these bulletins, both State and national, has vastly increased during the year, and while the actual number of copies has been largely in excess of the issues of former years this increase represents in a comparatively small degree the enormous extent which the circulation of the weather

crop bulletins has attained through the press of the country. In order that the bulletins might be given the widest circulation possible, after a careful consideration of the matter, it was decided to change the day of issue of the bulletin from Saturday to Tuesday. The change in the day of issue of the bulletin, which went into effect June 8 of the current year, has resulted in its publication in a much larger number of newspapers than formerly, as a large majority of the weekly papers of the country are published during the latter part of the week, and these did not heretofore extensively publish the bulletin for the reason that it did not reach them until the information contained in the bulletin was too old to be of sufficient interest to justify publication. Expressions from the directors of the various State weather services who were requested to inquire into and report upon the advantages or disadvantages of the change in the day of issue show that the object had in view, *i. e.*, increased circulation, has been fully realized. Such has been the demand for the National Bulletin that the edition has been more than doubled, and there is a constantly increasing demand. The text of the National Bulletin is telegraphed by the press associations and is reproduced either in its entirety or in part in a very large number of newspapers throughout the country. Special maps showing the temperature and rainfall conditions covering biweekly periods have been prepared and reproduced by photolithographic process in reduced size in the columns of several agricultural journals. As illustrating the extent of the circulation of these special charts, through reproduction in the columns of the various papers, it may be stated that through the regular Eastern and Western editions of the Farm and Home (published at Springfield, Mass., and Chicago, Ill.) are printed more than a quarter of a million copies of the special chart similar to that issued with the National Weather Crop Bulletin. These special biweekly charts are accompanied by brief notes on the temperature and rainfall conditions during each period covered by the charts.

The plan inaugurated last year of publishing a summary of the Weather Crop Bulletins, giving the more important meteorological elements, presented in such form as to enable those interested in agriculture to compare the weather conditions which prevailed during the growth of the crop with the actual yield of the several crops, is continued and is here re-presented in graphic form.

Plate I exhibits the seasonal conditions of rainfall from March 1 to October 3, 1892, throughout the United States. From this chart it will be seen that excessive rains occurred in the central portion of the cotton region, including the central portions of Alabama and Mississippi and the greater portions of Arkansas and Tennessee, thus giving the central portion of the cotton region a large excess of seasonal rainfall, while the east and west portions of the cotton region received much less rain than the usual amount.

A second area of excessive rainfall extends from New England westward over the lake region to the Dakotas, the greatest excess being in Upper Mississippi Valley, including the greater portions of Iowa, Minnesota, Wisconsin, and Illinois. From the chart it will be seen that the entire spring wheat region and the northern portion of the winter wheat belt received more than the usual amount of rain, while the greater portion of the winter wheat belt received slightly less than the normal rainfall.

The rainfall was below the normal in the Rocky Mountain region, while in the agricultural districts of the Pacific coast there were but slight variations from the normal rainfall.

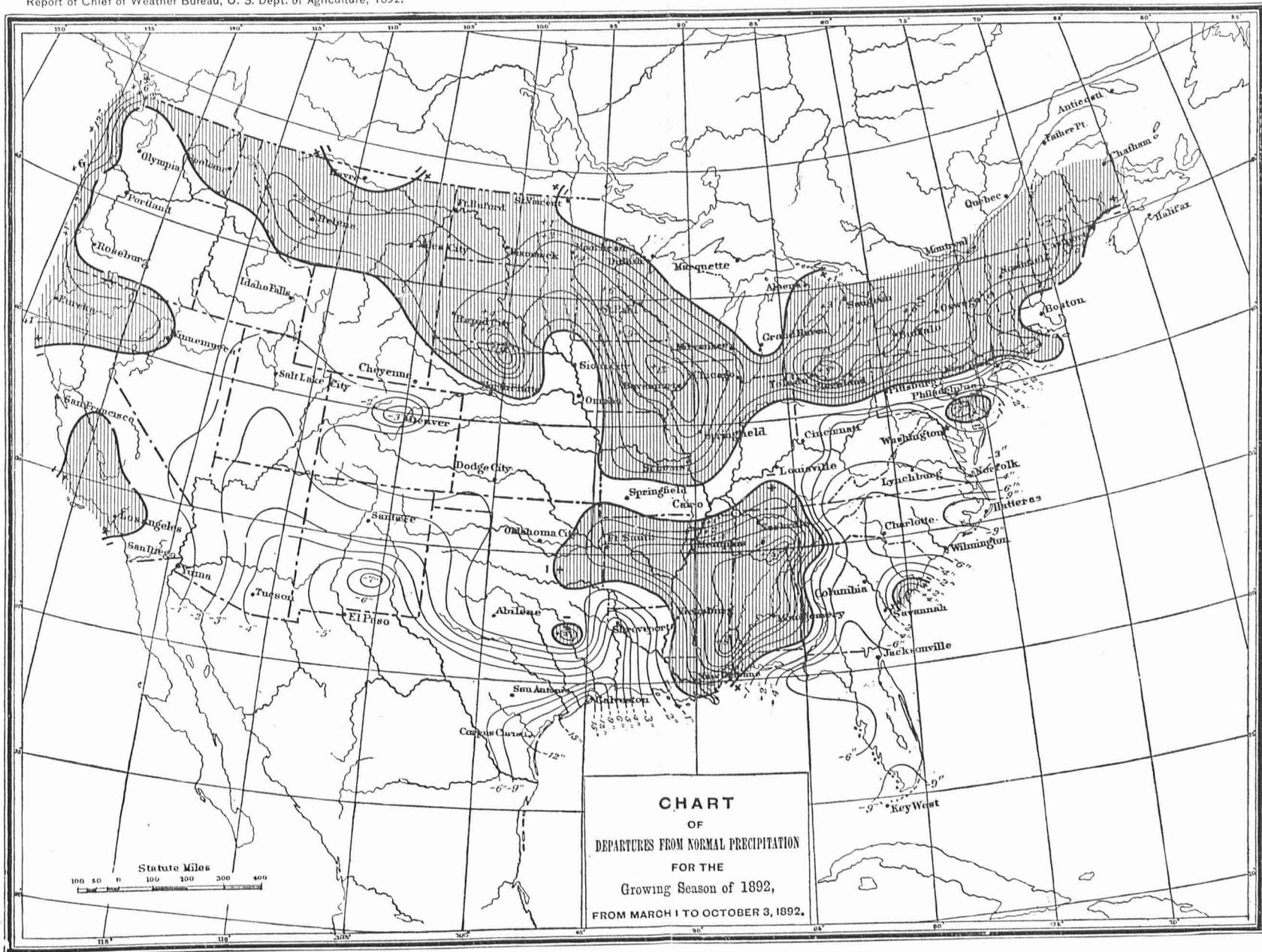
Examination of the tabular statement accompanying this report will enable one to determine the exact period of the occurrence of the excessive precipitation shown within the shaded areas, and indicated by the light lines on the chart, and also the period of drought, or deficiency in precipitation, indicated by the light lines on the unshaded portions of the chart.

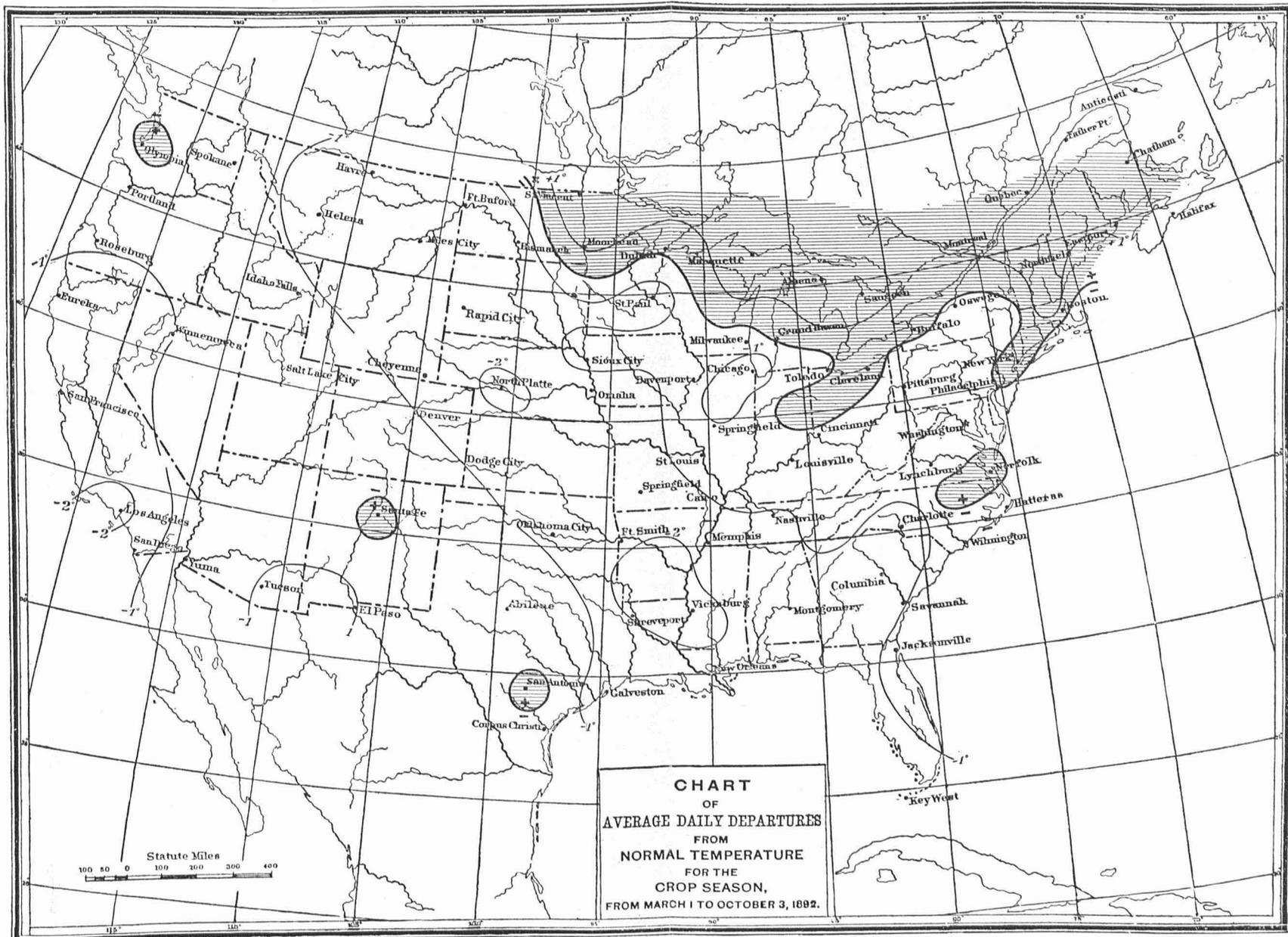
Comparing this chart with that for the previous year, it will be seen that there has been a deficiency in rainfall over the east and west portions of the cotton region during the two years, while in the central portion of this region the deficiency of last year has been replaced by a large excess. In the Ohio Valley both years show a slight deficiency, while in the lake region and Upper Mississippi Valley the deficiency of the last year has been replaced by well-marked excesses. During the year 1891 Kansas and Nebraska received more than the usual amount of rain, while in 1892 the rainfall was slightly below the average in these States, except in northern Nebraska, where the rainfall was heavy.

Plate II defines the regions where the temperature was in excess or deficient as compared with the average of previous years. From this chart it will be seen that over the greater portion of all agricultural districts the season was cooler than usual, the greatest deficiency of temperature being over the central portion of the cotton region and in southern California, where the temperature for the season averaged 2 degrees per day below the normal from March 1 to October 3. Over the wheat and corn States the temperature averaged about 1 degree below the normal, while the only portion of the country where an excess of temperature prevailed is that extending from northern New England westward to northern Minnesota.

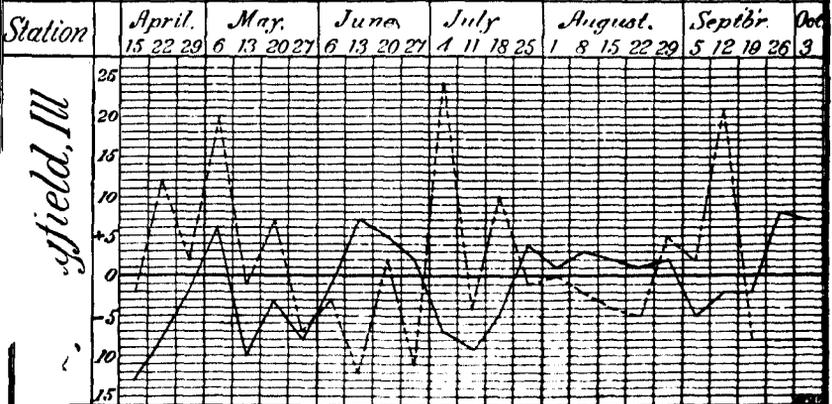
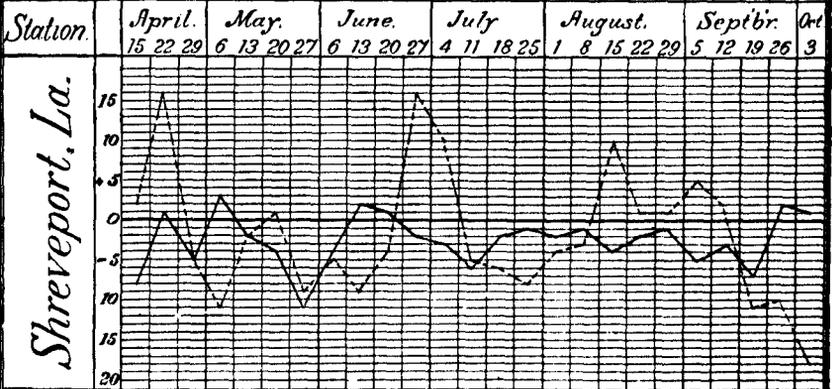
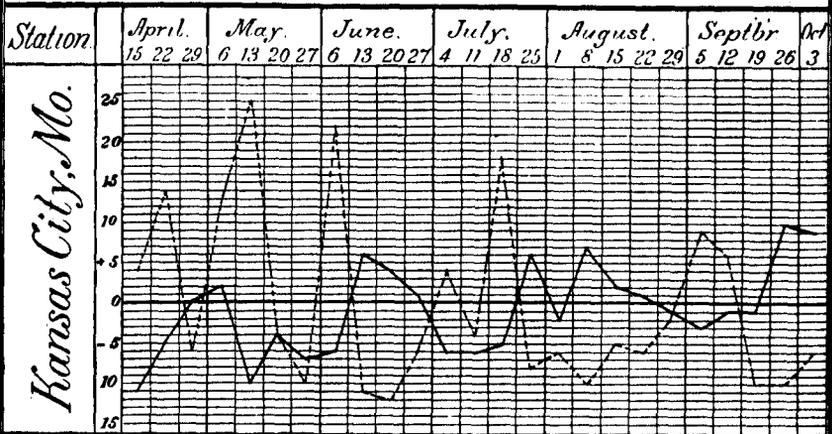
Comparing this chart with a similar chart for 1891, it will be seen that both years are almost identical, except on the Pacific coast, where the excess of last year has been replaced by a deficiency.

Plates III and IV show the conditions of temperature and rainfall, by weeks, at selected stations, so distributed as to give the approximate conditions of the Missouri Valley, the east and west portions of the cotton region, the central Mississippi Valley, and South Dakota. These diagrams will serve as a type to indicate the general weather conditions from week to week for the localities represented, and from the tabular statement similar diagrams may be constructed for each station named in the table. For example, take the diagram for Springfield, Ill., the same station selected for illustration in the previous report. The heavy horizontal line, marked 0, indicating the normal conditions of rainfall and temperature, and the figures to the left indicating degrees when referring to temperature, and tenths of an inch when referring to rainfall. The full black line refers to temperature and the dotted line to rainfall. It will be seen that, by comparing with the diagram of the previous year, the early spring months of last year were moist and cool, while May and the latter part of April of that year were warmer and received less than the usual amount of rain. During the current year, however, the entire spring was relatively cool and moist. In both years the month of June was warm and dry, and the month of July was moist and cool, the curves showing excess of rain and deficiency of temperature. In August, during the current season, the normal conditions prevailed, and there was an excess of rainfall in the first half of September, while during the season of 1891 there was an excess of rainfall in August, and September was dry and warm.



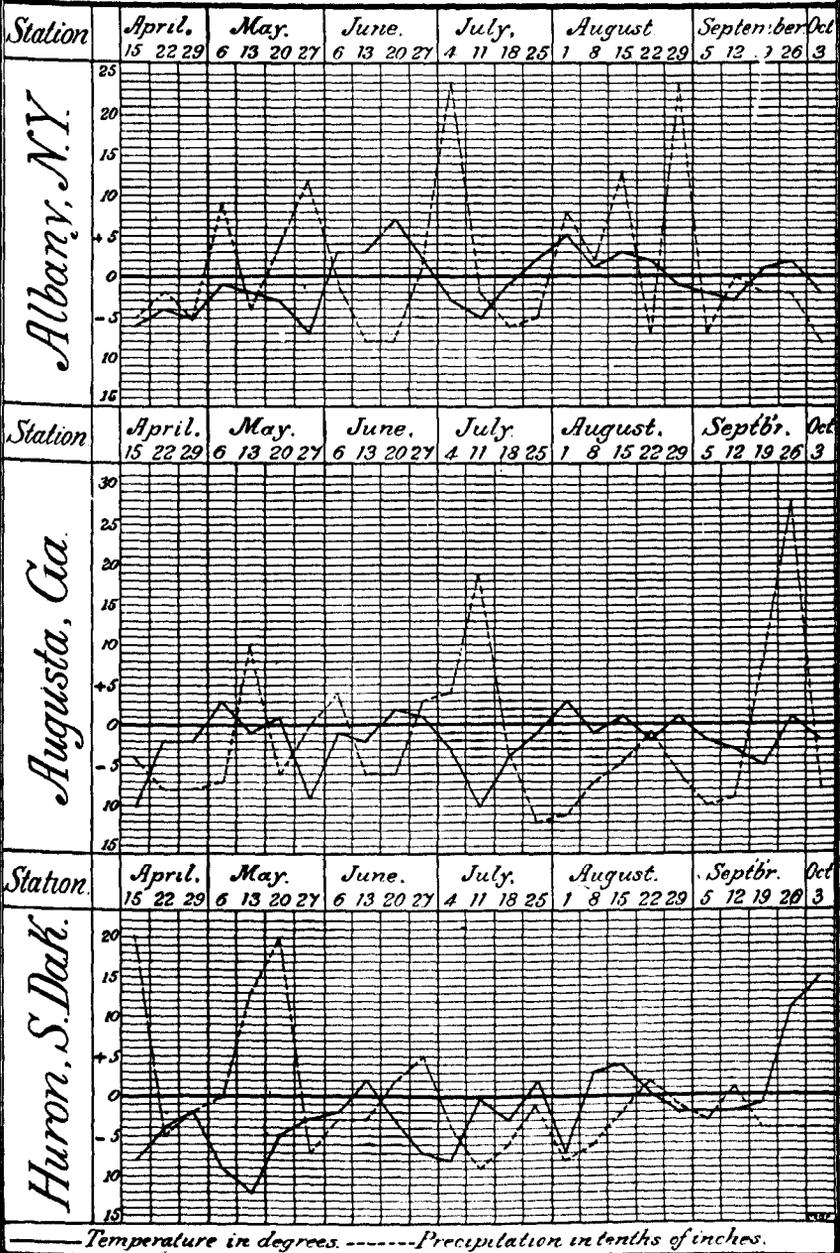


*Average daily Departures from Normal Temperature,
and weekly Departures from Normal Precipitation, from
April 15th to October 3rd 1892.*



— Temperature in degrees. - - - - - Precipitation in tenths of inches.

*Average daily Departures from Normal Temperature,
and weekly Departures from Normal Precipitation
from April 15th to October 3rd 1892.*



— Temperature in degrees. ----- Precipitation in tenths of inches.

The presentation of meteorological data in this form, when compared with the actual yield of crops in the locality, can not fail to give indications of the effect of weather upon the staple crops, and with additional years the comparison will become more accurate and therefore more valuable. In the tabular statement will be found the departures from the normal of both temperature and rainfall for each week for the season of 1892. The first column in each table contains the conditions as compared with the normals from January 1 to April 8, the date of the issue of the first weekly bulletin; the remaining columns give the departures for each successive week for the remainder of the season. The tables thus present the seasonal conditions for all agricultural districts of the country, and diagrams similar to those given may be readily constructed for any locality.

TABLE I.—Temperature departures for the season of 1892 from the normal of many years.

Stations.	From Jan. 1 to Apr. 8, inclusive.	For the weeks ending—										
		April			May				June			
		15.	22.	29.	6.	13.	20.	27.	*6.	13.	20.	27.
New England:												
Eastport, Me	+2.8	0	+1	+1	0	0	+1	-1	+2	+4	+2	-5
Portland, Me	+1.8	-2	+1	-2	-2	-1	-1	-5	+4	+3	+3	-5
Boston, Mass	+1.6	-2	+1	-1	+1	-3	-1	-2	+7	+3	+6	0
Middle Atlantic States:												
Albany, N. Y	-0.2	-6	-4	-5	-1	-2	-3	-7	+3	+3	+7	+2
New York City, N. Y	+0.4	-6	-3	-1	+3	0	-1	-4	+4	+2	+4	+4
Philadelphia, Pa	-0.2	-7	-4	-2	+5	-2	0	-6	+3	0	+5	+3
Washington, D. C.	-0.1	-10	-8	-3	+9	-3	+2	-7	+4	+1	+7	+6
Lynchburg, Va	+0.7	-10	-8	-3	+9	-3	+4	-8	+1	0	+5	+4
Norfolk, Va	-0.5	-8	-2	-4	+7	-1	+5	-5	+3	0	+4	+6
South Atlantic States:												
Charlotte, N. C.	-1.5	-10	-8	-3	+6	-1	+3	-9	0	-2	+3	+2
Wilmington, N. C.	-2.0	-8	-3	-3	+3	-2	+3	-4	-1	-2	0	+2
Charleston, S. C.	-1.0	-6	-1	-1	+1	-1	+2	-5	-3	-2	-1	+1
Augusta, Ga	-2.3	-10	-2	-2	+3	-1	+1	-9	-1	-2	+2	+1
Savannah, Ga	-1.9	-8	0	-2	+1	-1	+1	-5	-1	-2	0	0
Jacksonville, Fla	-1.3	-6	+3	-1	+2	+2	+2	-5	-3	-2	-1	-1
Gulf States:												
Atlanta, Ga	-2.4	-12	-3	-3	+6	0	+2	-9	+1	0	+3	+2
Mobile, Ala	-1.7	-8	-1	-3	+1	0	+1	-10	0	+1	-1	-1
Montgomery, Ala	-1.3	-8	+3	-1	+4	+2	+2	-10	0	0	+2	0
Vicksburg, Miss	-1.7	-8	+3	-3	+4	0	0	-11	-3	+2	-1	-3
New Orleans, La	-1.8	-5	0	-3	+2	0	0	-8	-1	0	-2	0
Shreveport, La	-1.4	-8	+1	-5	+3	-2	-4	-11	-4	+2	+1	-2
Fort Smith, Ark	-0.5	-10	+3	-2	+7	-5	-4	-9	-5	+3	+3	+2
Little Rock, Ark	-1.3	-10	+2	-1	+6	-4	-5	-9	-5	+3	+2	0
Galveston, Tex	-1.7	-2	0	-1	+2	0	+2	-7	-2	-1	-2	-2
San Antonio, Tex	-0.6	+3	+5	+4	+10	+3	+3	-3	0	+2	+3	+2
Ohio Valley and Tennessee:												
Memphis, Tenn	+0.1	-12	+3	0	+8	-3	-1	-9	-4	+3	+3	+1
Nashville, Tenn	-1.0	-12	+1	0	+8	-1	-1	-10	0	+3	+4	+3
Chattanooga, Tenn	-1.2	-11	0	-1	+0	0	+1	-8	0	+2	+3	+3
Louisville, Ky	-0.4	-13	-4	-2	+8	-6	-2	-8	+2	+4	+6	+3
Indianapolis, Ind	+0.3	-12	-5	-2	+8	-9	-3	-10	+3	+5	+6	+2
Cincinnati, Ohio	-1.8	-12	-4	-2	+9	-7	-2	-10	+3	+3	+6	+3
Columbus, Ohio	-0.1	-12	-5	-3	+9	-4	0	-9	+4	+6	+8	+2
Pittsburg, Pa	-0.2	-12	-4	-1	+8	-6	+1	-10	+4	+3	+8	+2
Lake Region:												
Oswego, N. Y	0.0	-6	-3	-5	-1	-5	0	-8	+4	+4	+4	-1
Buffalo, N. Y	+1.3	-7	-1	-5	0	-4	+2	-8	+4	+4	+5	+2
Cleveland, Ohio	+0.9	-8	-2	-3	+5	-5	+2	-7	+4	+6	+7	+2
Detroit, Mich	-0.8	-11	-4	-5	+1	-8	-1	-6	+3	+5	+6	+1
Alpena, Mich	+3.0	-3	-1	-2	+1	-2	+3	-1	+2	+6	+5	0
Grand Haven, Mich	+1.2	-10	-3	-4	+1	-6	+1	-6	0	+6	+1	-1
Milwaukee, Wis	+1.0	-8	-3	-3	+1	-7	-3	-3	-5	+5	+1	-2
Chicago, Ill	-1.5	-10	-4	-2	+4	0	-3	-7	-6	+5	+3	+3
Duluth, Minn	+1.2	-7	-1	-6	-0	-7	-3	-1	-3	-2	-3	+1
Upper Mississippi Valley:												
St. Paul, Minn	+1.5	-8	-4	-7	-7	-10	-5	-3	-4	+5	-5	-4
Lacrosse, Wis	+2.6	-8	-5	-5	-5	-8	-4	-3	-3	+6	0	-4
Davenport, Iowa	+1.2	-10	-5	-3	+2	-9	-5	-6	-4	+5	+3	0
Des Moines, Iowa	+1.8	-10	-7	-3	-1	-12	-6	-6	-6	+4	+3	-3

* The departures in the column for June 6 are for ten days, due to change of day of issue of Bulletin from Saturday to Tuesday.

TABLE I.—Temperature departures for the season of 1892 from the normal of many years—Continued.

Stations.	From Jan. 1 to Apr. 8, inclusive.	For the weeks ending—										
		April			May				June			
		15.	22.	29.	6.	13.	20.	27.	*6.	13.	20.	27.
Upper Mississippi Valley—Continued.												
Springfield, Ill.	-0.9	-13	-8	-2	+6	-10	-3	-8	-1	+7	+5	+2
Cairo, Ill.	+0.1	-12	-1	0	+8	-4	-2	-8	-1	+5	+5	+3
St. Louis, Mo.	0.0	-13	-6	-1	+6	-9	-3	-8	-2	+7	+5	+4
Missouri Valley:												
Springfield, Mo.	-0.6	-12	-1	-2	+6	-8	-7	-10	-5	+5	+5	+1
Kansas City, Mo.	+0.1	-11	-5	0	+2	-10	-4	-7	-6	+6	+4	+1
Concordia, Kans.	+2.0	-8	-5	-1	-1	-11	-5	-6	-6	+6	+1	+1
Omaha, Nebr.	+1.4	-9	-7	-1	-5	-12	-6	-7	-5	+7	+2	-2
Valentine, Nebr.	+1.1	-6	0	+1	-10	-16	-6	-2	-5	+3	-2	-7
Huron, S. Dak.	-2.6	-8	-4	-2	-9	-12	-5	-3	-2	+2	-3	-7
Extreme Northwest:												
Moorhead, Minn.	+5.4	-3	+1	-4	-8	-7	-4	-3	-2	+6	-2	-7
Bismarck, N. Dak.	+2.5	-6	-1	-7	-14	-11	-5	-2	-7	-1	-3	-10
Fort Buford, N. Dak.	+4.1	-4	0	-9	-15	-10	-2	+1	-7	-2	-2	-11
Rocky Mountain Slope:												
Havre, Mont.	+6.9	-2	-5	-11	-10	-9	0	+4	-5	-5	0	-5
Cheyenne, Wyo.	-0.1	-2	-9	0	-5	-12	-4	+2	-6	-1	-1	-2
North Platte, Nebr.	-1.7	-6	-8	0	-5	-13	-3	-1	-7	+2	-2	-5
Denver, Colo.	-1.5	0	-10	+1	-1	-12	-5	+1	-6	-2	-2	+1
Dodge City, Kans.	0.0	-4	-5	0	0	-11	-5	-4	-6	+5	-1	0
Pacific Coast:												
Olympia, Wash.	+2.0	-2	-1	-3	-1	-1	+2	+5	-4	-2	+1	+5
Portland, Oregon	+1.3	-3	-3	-6	-3	-3	+2	+4	-5	-5	0	+5
Roseburg, Oregon	+1.2	-4	-3	-5	-5	-4	+5	+5	-4	-6	+1	+3
Red Bluff, Cal.	+1.5	-4	-6	-9	-14	-10	0	+6	+1	-11	+1	+1
Sacramento, Cal.	+1.1	-3	-4	-6	-9	-7	+2	+2	+4	-8	+1	0
San Francisco, Cal.	+0.5	-3	-2	-5	-4	-3	+7	-1	-1	-5	-4	-1
Los Angeles, Cal.	+0.4	+2	-3	-3	-7	-5	+0	-1	0	-7	-7	-6
San Diego, Cal.	0.0	+1	-3	-2	-3	-3	+3	0	0	-4	-4	-4

* The departures in the column for June 6 are for ten days, due to change of day of issue of Bulletin from Saturday to Tuesday.

Stations.	For the weeks ending—													
	July				August					September				Octo-ber.
	4.	11.	18.	25.	1.	8.	15.	22.	29.	5.	12.	19.	26.	3.
New England:														
Eastport, Me.	-1	+2	+1	+2	+3	0	0	+5	0	+1	0	+4	+3	-2
Portland, Me.	-2	+3	+2	+1	+4	+2	+4	+4	-3	-2	-2	+4	+5	-1
Boston, Mass.	-2	+4	+2	+5	+4	+1	+6	+4	-2	-3	-5	+4	+4	-1
Middle Atlantic States:														
Albany, N. Y.	-3	-5	-1	+2	+5	+1	+3	+2	-1	-2	-3	+1	+2	-2
New York, N. Y.	-1	-3	0	+2	+6	+1	+4	+5	-2	-2	-3	+2	+2	0
Philadelphia, Pa.	-3	-4	+1	+2	+6	+1	+4	+3	+1	-3	-3	0	+4	-2
Washington, D. C.	-2	-7	-6	0	+7	+1	+4	+3	+3	-2	-4	-1	+3	-2
Lynchburg, Va.	-6	-11	-2	+3	+7	+2	+3	+3	+3	-1	-2	+3	+1	-2
Norfolk, Va.	-3	-10	-6	0	+7	+3	+4	+3	+3	0	-2	0	+3	-2
South Atlantic States:														
Charlotte, N. C.	-5	-14	-3	+2	+4	0	0	+1	+3	0	-2	-2	+3	-2
Wilmington, N. C.	-3	-9	-3	0	+4	+2	+3	0	+2	-1	-3	0	+4	-2
Charleston, S. C.	-4	-8	-3	0	+3	+1	+2	0	+1	+1	-2	-1	+1	-1
Augusta, Ga.	-3	-10	-4	-1	+3	+1	+1	-2	+1	-2	-3	+5	+1	-2
Savannah, Ga.	-4	-7	-3	-2	+2	-1	+1	0	+4	0	-2	0	+2	-1
Jacksonville, Fla.	-4	-3	-1	-1	+2	-2	0	-1	+1	0	-2	-1	+1	-1
Gulf States:														
Atlanta, Ga.	-4	-12	-4	0	+4	+1	+1	-3	+1	-1	-1	-5	+4	+1
Mobile, Ala.	-1	-6	-3	-2	+1	-2	-1	-2	+2	-1	-1	-3	+1	+1
Montgomery, Ala.	-1	-6	-4	0	0	-1	0	-2	+2	0	-2	-5	+2	-1
Vicksburg, Miss.	-3	-7	-5	-1	-3	+1	-2	-1	+1	-4	-3	-6	+3	+1
New Orleans, La.	0	-8	-2	0	-1	-1	0	0	+2	0	-3	-4	+2	-1
Shreveport, La.	-3	-6	-2	-1	-2	-1	-4	-2	+1	-5	-3	-7	+2	+1
Fort Smith, Ark.	-3	-6	0	-3	0	+3	0	+1	-1	-5	-4	-3	+5	+3
Little Rock, Ark.	-3	-8	-2	+2	-1	+1	-2	0	-2	-5	-4	-4	+4	+1
Galveston, Tex.	-2	-6	-3	+1	-1	-2	-1	0	+3	+1	-1	-3	+8	+1
San Antonio, Tex.	+3	-2	+1	+1	+1	-4	-2	-2	+2	+1	-2	-2	+4	+5
Ohio Valley and Tennessee:														
Memphis, Tenn.	-4	-9	-3	+3	0	+2	-2	+1	+1	-3	-2	-3	+6	+1
Nashville, Tenn.	-1	-8	-3	+2	+2	-1	0	0	+1	-2	-1	-4	+5	+1
Chattanooga, Tenn.	-2	-9	+1	+2	+4	-1	+1	-3	+1	-2	-1	-4	+3	-1

TABLE I.—Temperature departures for the season of 1892 from the normal of many years—Continued.

Stations.	For the weeks ending—													
	July				August				September				October	
	4.	11.	18.	25.	1.	8.	15.	22.	29.	5.	12.	19.	26.	3.
Ohio Valley and Tennessee—Cont'd.														
Louisville, Ky.	-8	-8	-4	+5	+2	+1	+1	+2	+2	-3	+1	-4	+4	+2
Indianapolis, Ind.	-7	-5	-4	+6	+4	+1	+2	+4	+3	+2	+2	+9	+6	
Cincinnati, Ohio.	-7	-5	-5	+4	+4	+1	0	+2	+1	-3	-1	+5	+2	
Columbus, Ohio.	-7	0	-6	+3	+5	0	+1	+3	+3	+2	+1	+6	+3	
Pittsburg, Pa.	-7	0	-5	+2	+5	0	+2	+3	+2	-3	-1	+5	+1	
Lake Region:														
Oswego, N. Y.	-5	-4	-3	+2	+5	+1	+3	+3	0	-1	-2	+0	-1	
Buffalo, N. Y.	-5	0	-2	+3	+6	+2	+3	+3	+2	0	0	+0	0	
Cleveland, Ohio.	-0	-3	-5	+4	+6	+1	+5	+3	+2	-1	+1	+6	+2	
Detroit, Mich.	-7	-2	-3	+0	+4	+1	+4	+2	+2	-1	0	+6	+2	
Alpena, Mich.	-3	0	0	+6	+2	+2	+5	+3	+2	0	0	+6	+5	
Grand Haven, Mich.	-8	-1	-4	+4	+4	+1	+8	+4	+4	-4	0	+7	+6	
Milwaukee, Wis.	-4	-3	-1	+9	+2	+3	+3	-1	+1	+7	-2	+7	+6	
Chicago, Ill.	-8	-4	-3	+8	0	-1	+2	0	0	-7	-3	+6	+6	
Duluth, Minn.	-1	+3	-1	+6	+3	+5	+4	+3	+7	-2	-2	+7	+13	
Upper Mississippi Valley:														
St. Paul, Minn.	-0	0	-2	+6	-2	+3	+2	0	+2	-4	-2	+10	+12	
Lacrosse, Wis.	-8	-2	-3	+5	0	+3	+4	+3	+2	-3	-2	+9	+10	
Davenport, Iowa.	-7	-4	-5	+5	+2	+4	+4	+2	+1	-5	-2	+0	+10	
Des Moines, Iowa.	-7	-4	-2	+6	-1	+3	+2	-2	-1	-3	-2	+11	+12	
Springfield, Ill.	-7	-9	-5	+4	+1	+3	+2	+1	+2	-5	-2	+8	+7	
Cairo, Ill.	-4	-8	-4	+3	+1	+1	0	0	-4	-1	-3	+7	+4	
St. Louis, Mo.	-8	-7	-5	+4	0	+4	+1	+2	+1	-4	-2	+9	+11	
Missouri Valley:														
Springfield, Mo.	-6	-7	-4	+4	-2	+4	0	+1	-1	-5	-3	+9	+6	
Kansas City, Mo.	-6	-6	-5	+6	-2	+7	+2	+1	-1	-3	-1	+10	+9	
Concordia, Kans.	-3	-7	0	+10	-2	+9	+3	-1	-2	-2	-1	+11	+12	
Omaha, Nebr.	-5	-4	-1	+8	-3	+7	+2	-1	-2	-2	0	+12	+13	
Valentine, Nebr.	-4	0	-2	+6	-1	+8	+8	0	-2	-1	-1	+3	+8	
Huron, S. Dak.	-8	0	-3	+2	-7	+3	+4	0	-2	-2	-2	+11	+15	
Extreme Northwest:														
Moorhead, Minn.	-5	+5	+1	+4	-2	+5	+5	+2	+3	-1	0	+12	+15	
Bismarck, N. Dak.	-6	+2	-1	+1	-8	+1	+6	-1	-2	-1	-5	+3	+9	
Fort Buford, N. Dak.	-4	+4	+1	+1	-7	+1	+4	-4	-2	-1	-1	+6	+13	
Rocky Mountain Slope:														
Havre, Mont.	+2	+1	-1	0	-8	-1	+1	-5	-1	-2	+1	+7	+5	
Cheyenne, Wyo.	-2	-2	-2	+5	-4	+5	+4	-2	-3	+1	+2	+7	+8	
North Platte, Nebr.	-5	-4	-2	+6	-3	+4	+4	-1	-2	-3	+2	+7	+11	
Denver, Colo.	0	-1	-1	+4	-6	+5	+5	0	-2	+1	-2	+5	+7	
Dodge City, Kans.	-3	-7	0	+6	-3	+7	+2	-1	-3	-4	-2	+1	+9	
Pacific Coast:														
Olympia, Wash.	+3	-3	-2	-3	+3	+2	+1	+3	+1	-1	+5	+1	+7	
Portland, Oregon.	+3	-4	-4	-7	+1	0	0	+4	+1	-3	-8	-2	+6	
Roseburg, Oregon.	+2	-2	-4	-4	0	-3	0	+1	0	-3	+6	0	+8	
Red Bluff, Cal.	+4	-2	-4	-1	-4	-3	-7	+5	+2	+4	+4	-1	+3	
Sacramento, Cal.	+4	-3	-3	-1	-2	+1	-3	+4	-2	-4	0	-5	+2	
San Francisco, Cal.	+1	-3	-3	-2	-4	-2	+1	+2	-4	-2	+3	-2	0	
Los Angeles, Cal.	0	-2	-5	-4	-3	-4	-4	+2	-3	-5	-3	-2	+3	
San Diego, Cal.	-3	-1	-4	-3	-3	-2	-4	0	-1	-3	-2	-4	0	

TABLE II.—Precipitation departures for the season of 1892 from the normal of many years.

Stations.	From Jan. 1 to Apr. 8.	For the weeks ending—												
		April			* May				June					
		15.	22.	29.	6.	13.	20.	27.	6.*	13.	20.	27.		
New England:														
Eastport, Me.	-2.03	-.33	-.54	-.02	-.73	-.80	-.83	+ .24	-.50	-.45	+ .87	-.26		
Portland, Me.	-2.81	-.41	-.87	-.28	-.40	+ .15	+ .26	+1.34	-.68	-.85	+ .84	+1.73		
Boston, Mass.	-2.03	-.89	-.38	-.48	+ .05	-.22	+ .94	+1.18	-.82	-.46	+ .08	+ .49		
Middle Atlantic States:														
Albany, N. Y.	-1.27	-.50	-.23	-.83	+ .94	-.25	+ .44	+1.10	-.09	-.84	-.76	+ .13		
New York, N. Y.	-1.35	+ .33	+ .18	-.48	-.31	+ .14	+ .54	+1.08	-.60	+ .12	-.16	-.01		
Philadelphia, Pa.	-.84	+ .16	+ .84	-.16	+ .27	-.60	+1.22	-.98	-.70	-.58	-.77	-.09		
Washington, D. C.	+ 3.40	+ .27	+1.93	-.05	-.72	-.27	+ .17	+1.44	-1.34	-.78	-.78	+ .31		
Lynchburg, Va.	+ .70	+ .17	+1.88	-.47	-.40	+ .24	-.79	-.37	+ .59	+ .15	-.42	-.38		
Norfolk, Va.	+ 2.28	-.00	+1.84	+1.87	-.91	+ .00	-.07	+1.45	-1.10	+ .95	-.36	-.35		

* The departures in the column for June 6 are for ten days, due to change of day of issue of Bulletin from Saturday to Tuesday.

TABLE II.—Precipitation departures for the season of 1892 from the normal of many years—Continued.

Stations.	From Jan. 1 to Apr. 8.	For the weeks ending—											
		April			May				June				
		15.	22.	29.	6.	13.	20.	27.	6.*	13.	20.	27.	
South Atlantic States:													
Charlotte, N. C.	+ .95	-.60	+ .58	-.53	-.80	-.16	-.52	-.74	+ .60	-.74	+ 1.05	+ .16	
Wilmington, N. C.	-.88	-.38	-.42	-.55	-.78	-.52	-.93	-.76	+.84	-.70	-.83	+.45	
Charleston, S. C.	4.38	-.72	-.04	-.83	-.08	+ .34	-.55	-.34	+ 1.95	+ .48	+ .61	+ .41	
Augusta, Ga.	+ 1.85	-.41	-.88	-.80	-.72	+ 1.04	-.64	-.04	+ .41	-.03	-.58	+ .29	
Savannah, Ga.	3.51	-.84	-.88	-.77	-.87	+ 1.11	-.40	-.29	+ .23	+ .01	-.75	-.90	
Jacksonville, Fla.	5.22	-.08	-.74	-.77	-.83	-.34	-1.00	-.06	+ .59	-.71	-.56	+ 1.17	
Gulf States:													
Atlanta, Ga.	+ 3.61	-.73	-.72	-.70	-.84	-.43	-.23	-.70	+ 1.32	-.20	-.67	-.21	
Mobile, Ala.	+ 2.26	-1.13	+ .24	00	-.96	-.58	-.38	-1.10	-1.19	-1.11	-.47	-1.13	
Montgomery, Ala.	+ 14.87	-1.05	-1.21	-.56	-.97	+ .18	-.39	-.60	+ .10	-.77	-.94	+ .70	
Vicksburg, Miss.	1.41	-1.17	-.77	+ 1.38	-1.25	-.95	-.87	-1.08	+ .04	-.70	+ .74	-.83	
New Orleans, La.	8.11	-1.26	+ 6.51	-1.28	-.90	+ .41	-.33	-1.28	-1.44	-.07	+ .89	-1.35	
Shreveport, La.	3.14	+ .23	+ 1.65	-.51	-1.11	-.22	+ .11	-.89	-.52	-.87	+ .40	+ 1.63	
Fort Smith, Ark.	1.32	-1.26	-.72	-1.31	-.98	+ 1.34	+ 5.20	+ .02	+ 1.21	-1.04	+ 1.58	-.94	
Little Rock, Ark.	4.32	-.95	+ 2.74	-.96	-.99	+ .94	+ 3.36	-1.05	+ 1.99	-.64	-.81	-.48	
Galveston, Tex.	5.81	-.70	-.69	+ .11	-.84	-.78	-.81	-1.03	-1.22	-1.19	+ .70	+ .78	
San Antonio, Tex.	2.91	-.81	-.81	-.61	-.77	-.71	-.03	-.71	-.07	-.63	-.60	+ 2.89	
Ohio Valley and Tennessee:													
Memphis, Tenn.	- 5.49	+ .01	+ 2.23	-.88	-.93	+ 2.93	+ .76	+ .02	+ 2.64	-.04	-.54	-1.01	
Nashville, Tenn.	- 4.54	-.93	+ 1.95	-.10	-.77	+ .89	+ 1.13	-.67	+ 2.37	-.75	-.02	-.27	
Chattanooga, Tenn.	-.76	-.18	+ .25	-.35	-.98	-.38	+ .76	-.28	+ 1.25	-.93	+ .91	+ 2.61	
Louisville, Ky.	4.52	-.79	+ 4.01	-.18	-.14	+ .15	+ 1.05	-.31	+ .59	-.82	-.23	-.00	
Indianapolis, Ind.	1.81	-.38	+ .76	+ .05	+ .32	+ .60	+ 1.40	-.30	+ 2.92	-.42	+ .01	-.81	
Cincinnati, Ohio.	3.71	-.38	+ 2.54	-.27	-.13	+ .42	+ 1.00	-.64	-.81	-.15	+ .17	-.06	
Columbus, Ohio.	1.71	-.21	-.17	-.78	-.55	-.83	+ 1.28	-.66	-.55	-.44	+ 1.79	+ .04	
Pittsburg, Pa.	-.56	+ .09	-.25	-.50	+ .71	-.34	+ .29	-.02	+ .17	+ .11	+ .07	-.28	
Lake Region:													
Oswego, N. Y.	- 2.53	-.25	-1.19	-.45	+ .95	-.26	+ .20	+ .77	+ 1.02	-.87	-.71	+ 2.29	
Buffalo, N. Y.	+ 1.55	-.40	-.30	-.62	+ 1.99	-.13	+ .28	+ 2.20	+ .53	+ 1.87	-.82	+ 2.27	
Cleveland, Ohio.	+ .78	-.25	-.19	-.23	+ 2.98	+ .20	+ .20	+ .36	+ .50	+ .04	+ .14	+ .42	
Detroit, Mich.	10	-.40	-.22	-.30	+ 3.13	+.38	+.98	+ .21	+ 3.46	+.08	+ .82	+ .14	
Alpena, Mich.	- 1.96	-.55	-.16	-.49	+ .55	+ .10	-.60	-.28	+ .56	-.80	+ 1.87	+ 1.54	
Grand Haven, Mich.	+ 1.85	-.55	-.31	+ .14	+ 1.35	+ .40	-.46	-.70	+ 1.33	-.24	+ 1.27	-.04	
Milwaukee, Wis.	-.53	-.19	-.25	-.16	+ 3.43	+ .78	+ .52	-.77	+ .81	+ .94	+ .84	+ .95	
Chicago, Ill.	- 1.08	-.41	-1.09	-.57	-.71	+ 2.70	-.15	-.08	-.28	+ .10	+ .37	+ 3.02	+ 4.35
Duluth, Minn.	+ 1.53	-.29	-.59	+ 1.06	+ .96	-.11	+ 2.33	-.58	+ .45	+ 1.13	+ .46	-.81	
Upper Mississippi Valley:													
St. Paul, Minn.	- .89	-.51	-.57	-.46	+ .24	+ .06	+ 2.07	-.69	+ .17	+ 1.28	+ 1.86	+ .09	
Lacrosse, Wis.	+ .61	-.17	+ .98	-.26	+ 1.54	+ .96	+ 3.00	-.67	+ .37	+ .14	+ 1.11	+ 2.77	
Davenport, Iowa.	+ 2.92	-.17	-.18	-.09	+ 4.31	+.05	+ .16	-.76	+ 1.21	+ 1.80	+ .36	+ 4.75	
Des Moines, Iowa.	+ 2.42	+ .63	-.06	-.79	+ 1.90	+ .67	+ 1.90	-1.16	+ .56	-.56	-.58	-.59	
Springfield, Ill.	+ 1.56	-.20	+ 1.20	+ .15	+ 2.03	-.12	+ .72	-.74	-.33	+ 1.15	+ .25	-1.08	
Carlo, Ill.	4.70	-.11	+ 1.09	-.57	-.83	+ 1.01	+ 1.84	-.81	+ .43	-1.00	-.58	-.20	
St. Louis, Mo.	+ 2.24	+ .04	+ 1.79	+ .05	-.23	+ 1.26	+ 1.50	-.91	+ 1.02	-.82	+ .30	-.77	
Missouri Valley:													
Springfield, Mo.	+ 1.48	+ .51	-.06	-.23	+ .50	+ .83	+ .75	-1.40	+ 3.23	-.60	-1.14	+ .80	
Kansas City, Mo.	+ 6.04	+ .45	+ 1.42	-.63	+ 1.34	+ 2.46	-.37	-.97	+ 2.25	-1.14	-1.18	-.58	
Concordia, Kans.	+ 2.41	-.35	-.24	-.59	+ .20	+ 1.96	+ 1.65	-.77	+ 1.46	-.96	-.08	-.80	
Omaha, Nebr.	+ 2.11	+ .86	+ .10	-.45	+ .51	+ 1.55	+ 2.61	-.80	-1.16	-.08	-1.38	-.88	
Valentine, Nebr.	+ 2.93	+ .94	+ .69	+ 1.14	+ .04	+ 1.87	-.25	-.77	-.20	-.42	+ 2.00	-.26	
Huron, S. Dak.	+ 2.61	+ 2.05	-.46	-.18	+ .04	+ 1.26	+ 2.02	-.71	-.32	-.84	+ .16	+ .50	
Extreme Northwest:													
Moorhead, Minn.	+ 1.51	-.06	-.49	+ .97	+ .14	-.20	+ 2.48	-.24	-.53	-.84	-.58	-.21	
Bismarck, N. Dak.	+ .10	-.31	-.56	+ 1.30	+ .42	+ .17	-.54	-.53	-.16	+ .71	-.70	-.10	
Fort Buford, N. Dak.	- .68	-.19	-.21	+ 2.04	-.10	-.14	-.37	-.48	+ .69	+ 1.06	-.84	-.45	
Rocky Mountain Slope:													
Havre, Mont.	- 1.59	+ .08	-.08	+ .04	+ .30	+ .10	-.28	-.25	-.54	+ 2.55	-.69	-.41	
Cheyenne, Wyo.	+ 1.40	-.26	+ .67	-.38	-.02	+ 1.66	-.07	-.42	+ 1.16	-.39	-.02	-.03	
North Platte, Nebr.	+ 1.41	+ .55	+ 1.56	-.19	-.20	+ 1.17	-.32	-.59	-.03	-.77	-.31	-.65	
Denver, Colo.	-.01	-.89	+ 1.10	-.56	-.57	+ .37	-.38	-.51	+ .97	-.81	-.06	-.12	
Dodge City, Kans.	+ 1.97	-.26	-.34	-.51	-.52	+ .49	+ .05	-.60	-1.08	-.77	+ 2.21	-.75	
Pacific Coast:													
Olympia, Wash.	- 11.70	+ .84	-.54	-.87	-.12	+ .39	-.04	-.43	+ .59	-.29	-.10	-.31	
Portland, Oregon.	- 10.11	+ .27	-.21	+ 1.31	-.45	+ .38	-.08	-.50	-.31	+ .28	-.29	-.24	
Roseburg, Oregon.	5.41	-.42	+ .09	+ .18	+ .51	+ .58	-.19	-.35	-.41	+ .26	-.28	-.28	
Red Bluff, Cal.	1.06	-.20	+ .19	+ .06	+ .96	-.14	+ 1.84	-.21	-.22	+ .12	-.14	-.09	
Sacramento, Cal.	3.09	-.51	-.06	-.42	+ .59	+ .04	+ 1.02	-.11	-.10	-.07	-.07	-.00	
San Francisco, Cal.	4.34	-.30	-.05	-.05	+ .44	+ .06	+ 1.01	-.12	-.10	-.07	-.07	-.07	
Los Angeles, Cal.	2.19	-.48	-.41	-.28	+ 1.89	-.08	-.07	-.07	-.08	-.06	-.00	+ .06	
San Diego, Cal.	-.19	-.21	-.21	-.19	+ .93	-.07	-.07	-.00	-.08	+ .13	-.00	-.00	

* The departures in the column for June 6 are for ten days, due to change of day of issue of Bulletin from Saturday to Tuesday.

TABLE II.—Precipitation departures for the season of 1892 from the normal of many years—Continued.

Stations.	For the weeks ending—								
	July				August				
	4.	11.	18.	25.	1.	8.	15.	22.	29.
New England:									
Eastport, Me.....	+ .43	+ .98	— .94	— .83	— .82	+ .05	+1.31	— .69	+ .88
Portland, Me.....	+1.07	— .77	— .58	— .80	+ .09	+ .26	+1.94	— .81	+3.37
Boston, Mass.....	+ .36	— .72	— .52	— .51	+ .26	— .50	+1.24	—1.05	+ .87
Middle Atlantic States:									
Albany, N. Y.....	+2.44	— .16	— .65	— .47	+ .81	+ .22	+1.26	— .70	+2.38
New York, N. Y.....	+ .06	— .47	—1.05	— .54	— .95	+ .38	+1.01	—1.05	— .12
Philadelphia, Pa.....	+1.93	— .96	— .72	— .97	— .58	— .05	— .60	—1.00	+ .65
Washington, D. C.....	+ .07	— .86	+ .47	+ .20	+ .52	— .20	—1.00	— .08	— .92
Lynchburg, Va.....	+1.10	— .08	— .34	+ .53	+1.00	— .80	— .57	— .88	— .55
Norfolk, Va.....	+3.79	+ .32	+1.15	—1.04	— .40	— .91	—1.47	—1.12	— .94
South Atlantic States:									
Charlotte, N. C.....	— .80	+2.22	— .30	—1.40	— .05	— .55	—1.26	—1.22	— .49
Wilmington, N. C.....	+4.60	— .12	+2.14	+ .81	—1.58	—1.24	—1.60	—1.72	— .04
Charleston, S. C.....	+2.87	+3.21	+1.62	—1.10	—1.75	—1.24	—1.22	—1.60	+2.23
Augusta, Ga.....	+ .36	+1.93	— .32	—1.18	—1.12	— .69	— .49	— .97	— .60
Savannah, Ga.....	+1.11	— .29	+1.78	+ .90	—1.28	— .51	+ .09	—1.71	—1.30
Jacksonville, Fla.....	— .46	— .21	—1.45	+ .07	—1.35	— .56	— .80	— .78	— .20
Gulf States:									
Atlanta, Ga.....	— .71	+1.68	+ .01	— .77	— .20	— .22	— .99	+ .58	+2.39
Mobile, Ala.....	—1.16	+4.98	— .34	+1.90	+1.01	+ .41	+1.32	+2.79	+1.94
Montgomery, Ala.....	— .60	+6.19	— .12	+ .29	— .70	+ .27	+ .46	+3.83	+ .26
Vicksburg, Miss.....	— .69	+1.70	+3.83	— .13	+ .18	+ .75	+ .20	+ .80	+ .27
New Orleans, La.....	— .84	+3.61	—1.20	— .05	— .81	+ .27	+ .93	+1.94	—1.24
Shreveport, La.....	+ .09	— .46	— .64	— .79	— .30	+ .31	+ .96	+ .07	+ .11
Fort Smith, Ark.....	+1.06	— .69	— .30	— .84	+ .47	— .91	+ .39	— .84	+1.07
Little Rock, Ark.....	— .80	+1.20	+ .02	— .73	— .50	— .89	— .28	— .26	+4.42
Galveston, Tex.....	— .60	+ .21	— .35	— .58	— .57	— .44	+3.28	—1.17	—1.45
San Antonio, Tex.....	— .63	— .58	— .63	— .63	+ .84	+1.80	+1.23	— .78	— .66
Ohio Valley and Tennessee:									
Memphis, Tenn.....	+ .91	+4.82	— .31	— .02	— .31	— .91	+ .83	— .55	+ .19
Nashville, Tenn.....	— .04	+1.14	+ .77	— .53	+ .22	— .86	— .04	— .65	+ .49
Chattanooga, Tenn.....	— .36	+2.26	— .62	+1.17	— .56	— .70	+ .00	+1.09	+ .99
Louisville, Ky.....	+1.54	— .88	+ .05	— .69	— .39	— .59	— .56	+ .34	+ .74
Indianapolis, Ind.....	— .18	—1.06	— .82	— .67	+ .30	— .35	— .71	— .39	— .40
Cincinnati, Ohio.....	+ .07	— .70	— .20	— .52	— .66	— .92	+ .07	— .06	+ .22
Columbus, Ohio.....	+1.25	— .81	— .58	+ .12	+1.99	+ .85	+ .64	— .08	— .62
Pittsburg, Pa.....	+1.77	—1.16	— .74	— .10	+1.85	— .16	— .42	— .75	— .15
Lake Region:									
Oswego, N. Y.....	+2.14	— .07	— .20	— .47	+ .25	+ .80	+1.18	— .54	+ .40
Buffalo, N. Y.....	+2.54	— .76	+ .10	— .86	— .70	+ .23	— .15	+ .24	+1.20
Cleveland, Ohio.....	+ .37	— .91	— .66	+ .41	+ .16	— .18	— .58	+ .71	+ .06
Detroit, Mich.....	+ .87	— .82	— .62	— .77	+ .33	— .37	— .70	+ .75	— .16
Alpena, Mich.....	— .56	— .69	+ .92	+ .10	+ .60	— .50	+1.31	— .77	+ .13
Grand Haven, Mich.....	+ .03	— .72	— .56	— .50	+ .32	— .59	— .48	— .67	+ .17
Milwaukee, Wis.....	— .02	— .77	— .77	— .73	— .05	— .64	— .44	— .23	+1.93
Chicago, Ill.....	+ .73	— .89	— .76	— .82	+ .02	— .39	— .51	— .50	— .02
Duluth, Minn.....	— .92	— .91	+ .11	+ .17	— .77	— .00	— .77	+ .34	— .45
Upper Mississippi Valley:									
St. Paul, Minn.....	+ .57	— .77	+1.13	— .64	+5.07	+ .81	— .82	— .77	+ .38
Lacrosse, Wis.....	— .28	—1.01	— .41	— .77	+1.68	+ .44	— .26	— .63	+ .17
Davenport, Iowa.....	+1.09	— .85	+ .10	— .16	— .22	— .91	— .49	— .83	+ .38
Des Moines, Iowa.....	+1.15	+ .82	+ .60	+ .72	+1.56	— .77	— .04	— .74	+ .87
Springfield, Ill.....	+2.40	— .37	+1.04	— .14	+ .93	— .22	— .38	— .50	+ .47
Caro, Ill.....	— .53	+ .23	— .78	— .69	+ .16	— .27	+2.78	— .58	— .13
St. Louis, Mo.....	+ .98	+ .35	+ .95	— .38	— .53	+ .39	— .00	— .56	— .85
Missouri Valley:									
Springfield, Mo.....	+ .53	+ .07	+1.37	— .99	+ .25	—1.05	+ .05	— .50	— .87
Kansas City, Mo.....	+ .37	— .44	+1.84	— .83	— .58	— .98	+ .56	— .65	— .24
Concordia, Kans.....	+ .46	— .70	+ .82	— .80	— .29	— .91	— .27	+ .15	+ .69
Omaha, Nebr.....	— .19	—1.34	—1.01	— .45	+ .61	— .77	— .38	+ .01	+ .56
Valentine, Nebr.....	— .33	+ .38	— .70	— .68	— .31	— .38	+2.83	+ .42	+ .68
Huron, S. Dak.....	— .45	— .91	— .63	— .08	— .76	— .65	— .23	+ .23	— .09
Extreme Northwest:									
Moorhead, Minn.....	— .01	—1.07	+3.19	— .31	— .66	— .44	+ .98	— .14	+1.07
Bismarck, N. Dak.....	— .44	+ .63	+1.22	— .53	— .42	— .54	— .20	— .11	+1.21
Fort Buford, N. Dak.....	— .04	— .45	— .32	+3.21	— .27	— .85	— .09	— .26	+ .13
Rocky Mountain Slope:									
Havre, Mont.....	— .65	+ .04	+ .02	— .45	— .24	— .41	— .35	+ .55	— .16
Cheyenne, Wyo.....	— .28	— .86	— .26	— .35	+ .19	— .22	— .23	— .15	— .22
North Platte, Nebr.....	— .70	— .57	— .53	— .35	+2.51	— .27	— .26	— .18	+1.48
Denver, Colo.....	— .26	+ .02	— .27	— .31	+ .14	— .18	— .35	— .31	+ .02
Dodge City, Kans.....	— .52	— .59	— .25	— .72	— .73	— .80	+ .37	+ .37	+1.96

TABLE II.—Precipitation departures for the season of 1892 from the normal of many years—Continued.

Stations.	For the weeks ending—								
	July				August				
	4.	11.	18.	25.	1.	8.	15.	22.	29.
Pacific Coast:									
Olympia, Wash.....	-.28	+.05	+.35	-.06	-.14	-.14	+.54	-.14	-.20
Portland, Oregon.....	-.23	-.02	+.43	-.13	-.14	-.14	+.03	-.14	-.14
Roseburg, Oregon.....	-.24	-.17	+.34	-.07	-.07	-.07	-.05	-.05	-.07
Red Bluff, Cal.....	-.05	.00	.00	.00	.00	.00	.00	.00	.00
Sacramento, Cal.....	.00	.00	.00	.00	.00	.00	.00	.00	.00
San Francisco, Cal.....	.00	.00	.00	.00	-.03	.00	.00	.00	.00
Los Angeles, Cal.....	.00	.00	.00	.00	-.04	-.04	.00	.00	.00
San Diego, Cal.....	.00	.00	.00	.00	-.01	-.03	-.06	.00	.00

Stations.	For the weeks ending—				
	September				October
	5.	12.	19.	26.	3.
New England:					
Eastport, Me.....	-.27	-.77	-.48	-.49	-.94
Portland, Me.....	-.75	-.17	+.98	-.13	-.72
Boston, Mass.....	-.58	-.69	+.59	-.22	-.83
Middle Atlantic States:					
Albany, N. Y.....	-.71	-.04	-.23	-.21	-.83
New York, N. Y.....	-.86	-.84	-.28	-.77	-.81
Philadelphia, Pa.....	-.93	-.58	+.29	-.06	-.84
Washington, D. C.....	-.98	-.83	+.33	+1.25	-.81
Lynchburg, Va.....	-.93	-.87	-.04	+.49	-.88
Norfolk, Va.....	+1.03	-1.21	-.73	-.26	-.96
South Atlantic States:					
Charlotte, N. C.....	-.83	-.74	-.07	+.79	-.87
Wilmington, N. C.....	+.62	-1.33	-.76	+2.91	-1.24
Charleston, S. C.....	-.63	+2.43	+1.82	+2.35	-1.24
Augusta, Ga.....	-.98	-.92	+.79	+2.82	-.75
Savannah, Ga.....	-.95	+2.76	+.54	+2.39	-.72
Jacksonville, Fla.....	-.15	+3.78	+1.55	-.06	+1.43
Gulf States:					
Atlanta, Ga.....	-1.10	-1.08	+1.50	-.92	-.76
Mobile, Ala.....	-.16	+.61	+.89	-.96	-.46
Montgomery, Ala.....	-.72	-.63	+1.76	-.69	-.67
Vicksburg, Miss.....	-.59	-.32	-.78	-.60	-.68
New Orleans, La.....	+.83	+1.23	-1.07	-.27	-.03
Shreveport, La.....	-.54	+.17	-1.12	-1.00	-.76
Fort Smith, Ark.....	-.14	+.46	-.77	-.70	-.62
Little Rock, Ark.....	-.87	+2.59	-.84	-.70	+.54
Galveston, Tex.....	-1.45	-1.66	-1.80	-1.35	-.86
San Antonio, Tex.....	+2.98	-.83	-1.01	-.89	-.09
Ohio Valley and Tennessee:					
Memphis, Tenn.....	-.36	-.78	-.49	-.62	-.74
Nashville, Tenn.....	+.05	+.04	+1.19	-.27	-.74
Chattanooga, Tenn.....	-.43	-.28	+1.42	+.53	-.82
Louisville, Ky.....	-.74	-.73	+1.61	-.53	-.83
Indianapolis, Ind.....	-.66	-.26	+1.17	-.51	-.70
Cincinnati, Ohio.....	+.05	-.60	+1.55	+.49	-.52
Columbus, Ohio.....	-.20	-.62	+.03	-.16	-.69
Pittsburg, Pa.....	+.57	-.19	-.27	+.04	-.52
Lake Region:					
Oswego, N. Y.....	-.17	-.50	-.24	+.07	-.45
Buffalo, N. Y.....	-.38	-.48	+.40	-.34	-.83
Cleveland, Ohio.....	.00	-.26	-.27	-.45	-.65
Detroit, Mich.....	-.20	-.37	+2.19	-.41	-.56
Alpena, Mich.....	-.36	-.72	+1.08	-.65	-.88
Grand Haven, Mich.....	-.73	+.34	-.50	-.74	-.63
Milwaukee, Wis.....	-.49	+1.51	-.70	-.70	+.25
Chicago, Ill.....	-.26	+.52	-.68	-.60	-.69
Duluth, Minn.....	+1.10	-.83	-1.00	-.94	-.98
Upper Mississippi Valley:					
St. Paul, Minn.....	-.37	+.95	-.77	-.72	+.49
Lacrosse, Wis.....	-1.08	+1.85	-1.13	-.98	-.72
Davenport, Iowa.....	-.77	+1.31	-.77	-.76	-.70
Des Moines, Iowa.....	-.68	+.08	-.84	-.77	-.77
Springfield, Ill.....	+.25	+2.07	-.82	-.84	-.84
Cairo, Ill.....	-.57	-.63	+.22	-.50	-.56
St. Louis, Mo.....	-.10	+.07	-.80	-.73	-.66

TABLE II.—Precipitation departures for the season of 1892 from the normal of many years—Continued.

Stations.	For the weeks ending—				
	September				October
	5.	12.	10.	20.	3.
Missouri Valley:					
Springfield, Mo.....	-.42	-.34	-.83	-.77	-.64
Kansas City, Mo.....	+.94	+.39	-1.05	-.98	-.92
Concordia, Kans.....	-.33	-.40	-.56	-.56	-.51
Omaha, Nebr.....	-.01	-.20	-.77	-.71	-.41
Valentine, Nebr.....	-.24	-.04	-.35	-.25	-.35
Huron, S. Dak.....	-.32	+.10	-.35	-.35	-.35
Extreme Northwest:					
Moorhead, Minn.....	-.49	-.34	-.56	-.56	-.50
Bismarck, N. Dak.....	-.31	+.33	-.21	-.24	-.28
Fort Buford, N. Dak.....	-.16	-.17	-.21	-.21	-.08
Rocky Mountain Slope:					
Havre, Mont.....	-.08	-.27	-.28	-.16	-.88
Cheyenne, Wyo.....	-.06	-.25	-.21	-.14	-.14
North Platte, Nebr.....	-.37	-.03	-.85	-.20	-.28
Denver, Colo.....	-.30	-.29	-.16	-.14	-.14
Dodge City, Kans.....	+.69	-.23	-.21	-.28	-.34
Pacific Coast:					
Olympia, Wash.....	-.35	-.41	+2.55	-.04
Portland, Oregon.....	-.21	-.34	-.37	+1.12	-.66
Roseburg, Oregon.....	-.08	-.14	-.32	+ .32	-.37
Red Bluff, Cal.....	-.11	-.14	+ .15	-.14	-.17
Sacramento, Cal.....	-.05	-.07	-.07	-.07	+ .08
San Francisco, Cal.....	-.00	-.02	-.07	-.07	-.08
Los Angeles, Cal.....	-.00	.00	.00	-.02	-.10
San Diego, Cal.....	.00	.00	.00	-.03	-.07

STATE WEATHER SERVICE DIVISION.

By H. H. C. DUNWOODY, Major, Signal Corps.

INTRODUCTION.

State weather service work, the general features of which have been fully outlined in previous similar reports, has been carried on to a much greater extent than heretofore, and the results accomplished during the year fully sustain the high standard of usefulness claimed for State weather service organizations. The entire territory of the United States, with the exception of Alaska, is now covered by local weather services, the last organized being that for Idaho, where energetic work is now being done toward perfecting the service in that State.

During the year Iowa, Maryland, New Jersey, and Ohio have by legislative enactments provided for the maintenance of their respective State weather services, and it is expected that the action of these States will be imitated by numerous others during the coming year. The work in New England was until March 22, 1892, conducted under the direction of the New England Meteorological Society, with central station at Cambridge, Mass., but on the date named a change was effected whereby the central station was transferred to Boston, and the title of the organization under which the work is now carried on is "The New England Weather Service." In Kansas, the director, owing to press of duties in connection with the Washburn College, in April, 1892, felt compelled to withdraw from the local service, much to the regret of the Chief of the Weather Bureau. The Kentucky service, until August, 1891, was operated under the auspices of the Polytechnic Society, Louisville, but in that month was placed under the direction of the Weather Bureau observer at Louisville. Until August, 1891, the Dakota weather

service covered the territory of both North and South Dakota. In the month named action was taken to form separate services, Bismarck being selected as the central station of the North Dakota service and Huron for South Dakota. In addition to the usual work of the California service there have been issued from Red Bluff, Fresno, and Los Angeles weekly weather crop bulletins devoted to their respective localities, and these local bulletins have met with much favor.

PUBLICATIONS.

The character of the publications issued by the local services has been so greatly improved that among the weekly and monthly reports now published may be found many possessing a high standard of excellence from both literary and typographical standpoints. Too much can not be said in praise of the valuable work of the directors of the several local organizations in the line of improving their publications. The regular monthly reports now contain tables of meteorological data and the several elements are generalized and discussed, and in many reports the graphic illustrations are of a highly creditable character. With access to these State reports it will be possible to determine the special features of the climate of every section of the United States, and it would be difficult to estimate the value of this one feature of State weather service work, affording as it does a means of supplying to immigrants, invalids, and meteorological students detailed information which it would not be possible to secure were it not for the existence of the extensive system of meteorological observations conducted by State weather services.

The Weather Crop Bulletin has been prepared as usual in the State Weather Service Division, and full description of the value of this important feature of Weather Bureau work will be found under the special heading "Weather Conditions of the Crop of 1892."

THUNDERSTORMS.

During the year special attention has been given to the collection of data relating to thunderstorms over the Northern and Central States from the Mississippi Valley eastward to the Atlantic coast, and at a number of designated centers special forecasts of the occurrence of thunderstorms have been issued, the object of this special thunderstorm work being to give information as to the prevalence of severe storms of this class at points from which reported, with forecasts of their occurrence in other localities in the direction of the storm's course. The work in this line during the summer of 1892 was of an experimental nature, but the results accomplished have been very satisfactory, and has demonstrated that in this direction there is opportunity for doing valuable and effective work.

VOLUNTARY STATIONS.

In April, 1892, the work pertaining to the selection and equipment of voluntary meteorological stations was transferred from the Records Division to the State Weather Service Division. During the year there have been nearly seven hundred new voluntary stations established.

MAP DISPLAYS AT U. S. CAPITOL.

The State Weather Service Division has also had charge of the display of weather maps, etc., at the United States Capitol, where large

weather symbol maps have been shown in the Senate and House lobbies. The interest in this work is constantly increasing.

IMPROVEMENT OF THE WEATHER SERVICE.

At the session of the National Grange, Patrons of Husbandry, held at Springfield, Ohio, November 11 to 19, 1891, the following resolution was introduced by Leonard Rhone, master of the Pennsylvania State Grange, and referred to the committee on agriculture:

Resolved, That the National Grange confer with the Secretary of Agriculture as to a more complete weather service by arranging with manufacturers for a system of signals by use of the steam whistles connected with their establishments, on the same principles as that of the Bell telephone of long and short rings.

And upon which resolution the committee reported as follows:

WORTHY MASTER:

Your committee on agriculture have duly considered the resolution asking for more complete weather signals for the benefit of agriculture, introduced by the master of Pennsylvania State Grange. We fully concur in its suggestions, believing that great benefit would be derived from the adoption of such a code of signals.

We report favorably and recommend the adoption of the foregoing resolution by this body.

W. C. GIFFORD,
S. H. ELLIS,
Mrs. PATIENCE HUNT,
Mrs. A. F. CLARDY,
Committee.

Acting upon the above resolution the Chief of the Weather Bureau on February 12, 1892, addressed the following letter to the masters of the various State granges:

DEAR SIR: After conference with Mr. Trimble, secretary, and Messrs. Rhone and Charters, of the executive committee, National Grange, Patrons of Husbandry, in regard to the resolution adopted by your order relative to the better dissemination of weather forecasts by whistles, I am pleased to inform you that the Weather Bureau will cordially cooperate with your order in placing the daily forecasts within reach of as many of your members as the limited appropriations of the Bureau will permit.

In order to place this information directly before the members of the grange, I would request your assistance by furnishing me with a list of the names and addresses of the secretaries of the live subordinate granges within your jurisdiction. Inclosed please find franked addressed envelope for forwarding the list so that it will safely reach me.

As part of the duties enjoined by the law transferring to the U. S. Department of Agriculture, the extending of the benefits of the service in the agricultural districts is one of the most important, and to this end the inclosed circular explaining the code adopted for the use of whistles was issued to cover the exact ground indicated by your resolution. It is the intention to forward a copy of this circular to each of your subordinate granges with a letter explaining the assistance required in selecting stations that will be most useful to their interests.

I would suggest that you address a letter to each of the granges informing them of the action taken by the Weather Bureau to comply with their requests as indicated by the resolution quoted.

As rapidly as the lists of addresses of the secretaries of the local granges, requested in the preceding letter, were received, the following letter was mailed to each:

DEAR SIR: I am instructed by the Chief of the Weather Bureau to communicate with you in reference to the display and use of weather forecasts and cold-wave signals within the limits of your grange jurisdiction, for the benefit of farmers of your section. This is done in order to carry out the expressed wishes of the National Grange, as will be seen noted upon the inclosed printed slip.

Your grange with your name is found upon the list furnished by your State officials as one recommended for carrying out the details of this work.

Will you kindly, at the earliest moment, bring the subject before a meeting of

your grange, discuss it thoroughly, and then forward the name of the member chosen to cooperate with us in carrying out the details of the work. Such person will be regularly appointed and full instructions furnished as to the duties required, which must be performed without compensation, except the benefits to be received by himself (or herself), in connection with the farmers of your locality, in being promptly warned of coming storms, cold waves, frosts, etc. A set of signal flags will be furnished as far as the limited appropriations will permit. If the whistles are used, there will be no expense, and in this connection some large mill or factory in your vicinity would be utilized.

The law transferring this Bureau from the War Department to the Department of Agriculture was urged and supported by your organization, and it is the earnest desire of the Secretary of Agriculture and the Chief of the Weather Bureau to make it of the greatest possible practical value to the agricultural interests of the whole country. The Chief of the Weather Bureau will, to the full extent of the limited appropriations for this service, cooperate with the farmers in this direction.

Permit me to urge early and prompt action in this matter, sending your reply in the inclosed franked envelope, which requires no postage.

Very respectfully,

N. B. CONGER,
Acting Chief of Division.

This letter was sent to the secretaries of more than 3,100 local granges throughout the country, and as a result there were established a large number of weather forecast signal stations.

ROUTINE WORK.

During the year in the routine work of the State Weather Service Division, there have been sent nearly 16,000 letters and more than 6,000 letters have been received, recorded, and acted on. The work of conducting this enormous correspondence, together with the preparation of the text and charts of the Weekly Weather Crop Bulletins, has been performed with the small force of seven clerks.

The following is a list of the several State weather services, with the names and addresses of the officials in charge:

State Weather Services.

[Persons marked thus * are employees of the Weather Bureau.]

State and central station.	Director.	Assistant director.
Alabama, Auburn	Prof. P. H. Mell *	
Arizona, Tucson	J. C. Hayden *	
Arkansas, Little Rock	M. F. Locke	F. H. Clarke. *
California, Sacramento	James A. Barwick *	
Colorado, Denver	W. S. Miller *	
Florida, Jacksonville	E. R. Demain *	
Georgia, Atlanta	Park Merrill	
Idaho, Idaho Falls	J. H. Smith *	
Illinois, Springfield	John Craig *	
Indiana, Indianapolis	Prof. H. A. Huston †	C. F. R. Wappenhaus. *
Iowa, Des Moines	J. R. Sage	Dr. G. M. Chappel. *
Kansas, Topeka	T. B. Jennings *	
Kentucky, Louisville	Frank Burke *	
Louisiana, New Orleans	Geo. E. Hunt *	
Maryland, Baltimore	Dr. Wm. B. Clark	Dr. C. P. Cronk. *
Michigan, Detroit	E. A. Evans *	
Minnesota, Minneapolis	J. H. Harmon *	
Mississippi, University	Prof. H. B. Fulton *	
Missouri, Columbia	Levi Chubbuck	H. A. McNally. *
Montana, Helena	E. J. Glass *	
Nebraska, Crete	Prof. G. D. Swezey	G. A. Loveland. *
Nevada, Carson City	Chas. W. Friend	Ford A. Carpenter. *
New England, Boston	J. Warren Smith *	
New Jersey, New Brunswick	E. W. McGinn *	
New Mexico, Santa Fe	H. B. Heryay *	
New York, Ithaca	Prof. E. A. Fuertes	R. M. Hardinge. *
North Carolina, Raleigh	Dr. H. B. Battle	C. F. von Herrmann. *

† Address, Lafayette, Ind.

State Weather Services—Continued.

[Persons marked thus * are employees of the Weather Bureau.]

State and central station.	Director.	Assistant director.
North Dakota, Bismarck.....	W. H. Fallon *	
Ohio, Columbus.....	L. N. Bonham.....	C. M. Strong. *
Oklahoma, Oklahoma City.....	J. I. Widmeyer *	
Oregon, Portland.....	H. E. Hayes†	B. S. Pague. *
Pennsylvania, Philadelphia.....	W. P. Tatham.....	H. L. Ball. *
South Carolina, Columbia.....	A. P. Butler *	
South Dakota, Huron.....	S. W. Glenn *	
Tennessee, Nashville.....	J. B. Marlbury *	
Texas, Galveston.....	D. D. Bryan.....	Dr. I. M. Chline.*
Utah, Salt Lake City.....	G. N. Salisbury.....	
Virginia, Lynchburg.....	Dr. E. A. Craighill.....	J. N. Ryker. *
Washington, Olympia.....	E. B. Olney *	
West Virginia, Parkersburg.....	W. W. Dent *	
Wisconsin, Milwaukee.....	Willis L. Moore *	
Wyoming, Cheyenne.....	E. M. Ravenscraft *	

† Address, Oswego, Oregon.]

OPERATIONS OF STATE WEATHER SERVICES.

The following reports of the operations of the several State weather services have been prepared and submitted by the directors:

ALABAMA.

(P. H. Mell, Weather Bureau, director.)

The work of the service may be divided into four distinct departments:

- (1) Telegraphic system. Under this head is disseminated the weather forecasts and special warnings. This service is under the charge of the observer at Montgomery.
- (2) Collecting meteorological data through the agency of regular and voluntary observers throughout the State.
- (3) Publishing bulletins.
- (4) Compiling and studying the records of the service for the purpose of preparing special bulletins on climatology.

The benefits resulting to the people of the State from the dissemination of weather forecasts are greatly appreciated in most sections. In a few localities, however, the warnings did not seem to be as highly valued as their merit warrants, and the result has been that the displaymen have lost interest and the services have been discontinued. These localities, however, are but few, and they are more than balanced by those places where the flags are closely watched each day and the fulfillment of the warnings highly valued. The frost predictions have been of great benefit to the market gardeners and truck farmers; to the farming communities, however, the valuable results have not been so manifest. The means of telegraphic communication outside of the cities, towns, and villages are so meager that the farmers, as a class, are not reaping the benefits from this system that is desirable.

The work of the observers in collecting meteorological data is of a high order of efficiency. Fifty per cent of these observers have been connected with the service for over five years, and they have taken much interest in the progress of the weather system in Alabama. The observers reporting to the central station at the close of the year number forty-three, and with one or two exceptions they are all provided with maximum and minimum thermometers of the authorized standard. As in other States, so in Alabama, the chief work of the observers is the reading of thermometers and reading the amount of precipitation. Some investigations have been conducted during the year toward the study of thunderstorms and electrical disturbances, and observers have been requested to give full reports concerning all such phenomena.

In the publication of meteorological data, the work has been of two natures: (1) the regular monthly bulletins that are issued on the 15th of each month throughout the year, and (2) the weekly crop bulletins that were printed on Saturday of each week during the crop season from April 1 to November 1. Copies of these two bulletins are sent to all newspapers in Alabama, all observers, the directors of the State weather services in the United States Weather Bureau, and all parties who make application for them. The newspapers of Alabama have shown much interest

in the service by republishing the weekly bulletins and extracts from the monthly bulletins.

The study of the data that have been accumulating at the central office during the past ten years has been steadily pushed ahead, and material for future bulletins relating to climate is nearly in shape for the printer. The policy of the director of the Alabama weather service has been to open the files of the office to the examination of students of meteorology, and, where the value of the work would warrant, to publish their investigations under the head of "Special Bulletins of the Alabama Weather Service." Several such works have been issued in the past, and, as already stated, others are in progress of preparation.

During the past five months the director has been engaged in the preparation of a monograph, at the request of the Chief of the Weather Bureau, on the climatology of the cotton plant. This work is intended for publication by the Bureau in its annual report for the year ending June 30, 1892. In the preparation of this monograph it has been necessary to examine the records of all stations located in what is technically known as the cotton belt, extending from Virginia to western Texas.

ARIZONA.

(J. C. Hayden, Weather Bureau, director.)

The local service was organized in September, 1891, and the first monthly bulletin was issued in October. No forecasts have been issued to the public during the year, and as the people are engaged more in mining and cattle-raising than in agricultural work, forecasts would probably have been of very little benefit. People are, however, beginning to direct their attention to agriculture, and during the coming season of frosts several display stations will probably be established, from which it is expected much good will result.

Weekly weather crop bulletins were commenced on April 8, 1892. The average issue to the public is about 75 a week, and many receiving them state that they are very interesting and valuable. The number of crop correspondents at present reporting to this office is twenty-two.

The monthly meteorological reports issued from this office appear to be of great interest to the public, and will prove valuable to the Territory, as they are carefully scrutinized by persons outside the Territory who entertain views of engaging in the raising of semitropical fruits. Many persons have addressed the local bureau for meteorological statistics relating to the climatology of certain sections of the Territory, which information has always been furnished as far as possible. The average issue of the monthly bulletin is about 100. Fifty-seven voluntary meteorological stations are now in operation in Arizona. A majority of these are using their own instruments. Seventeen stations have been established during the year. Five have been discontinued.

ARKANSAS.

(M. F. Locke, director; F. H. Clarke, Weather Bureau, assistant director.)

During the past year the service has received its entire support from the National Weather Bureau. It has continued its work on substantially the same plan as outlined in my report made a year ago. It has been the aim of the director to secure only such voluntary observers who manifested an interest in the work and how would consent to make a continuous record. Owing to this requirement, the increase in the number of stations has not been as rapid as could be desired; but it has been a healthy growth, and the regularity with which reports are rendered and the care taken in their preparation prove that the selections made were good ones.

The number of display stations has been increased from 13 to 19, besides 5 places to which forecasts are sent by telephone, free of expense to the Government, but which do not display flags. There are also on hand 6 applications for the daily forecasts and 6 for frost warnings. Increased interest is shown in this branch of the service by several applications from points along the railroads where there are no telegraph offices at present, to have this office use its influence in having offices opened in order that they may receive the weather forecasts.

The lack of telegraphic facilities makes it impossible to reach a large portion of the State where the forecasts would be of great value. This is especially true of the plateau region in the northern and western parts of the State, where the fruit crop predominates.

Reports from displaymen state that the forecasts are watched closely, and that farmers in the vicinity and shippers of perishable articles are governed thereby.

The interest taken in the Weekly Weather Crop Bulletin continues to increase, as is shown by the increased demand for same both at home and abroad. At date of

last report the weekly edition was 250, whereas at present it is 362, making total number of bulletins issued during the thirty-six weeks it is published 13,032. They are also published in full in the city papers, and Memphis Commercial, and the editorial part in many weekly papers throughout the State. The crop report is also included in a "patent inside" which is furnished by the Arkansas Democrat Company to about forty weekly papers in the State.

A marked increase in the number of crop correspondents is also noted. Every county in the State, except three, is represented by from 2 to 5 correspondents, the total number reporting being 193. A much larger number could be procured were mail facilities better over a large portion of the State. The crop bulletins of the various State services are displayed in a place set apart for the purpose in the Board of Trade and are carefully perused by those interested.

The monthly report of voluntary observers is included in that of the State Commissioner of Mines, Manufactures, and Agriculture, who has kindly allotted three pages of it to the State service. The monthly edition consists of 1,500 copies, which are mailed free to all applicants. Reports are received regularly from 39 voluntary observers and 3 regular Weather Bureau stations. Two cotton region stations were closed during the past year by direction of the Chief of the Weather Bureau, and 9 voluntary stations have been established and applications are on file for 4 more stations in desirable localities. The monthly reports from observers continue to improve in accuracy, amount of data furnished, and promptness with which rendered.

Some simple form of instrument shelter should also be furnished to observers. I am confident that a much less number of thermometers would be broken, and thus in a short time the saving from this source would more than pay for the shelter.

I would again suggest the advisability of an inspection of voluntary stations. I am confident that much good would be accomplished, which would be ample compensation for the time and money expended.

CALIFORNIA.

(James A. Barwick, Weather Bureau, director.)

The State weather service of California was established in September, 1891, in compliance with instructions from the Chief of the Weather Bureau, and is being conducted in cooperation with the State Agricultural Society, which bears the expense of printing the weekly and monthly bulletins. The monthly meteorological bulletin for June, 1892, will contain about 300 reports from observing stations, showing an increase of about 80 reports in ten months. Over 200 monthly reports are received from stations established by the Southern Pacific Railroad Company, in its Pacific division. The regular edition of the monthly meteorological bulletin is 600 copies, which are judiciously distributed.

The Weekly Weather Crop Bulletin is also printed at the expense of the State Agricultural Society, 600 copies being issued weekly. When haying and harvesting are completed and the marketing of fruit commences, the number of crop reports begins to drop off, as during the heated term of July and August many of the observers and crop correspondents leave for an outing without arranging for a continuance of the reports. The interest in the State weather service work is generally confined to the months from September to July. Haying and harvesting are usually completed in July, and these crops lie out in the field for several months—often until the first rains of September or October. Fruit-dealers buy the fruit crop while still on the trees, and the work of picking and marketing is done by them, the grower having no concern in the crop after the sale is consummated. It will therefore be understood why so many correspondents discontinue their reports and pay no attention to requests to forward them after they have disposed of their own crops.

COLORADO.

(W. S. Miller, Weather Bureau, director.)

The most popular branch of State service work continues to be the weekly weather crop bulletins. The number of crop correspondents this season is 85. The weekly edition of the bulletin averages 325.

The total number of voluntary observing stations is 101; during the year 34 stations were discontinued and 28 established. The stations are all equipped with standard instruments. The observers are very faithful in performing the labor involved, and they are more than deserving of all the commendation and appreciation their work calls forth.

From the data received from voluntary observers and crop reporters is compiled a "Monthly Review." The number of copies issued monthly is about 450. The in-

terest in this and other publications of the service is best evidenced by the complimentary notices received.

At the close of the year there were 26 weather-signal display stations in operation within the State. The forecasting of frosts and cold waves is especially appreciated during critical periods of crop-growth and harvesting.

The greater part of the time which could be spared from current work was devoted to the preparation of normal monthly, seasonal, and annual temperature and precipitation data. The tables are now completed, and base maps have just been received on which these data will be graphically charted and distributed among those specially interested.

During the year a great deal of miscellaneous data has been prepared for publications, for the use of State officials, and in compliance with individual requests, etc.

FLORIDA.

(E. R. Demain, Weather Bureau, director.)

The organization of a weather service for Florida was undertaken last summer in accordance with directions contained in letter from the Chief of the Weather Bureau in July, 1891. There were at the time 19 voluntary and 7 Weather Bureau stations in the State. The voluntary observers were transferred to the State weather service, and the first monthly summary, that for September, was issued about the middle of October.

Meanwhile a call for voluntary observers in sections of the State not represented was issued through the press and by correspondence, and the promise was made that instruments would be furnished. In a short time about 20 additional observers had offered their services, but on account of the stock of thermometers and rain gauges for issue to volunteers having become nearly exhausted, only those located in counties from which no reports were received were supplied. Since the first monthly report was issued, 14 new stations have been added, 13 of which were equipped with Weather Bureau instruments. This made a total of 40 stations. Three stations have been discontinued and the instruments called in. Three more have rendered no reports for several months and the observers have probably ceased making observations. There were at the close of the year 34 meteorological stations, voluntary and regular, in operation in the State.

Weather forecasts were wired to 18 different points until June, when 14 were discontinued until October, as they were considered of little benefit during the heated term.

Frost warnings were wired to 26 places at Government expense, and to 1 at the expense of the individual, and were mailed to 2 persons. In a number of instances when frost seemed probable, telegrams were received from different sections of the State, requesting that the forecasts be wired. Frost warnings were displayed during the season on the steamer *Manatee*, between Jacksonville and Mandarin, for the benefit of the truckers and fruit growers living near the St. James River. This steamer also carries the weather signals daily.

The distribution of the a. m. forecasts by mail was begun March 22, 1892. On that date they were bulletined and mailed to 135 selected post-offices in parts of the State that it was believed could be reached in time to make the information valuable to the people. Changes have since been made, as it was found that some of the points could not be reached in time. At the close of the year the a. m. forecasts were mailed to 121 offices and the p. m. forecasts to 3 offices. The postmasters at several points, in addition to posting the bulletins in their offices, procured flags and made displays for the benefit of their localities.

As to the benefits resulting from the liberal distribution of the forecasts and warnings, it is conceded by all with whom I have communicated that the frost warnings during the past season were the most satisfactory ever issued, but there is still room for improvement. One or two frosts occurred late in the spring, for which no warnings were received, and did considerable damage to trucking interests. The forecasts and warnings are received with much eagerness during the season when damage is liable to occur from frosts, and the interest in the work of the service generally is increasing.

The crop-bulletin feature has been very favorably commented upon by the two leading agricultural papers of the State, as well as by many individuals. The editor of the "Dispatch, Farmer, and Fruit-Grower" wrote upon the receipt of the first bulletin that, in his opinion, it was the best thing yet undertaken by the Weather Bureau, and that he would gladly give the bulletins space in his paper. He publishes them in full. The average issue of the bulletin is 95 copies, and we have at present 50 crop correspondents. Efforts are constantly being made to increase the number. Poor mail facilities in many sections of the State greatly interfere with

the success of this work, but so far we have succeeded in getting enough reports from which to prepare bulletins that have been favorably received by the public.

The average number of monthly summaries issued has been about 125.

GEORGIA.

(Park Morrill, Weather Bureau, director.)

The work of organizing this service began on October 10, 1891. It has been established entirely through the agency of the Weather Bureau without State support. The only thing lacking under the present system, and one which might justify the seeking of State aid, is an adequate printing fund. Were an allowance of \$500 per year made for printing, the service in its present form would be perfectly efficient. There being no State service in Georgia up to October, 1891, the growth of the service and its present magnitude are one and the same.

The daily a. m. forecasts are telegraphed to 121, and the p. m. to 2 points. At 44 of these stations weather-signal flags are displayed, and at the remaining 79 the forecasts are bulletined. Frost and cold-wave warnings are telegraphed to 77 points, including the 44 regular forecast display stations, and 33 special frost-warning stations. The latter are supplied with cold-wave flags.

Many commendations have been received both of the general forecast, and the special frost-warning services. Both of these might well be increased to an indefinite extent. The opportunity for the use of frost warnings is especially great in the fruit and truck industries, as they are coming to rank among the most important in the State.

The data for the weekly weather crop bulletins are collected through the agency of 320 crop reporters. Reporters delinquent for more than one month are dropped from the lists.

The bulletin is published entire in the "Constitution" each Wednesday morning, and the same type is used for printing 500 copies of the bulletin under proper heading. These copies are mailed to all crop reporters and voluntary observers in the State, to 85 weekly newspapers, to directors of other State services, and to other interested parties.

The appreciation of these reports is most clearly shown by the recent action of the "Constitution" in adding to its weekly publication of the Georgia Bulletin the publication of a telegraphic summary from each of the ten other State services of the South.

The system of weather crop reports, I think, is probably the most popular feature of the State service. Information in regard to crop prospects is always eagerly sought, and is attainable at regular intervals only from this source.

Two hundred copies of the monthly report are mailed to the reporting stations, to other State services, and to 88 papers in Georgia. This report is now prepared by milligraph, and embraces 7 large bulletin sheets. In this form it is unattractive in appearance. Means should be provided for properly printing it. The milligraph process, while useful in many ways, is not fitted for the production of any large issue of matter of permanent value. These monthly reports certainly ought to be printed in a neat and uniform manner.

In October, 1891, there were 12 voluntary meteorological stations from which reports were received. To these 27 others have been added. These, together with 28 cotton region and river stations, give 67 stations provided with standard instruments and rendering monthly reports. In addition to these there were, in October, 1891, 4 stations from which reports were not being received. These were delinquent for a considerable time previous. From two of them the instruments have been reclaimed, while in case of the other two they have been abandoned. With these exceptions no stations have been discontinued.

The 67 points from which the reports are now received cover the State quite well. A few more stations are needed in the southern section. It is very difficult in that portion of the State to secure satisfactory observers. I think that 15 additional stations in the proper locations would be all that are required for complete and satisfactory climatic data.

The most pressing need of this branch of the work is a careful inspection of all the stations now in operation and provision for an initial inspection of each new station established. New observers as a rule have no technical knowledge of the use of their instruments or the theory of proper exposures. Great improvement would result from an inspection of stations by a competent observer.

I would also suggest the issuance of flood warnings either from this point or from Washington to certain exposed points on rivers which have their source in the mountains of north Georgia, notably Columbus, Rome, and West Point. Nearly every year serious damage is occasioned by flood in these places, and at present we

provision is made to warn them. Such warnings could be readily issued, as stations are already established on these watersheds and considerable data exist as to past rainfalls and floods.

The matter of increasing the number of regular frost-warning stations has already received your attention. I think that a large increase should be made in the number of these stations in Georgia, but that it can be best accomplished a little later in the season. With this increase, and with the moderate increase suggested in the number of voluntary observation stations, I think that the Georgia weather service might well be considered efficient and complete.

ILLINOIS.

(John Craig, Weather Bureau, director.)

Since the transfer of the Bureau from the War Department to the Department of Agriculture, considerable progress has been made in the work pertaining to this branch of the service. Reports are now received on an average from about 55 stations; this includes 6 reports from regular Weather Bureau stations. The increase is owing to the liberal policy pursued by this Department in furnishing instruments to the observers. At the present time about 70 per cent of the stations from which reports are received have been equipped with Weather Bureau instruments. Forms 1011 and 1012, compiled from the reports received, have been forwarded to Washington on the 15th of each month. A monthly report, cyclostyle, has been issued to the principal newspapers throughout the State.

During the present season, weekly crop reports have been received from about 42 counties, and the information contained therein is used in compiling the crop bulletins issued from this station on Tuesday of each week. Four hundred and seventy copies are issued weekly, 209 of which are issued to the secretaries of local granges in the State, this being done at the request of the grand secretary of Illinois, and the balance are distributed among the correspondents reporting to the various State weather centers, and to the principal newspapers of Illinois and St. Louis, Mo. This part of the work is highly appreciated by those interested, and it is considered one of the best features of the service. As a general thing, the reports are published in full by the principal newspapers of the State.

Weather forecasts and warnings are telegraphed to the principal points in the State. Eighty-seven stations are receiving reports daily, except Sunday, at government expense.

The Ohio and Mississippi and the St. Louis, Alton and Springfield Railways furnish without expense to the Government, the forecasts and warnings to the stations (46) along their respective lines. These forecasts and warnings are greatly appreciated by the citizens.

INDIANA.

(Prof. H. A. Huston, director; C. F. R. Wappenhans, Weather Bureau assistant director.)

During the fiscal year ending June 30, 1892, 81 display stations received the forecasts by telegraph—49 in the morning and 29 at night; and the night message was mailed to 3 stations. One station received the cold-wave message only; and frost, thunderstorm, storm warnings, and the cold-wave messages were sent to all display stations by telegraph.

In January, 1892, the sending of forecasts to railroad agents was resumed; it had been done for a great number of years, but after the novelty had worn off, station agents became careless in posting the bulletins every day, leaving old ones for display, which misled the public, and this mode of dissemination of the forecasts was gradually discontinued. At present the forecasts are sent by telegraph to 12 depots of the Pittsburg, Chicago, Cincinnati and St. Louis Railway, and to 4 depots on the Indianapolis, Decatur and Western Railway. By baggage-masters of the night trains of the various divisions of the "Big Four System," the forecasts on form 1036 are sent to 58 depots, on the Cincinnati, Hamilton and Indianapolis Railway to 4 depots, on the Louisville, New Albany and Chicago Railway to 9 depots, and on the Lake Erie and Western Railway to 8 depots. The displaymen and everyone else with whom I spoke about it assured me that the people appreciate the display and the forecasts very much, especially where the forecasts are heralded by steam whistle (which is being done at 7 stations), as the sound reaches farther than the flags can be distinguished, and therefore many more people living in the country have the benefit of the signals, and watch for the time when they usually are sounded.

Starting with the issue of 150 weekly crop bulletins at the beginning of the season, I have been compelled to increase the number issued to 400, which is the number issued at the end of the fiscal year. The Indiana Farmer, with a circulation of

about 15,000 copies, publishes the full bulletin regularly; the city papers, and a few of the weekly papers in the State, publish the synopsis, and this is also sent by the operator of the Associated Press. There are about 30 correspondents who send reports regularly, and a few who do so occasionally. Merchants on 'change and others who read or receive the bulletin, expressed themselves quite favorably in regard to the publication, and it seems the bulletins are of general benefit.

Five hundred monthly bulletins of the Indiana State weather service are published every month. There are at present 34 volunteer observers who send reports; none were discontinued, and 6 were established during the year.

In order to make the observations of the service more uniform and of more value, I would respectfully suggest that all those observers who have exposed thermometers only may be furnished with a maximum and minimum thermometer. When I have more time at my disposal I will furnish a list of those observers to whom self-registering instruments ought to be sent. If there should be volunteer observers in Indiana who, having instruments provided by the Weather Bureau, and who send their reports only to the central office at Washington, I would respectfully suggest that they may be instructed to send the reports to my address and, if desired, after making copy of the report, I could forward the original to the central office.

IOWA.

(J. R. Sage, director; Dr. G. M. Chappel, Weather Bureau, assistant director.)

That this service has steadily grown in public favor, since its establishment by law in 1890, is attested by the fact that the bill appropriating an increased amount for its support the coming biennial term passed both branches of the late general assembly without a negative vote. A very earnest effort has been made by those charged with its management to increase its efficiency and to make it worthy of public support and confidence.

Monthly meteorological reports are now received from 94 stations, including the 5 Weather Bureau stations within this State, and 2 (Omaha and LaCrosse) in contiguous States. Weekly weather crop reports are received during the crop season from the observers at the most of these stations, and from 86 weather crop observers who are not supplied with standard instruments. In addition to these, there is connected with this Bureau a well-trained and intelligent corps of crop correspondents, numbering about 1,050, from whose reports monthly tabulations, showing the condition and acreage of staple crops, are made during the season. These are published in the Monthly Review, and widely distributed by advance sheets to the press of the country. Of the Monthly Review, there were issued during the year 24,500 copies. The total number of weather-crop bulletins issued during the year (twenty-six weeks) was 36,500, and the issue during the current season has been increased to 1,700 per week. These are distributed to the press of the State, and to all who are sufficiently interested to make application for copies. Summaries of the weekly bulletins are given to the Associated Press, and are published in all the papers receiving the same in time for their weekly issues. The general appreciation of these publications has been attested by numerous letters and flattering press notices.

There are within the State 85 display stations at which daily forecasts are received and displayed by flags or given to the public by whistle signals. There is an evident increase of public interest in this work of the National Bureau, and the State service has done all in its power to give the widest possible dissemination to the weather forecasts.

This service was established as an auxiliary organization, and it has been the aim of those charged with its administration to take up the work of extension at the points where, by necessary limitation, the National Weather Bureau left it incomplete. With this in view, upon ascertaining that the National Bureau had no available funds for the purchase of instruments, the State appropriation has been drawn upon for the equipment of 9 stations, at which thoroughly competent observers have been secured.

The director has also agreed to pay for the paper and printing of 100,000 penalty wrappers, to be used in mailing the bulletins, weather maps, and other issues at the central station, to be used during the current season.

Frequent requests have been made for the donation of flags for the equipment of display stations at various places within the State; but this service has not approved such applications, believing it would be better for the general public to expend the money appropriated for that purpose in sending the forecasts to stations where the people will contribute the small amount necessary to purchase the required outfit of flags, etc.

The establishment of a local forecast station at Des Moines, for the State of Iowa, has greatly increased public interest in the service, and the issue of weather maps,

which now reach over 330 points at an hour sufficiently early to give value to the forecasts thereon, has also contributed to the same end.

This service has undertaken the work of preparing data in form of charts, tables, maps, and pamphlets illustrating the climatic features of the State, as related to crop production and the public health, to be used as a part of the Iowa exhibit at the World's Columbian Exposition. This work will necessarily entail a considerable draft upon the clerical force of the office.

KANSAS.

(T. B. Jennings, Weather Bureau, director.)

This service consists of 1 central station, 72 voluntary stations, 5 regular stations of the National Service, 1 station of the U. S. Army Medical Service, 20 stations of the Union Pacific Railroad, 85 weather crop reporters, and 16 forecast and cold-wave warning display stations.

Owing to the large increase of duties devolving upon him, requiring his whole time in the class room and laboratory of the college, Prof. Lovewell withdrew from the directorship of this service in April last, and the present director assumed charge.

On April 9 the office of the central station was moved from Washburn College into the city, thus permitting it to be in close touch with the press and public and giving it the benefit of immediate telegraph and mail facilities.

The weekly weather crop bulletins were continued until September 19 and resumed April 15. They are furnished to each United States Weather Bureau station in the State, each voluntary station, and each weather crop reporter of this service, to 423 daily and weekly newspapers in the State, 4 of the largest agricultural papers outside of the State, 103 post-offices in the State, each State weather service, and to the following railroads, viz, the Atchison, Topeka and Santa Fe; the Chicago, Rock Island and Pacific; the Kansas City, Fort Scott and Memphis; the Missouri, Kansas and Texas; the Missouri Pacific, and the Union Pacific.

In connection with the weekly bulletin, a weekly rain chart is issued showing the distribution of rain over the State during the preceding week, and is based on the same reports that are used in compiling the bulletin. Three hundred copies of this chart are milligraphed and sent to the State educational institutions, a large number of post-offices, three high schools, the public libraries, the State societies—agricultural, historical, horticultural, etc., county agricultural associations, and the observers.

The monthly bulletins are printed by the State Board of Agriculture, 5,000 copies being printed each month for general distribution. Owing to a law passed by the last legislature requiring all State printing to be submitted to a board on printing for approval before incurring the expense, this feature of the work has been seriously, though unintentionally, hampered by much delay in getting the monthly data into the hands of the public and thereby tending to discourage a few of the voluntary observers.

A monthly rain chart is issued with the bulletin, by aid of the milligraph, and 300 copies distributed on a plan similar to that of the weekly edition.

In connection with the monthly rain charts are issued 50 charts showing the departure from the normal temperature and 50 showing departure from the normal rainfall for the month, based on records extending from six to forty years. These, being prepared for study, are issued in a limited quantity and sent to meteorological investigators, and a few scientific institutions interested in this line of study.

Meteorological and climatic data have been compiled by this office, at various times, for the State Board of Agriculture, the State Horticultural Society, some of the railroads, and occasionally for newspapers, while each autumn requests come from many of our largest cattle-owners for information covering the preceding season, to enable them to decide where to winter the cattle, at home or in some other part of the State.

The present director has begun the study of two important subjects—hot winds and the relation of rainfall in Kansas to areas of low pressure. The daily details of the State service, together with those necessarily devolving upon him in its connection with the National Service, permit of but slow progress, yet much encouragement is had from the progress already made.

It is here desired to acknowledge the valuable assistance afforded this service during the year by the Chief of the Weather Bureau, without which its measure of success would have been reduced to a minimum.

KENTUCKY.

(Frank Burke, Weather Bureau, director.)

Until the early part of August last, the Kentucky weather service was operated under the auspices of the Polytechnic Society of Louisville. During the latter part of that month, owing to lack of proper support by that body, it was transferred to

the charge of the observer at Louisville, and has remained under his direction to date.

The expansion of the service and the appreciation of its benefits by the public during the past year have shown a marked and most encouraging increase. It has now passed beyond the tentative period of its existence and is rapidly acquiring a *substantial footing among the recognized public institutions of the State*. Though the attempt made two years since to secure legislative support for it met with failure, there is every reason to believe that a second presentation of a bill providing for its maintenance would be successful. The wide dissemination of its publications throughout the State, the interest manifested in it by the press, and the display of weather forecast signals in most of the important towns, have accomplished much in the way of educating the people to its purposes and benefits. That there is a largely increased interest in it is evinced by the comparative ease with which observers and crop correspondents can now be obtained, which work was formerly attended with the greatest difficulty. The outlook for the service is brighter now than at any other period in its history, and, despite the many drawbacks incident to its progress in this State, it has advanced to a position of recognized usefulness, and, with proper support by the general assembly of the State, will compare favorably with any other similar organization in the country.

The number of forecast telegrams sent out daily at present is 40, a larger number than at any other time since the organization of the service. These figures, however, do not by any means represent the extent of the actual displays made in the State, as about a third of the places to which the telegrams are sent serve as subcenters of distribution, from which they are distributed in various ways throughout the contiguous country without expense to the Government. The telephone is utilized extensively for this purpose in the interior towns, and the whistle system is rapidly acquiring popularity in places where the facilities for its use exist. It is to be regretted that the telegraphic system of the State is so incomplete, as frequent cases have arisen of places where the warnings were greatly desired by the people, but which, owing to lack of proper communication, or to excessive "other lines" tolls, the possibility of sending them was precluded. The numerous applications for, or inquiries relative thereto, and the willingness of most displaymen to incur the expense of purchasing flags for the display of signals, give ample evidence of the increasing popularity of this branch of the work of the service. Efforts have been made, from time to time, to increase the distribution of warnings through the mails, but it has been impracticable to do so, except to a limited extent from this center. This is due mainly to the lack of departing trains at suitable hours and the infrequent stops made by those which might be available for the delivery of forecasts. There are, however, a number of displays made by persons who obtain the forecast from the morning papers, notably along the line of the Louisville Southern Railroad.

The frost-warning system of Kentucky is perhaps the most highly developed in the country. Although the weather conditions of the past autumn did not admit of the best utilization of these warnings, the knowledge of the coming of a dangerous frost would have been promptly received by at least 250 persons, and by them distributed throughout their respective districts. The manager of the Newport News and Mississippi Valley Railroad, and the manager of the Western Union office here have rendered valuable aid in the perfecting of this system. The Louisville Tobacco Board of Trade has assisted in the work by the subscription of funds for the purchase of frost-warning flags and in securing reliable displaymen in all parts of the tobacco districts of the State. A single frost warning sent out at a critical time may result in immeasurable benefit to tobacco-growers, but great care should be exercised in the phraseology of the telegrams, and a clear distinction made between the predictions of light and heavy frosts, as the cutting of the crop while partially green is more injurious to it than are the effects of a light frost.

There are issued weekly at the present time 500 copies of the crop bulletin. This includes many sent outside the State, and represents nearly double the number issued last season. The report is compiled from the weekly statements of about 200 correspondents distributed through all the agricultural counties of the State. Its publication in nearly all of the principal newspapers of the State secures for it a wide circulation, which is constantly increasing. The addition of the rainfall chart to the bulletin has greatly enhanced its value and has excited much interest and favorable comment. The reports are especially valuable during that portion of the season while tobacco is maturing, and they are eagerly read by speculators and others interested in that crop. It is intended to make the condition of this important staple a special feature of the reports, and to that end the number of correspondents in the tobacco-growing counties is now being largely increased. With the completion of the arrangements now in progress, very complete reports will be received from every tobacco district of the State. It is in contemplation to issue, at regular intervals during the remainder of the season, a special tobacco bulletin. It

is thought that there is a need for such a publication and that it will meet with the approbation of everyone interested in the crop.

At the commencement of the year there were 18 stations in operation from which meteorological reports were received. None of these were discontinued wholly, but from several of them full reports were not received. At the present time there are 32 stations making full reports and 13 rainfall stations. The work of increasing the number of these stations is necessarily slow, as by past experience it has been found that scarcely more than half of those who signify their willingness to undertake the work fulfill their promises. Consequently great care has been exercised in the selection of observers, and as a result nearly all on the present list have proved to be competent and reliable. The strictures placed upon this work by the inadequate supply of instruments available for issue has prevented a larger increase than that exhibited. Thirteen stations were, however, supplied with rain gauges purchased by funds raised through subscription among the tobacco dealers of Louisville, and the observers thereat will make temperature and other observations as soon as the necessary instruments can be issued to them.

It is hoped that during the present year some method will be devised to accomplish the printing of the publications of the service, and thereby save the vast labor entailed by the present duplicating process, the results of which at the best are very unsatisfactory. This may be done through the coöperation of the State Board of Agriculture, but that organization has at present no funds available for such purpose.

A field for work for the service in this State which would doubtless be most prolific of good results and practical benefits is the study of the climatic influences affecting the growth of tobacco, which is by far the most important crop raised in the State. No plant is perhaps more keenly susceptible to soil and weather conditions, and a knowledge of the influences to which it is subject would more than repay the research required.

Another matter which might be embraced within the scope of the work of the State weather service is the investigation of local climatic peculiarities. There are many well-authenticated cases in the State of comparatively small areas which show markedly different climatic features from their environments. Excessive or deficient precipitation, the relative frequency and character of frosts, light or killing, are subjects which might be considered in this connection. It is within the power of a well-equipped weather service to throw much light upon these and kindred matters, and it is hoped that at an early day some attempt may be possible toward the accomplishment of these ends. It is a matter for congratulation that at last its efforts are meeting with the encouragement and appreciation of those who derive the greatest benefit from its work. Its further extension is now but a matter of means for the consummation of the ends in view, and there is scarcely room to question the willingness of the next general assembly of the State to provide them.

LOUISIANA.

(George E. Hunt, Weather Bureau, director.)

The year closes with 49 active stations, rendering regular weekly and monthly reports; of these 31 are strictly voluntary, the remainder being cotton region, river, and sugar and rice observers, who, in addition to their regular work, coöperate in the State work, and their reports form a part of the State publications.

The generous action of the Chief of the Weather Bureau in extending the scope covered by the Government forecasts, and furnishing prepaid weather and temperature messages to parties interested, meets with high appreciation in this State, as is testified by the fact that there are now 30 stations receiving the forecasts daily by telegraph. Many of these stations were furnished flags by the Government, by means of which they display the forecasts on flagstaves which they have erected; others have provided themselves with flags at their own expense, while the remainder give the forecasts publicity by means of bulletins which are posted conspicuously at post-offices and other places of general resort. In addition to the above, there are 21 points accessible at an early hour by the morning trains from New Orleans, which receive the forecasts by mail.

The establishment of 7 stations in the sugar and rice region of this State was brought about mainly in my capacity as director, and several of the appointed observers were selected from the old voluntary corps. These stations are: Baton Rouge, Donaldsonville, Franklin, Lake Charles, Opelousas, Rayne, and Schriever. Additional stations were authorized at Covington and Point-a-la-Hache, but they have not yet been placed in working order, owing to a question of telegraphic communication at the one place and the inability to secure a competent person to assume the duties at the other. The reports from these stations are valued additions to the meteorological records of the State, as they come from districts devoted especially to the cultivation of sugar and rice.

The popularity of the weekly weather crop bulletin continues undiminished, while its circulation has increased to over 200 copies. In addition to its private distribution, which is large, it reaches every newspaper in the State, and is reproduced generally in their columns.

As in previous years, the publications of the State service have been prepared and distributed without cost to the Government. It has depended upon the advertising patronage of the Weather Journal and a monthly subscription of \$12 given by the commercial bodies of this city for its support. The amounts received in this manner have sufficed to defray all expenses, giving a gratuitous distribution of meteorological data published in the Journal to representative citizens in all portions of the State, and to many persons in adjoining States whose requests for the paper have been granted. The director has all along had in contemplation the plan of placing the State service on a permanent basis by means of legislative enactment whereby sufficient funds would be appropriated to render it independent of both national and private aid, and at the same time admit of a more complete and satisfactory publication of the meteorological data compiled at the observing stations. In this matter he moved slowly and cautiously, not forgetting the fact that several previous efforts in that direction had started out with every promise of success, only to meet with complete failure. In sounding the sentiments of the people, he found unanimous approval of his plans; the representative men of the city and country gave their hearty indorsement, and the leading dailies of the State discussed the matter in their editorial columns, urging that the proposed bill be made a law.

Copies of these editorials were forwarded to the chief office from time to time as they appeared. Encouraged by this hearty support, the director framed a bill to establish a State weather service for the State of Louisiana, coöperating with the United States Weather Bureau, for the collection and dissemination of crop statistics and meteorological data, which was introduced in the legislature by the Hon. S. J. Kohlman.

The bill was considered favorably by the appointed committees in both houses, but the director now learns that action on it has been indefinitely postponed, leaving its fate an uncertainty. It is hardly probable that the bill will pass, the main obstacle which now, and has in the past, prevented its becoming a law being the lack of funds in the State treasury.

In the event of the failure of the bill to become a law, the service will, of course, continue as at present; and while the work can not be conducted on as high a plane as the modest ambition of the director might desire, it will, with the support of the voluntary observers, continue to be a power for good to the commercial and agricultural interests of Louisiana.

MARYLAND.

(Dr. William B. Clark, director; Dr. C. P. Cronk, Weather Bureau, assistant director.)

Forty places in Maryland and Delaware are supplied with weather forecasts and special warnings. Of these 20 receive them by telegraph at Government expense, 23 giving the forecasts to the public by means of flags, 2 giving them by means of whistle signals, and 3 stations displaying the frost and cold-wave flags only. Four of the remaining 12 stations or persons receive the forecasts by mail, the other 8 by telephone.

The benefits from the forecasts have been acknowledged in many cases, and there has been but one instance during the year of telegrams being discontinued for want of interest in the forecasts. The increasing interest in the forecasts is shown by the numerous applications for them received both from Maryland and Delaware.

Up to June 14 the issue of the Weekly Weather Crop Bulletin had averaged 1,500 copies, there having been a gradual increase from 900 to nearly 2,000. The expense of so large a weekly edition being greater than the size of the printing fund warranted, the post-offices of the State were stricken from the list, and consequently the weekly edition has been reduced to 800. Since the change in the day of issuing the bulletin from Saturday to Tuesday, it has been printed weekly, in part or in full, by several State papers, so that it is given a wide circulation.

The attention given the bulletin by the newspapers is perhaps the best evidence of its popularity and value, but letters received from many farmers give direct proof of its usefulness. Through the medium of the bulletin, farmers are enabled to institute a closer comparison of their own crops and soils with those in other sections, and to determine better the value of the product. It also creates an additional interest in farming, and opens the way to improvement in agriculture and the enlightenment of the farmer. The number of correspondents is now 54, and is increasing.

Monthly reports were issued until November, 1891, when, from the lack of funds, publication was temporarily suspended. However, a bill appropriating \$2,000 annually for the maintenance of a State weather service was passed by the legislature of Maryland, and signed by the governor with the understanding that but \$1,000 annually should be used.

Considerable trouble was encountered in the devising of plans for the publication of complete and presentable reports commensurable with the small balance available for printing. Finally it was decided to begin a new series of reports with the April number, and to include in this report a summary of the four months from December, 1891, to March, 1892, inclusive. This was done, and the edition numbered 2,000. The report for the month of May, current year, has also been issued, and that for June will soon follow. A neatly engraved map, in colors, exhibiting the monthly distribution of rainfall and monthly isotherms is included in the report. This publication has been well received.

There are now in operation 19 voluntary meteorological stations, and of these 9 have been established during the fiscal year ending June 30, 1892. Five stations have been discontinued during the year. With a transportation fund for use in establishing and inspecting stations, much better results could be accomplished in the securing of competent and reliable observers and in the giving of necessary and important instruction relative to the proper usage of instruments and the correct method of preparing meteorological forms.

MICHIGAN.

(E. A. Evans, Weather Bureau, director.)

Owing to the failure of the State legislature of 1890 and 1891 to appropriate means whereby the State service could be maintained, and in order to economize in the expense of keeping up the work of the service, the station at Lansing was discontinued July 31, 1891, and removed to Detroit August 15, where the work has since been carried on.

The work of the service has been the establishment of voluntary observers' stations throughout the State and to collect the reports of such voluntary observers for publication each month. There has also been published in connection with the summary of each report charts showing the rainfall and temperature for each month. These charts show graphically the temperature conditions and distribution of rain throughout the State.

There are 54 stations receiving forecasts and cold-wave warnings by telephone, and 32 by telegraph at Government expense. Of these 86 stations, 83 are displaying flags and 3 sound whistle signals.

There are 32 stations on the line of the Detroit, Grand Haven and Milwaukee Railway, which receive the p. m. forecasts through the superintendent of this railway by telegraph over its lines free of cost to the Government. These forecasts are used for bulletin purposes, frames having been supplied at Government expense in which the messages are posted upon receipt.

Railway train signals are carried upon seven of the railroads in the State, as follows: Detroit, Grand Haven and Milwaukee Railway, Chicago and Grand Trunk Railway; Port Huron Division, Grand Trunk Railway; Michigan Central Railway, Chicago and West Michigan Railway, Grand Rapids and Indiana Railway, and Pontiac, Oxford and Port Austin Railway. The forecasts in general have given excellent satisfaction throughout the State, and many favorable comments have been received at this office as to the correctness of same.

The average issue of the Weekly Weather Crop Bulletin from this office is 366.

This feature of the work in this State is fast becoming popular and of great interest, more particularly among the farming community, as is evinced by many in their willingness at all times to cooperate and extend the area of circulation of the bulletin. Together with the bulletin issued every Tuesday is a chart showing the distribution of rainfall during the week and departure of temperature from the normal. There are at present 91 crop correspondents reporting to this office weekly.

Relative to the change of date of issue of the bulletin from Saturday to Tuesday, I would state that under the old plan the Michigan Farmer, with large circulation among the agricultural districts of the State, published the bulletin in full, with the rainfall chart; but owing to the fact that their publication day was Friday, and most of the reports closed Saturday, the weekly bulletin and chart was discontinued on account of the information not being available for publication. This was a net loss of nearly 20,000 circulation in the State.

There are 4,000 monthly summary of reports of voluntary observers published in this State by the secretary of state at Lansing, of which 260 are sent out from this office, the balance being distributed by the secretary of state.

There are in operation in the State 102 voluntary observers' stations. During the past year 9 new stations have been established and 11 discontinued. Considering the work of the observers being entirely voluntary, great credit is due them for their faithfulness and the care and accuracy with which their records are kept.

MINNESOTA.

(J. H. Harmon, Weather Bureau, director.)

When the present director took charge of the service, August 5, 1891, the crop correspondents numbered 40, voluntary observers 18, regular observers of the Weather Bureau 5, and display stations 15. The policy outlined by the previous directors has been continued, and the progressive policy of the Chief of the Weather Bureau has been pursued, and at the present time the crop correspondents number 142, voluntary observers 40, display stations 90, and the regular Weather Bureau stations 6.

The Weather Crop Bulletin continues to be the leading feature of the service, and every effort is made to give it the widest possible circulation both through the mail and publication by the press, it being printed on Tuesday and mailed that night to 300 addresses, mostly in this State. There is also published a bulletin containing the report in detail from each correspondent, a general summary of conditions and precipitation chart, graphically drawn. These are furnished whenever requested.

The interest in the service has generally increased during the past year, resulting in a large increase in the work of the station, necessitating additional assistance.

The demand for the daily forecasts has been so great that applications for them had to be discouraged. Of the display stations established during the year, in all but two instances the display flags were purchased by enterprising citizens or by the city councils.

It is much to be desired that rain gauges be furnished to certain crop reporters in order that the rain chart may be of greater value; also that the number of voluntary observers be increased until each county is represented.

The time required to manifold the crop bulletin with the rainfall map by means of the milligraph process is such as would warrant an effort being made to have the appropriation increased to such an extent as to allow the same to be done by some local printer, or by means of logotypes in this office. This would allow a circulation of from 5,000 to 10,000 copies in place of a few hundred. Reports could then be printed upon one sheet that now require three, and would be in much better form for display as exchanges, etc., as a concise report is generally desired, and a report of over 2 pages is seldom looked at. A sheet of a uniform size should be used for this purpose whenever possible, with a heading that will plainly show the State for which it is a report. This suggestion also applies to the monthly reports issued by the various State weather services. The monthly report of this State service consists of a general summary, a report by stations in detail, and a precipitation chart.

The Minnesota State service receives no financial aid from the city, State, or from any private institution.

MISSISSIPPI.

(Prof. R. B. Fulton, Weather Bureau, director.)

There has been a large increase in the number of stations in this State desiring and receiving the daily forecasts. This is due to a rapidly growing interest in the work of the United States Weather Bureau throughout the State, to an intelligent apprehension of its aims and methods, and to the cooperation of the Louisville, New Orleans and Texas and Illinois Central Railroads.

There are 48 stations (display) receiving forecasts at Government expense by wire, and 58 by telegraph through the cooperation of the railroads named above, 17 others receive the cold-wave warnings by mail from near telegraph stations. Most of these stations display flag signals.

There has been a decided improvement in the promptness with which messages are transmitted.

As the public is being educated to appreciate the purpose and value of the forecasts the demand for them increases.

An effort will be made next season to distribute cold-wave warnings largely to small post-offices away from telegraph lines by mail from regular display stations. A satisfactory beginning of such work was made last winter through the cooperation of Mr. B. T. Webster, of Louisville, addressed cards being furnished from this office.

The storm and wind signals displayed by volunteer displaymen on the Gulf coast at 3 stations have been much appreciated by the maritime interests, for whose use they were intended.

The work of this office has been largely directed toward educating the public by correspondence and other means to a fuller appreciation of the forecast work of the Bureau, and with more success than in any preceding year.

It is probable that the weather forecasts will soon become as important a factor in business, domestic, and social life as the accurate measurement of time for practical purposes has become.

The edition of the Weekly Crop Bulletin issued is continually enlarging, and now amounts to 220 copies per week. These are distributed to crop reporters, to newspapers, to business exchanges and firms, and to the weather services in other States.

They are sent regularly to 13 daily and 32 weekly newspapers, which publish them in whole or in part. Many dealers in staple agricultural products request special copies.

Reports are received from about 50 counties in the State, covering the most important agricultural districts.

In making up the weekly bulletin the brief synoptical form seems to be most popular, but some daily papers prefer the extracts from the original reports from the counties. These are given occasionally at critical times in the weekly bulletin.

For the monthly bulletin reports are used from 44 stations in the State, some of the observers being cotton region observers, who continue their records during the winter season as volunteers.

The number of new volunteer stations established during the year is 4, and the number of stations discontinued is 3. A number of other stations have been applied for within 50 miles of some established station.

From the very considerable damage wrought by freshets in the larger tributaries of several rivers in the State, notably in the case of the Tombigbee, Big Black, Tangipahoa, and Yalabusha last spring, it is certain that an increase in the number of river stations in the State would be valuable to many interests. They should be placed for the protection desired nearer the head of each stream than the highest limit of navigation, and possibly on important tributaries. I suggest that such information as these stations could furnish by telegraph in regard to rainfall and stage of water would afford valuable protection to many interests.

Such stations would be serviceable at Tupelo and Tibbee or Muldrow on the head waters of the Tombigbee; at New Albany and Grenada on the Tallahatchie and Yalabusha; at Durant or West's on the Big Black; at Jackson or Byram on the Pearl.

The channels of these streams are filling up year by year, and their valleys consequently rendered more liable to overflow.

MISSOURI.

(Lovel Chubbuck, director; H. A. McNally, Weather Bureau, assistant director.)

The State legislature which met last year, recognizing the importance of and benefit to be derived from, extending and systematizing the work of the department of the State Board of Agriculture, included in its appropriations the sum of \$1,000 to be expended annually in purchasing instruments and other paraphernalia to be loaned voluntary observers, publications of data obtained therefrom, more extensive dissemination of the weekly weather crop bulletin, and other necessary expenses incidental to the better equipment of the service and the facilities for carrying on the work. The benefits derived from this appropriation are obvious, and the general method of expenditure is discernible under the various headings noted later in this report.

The meteorological data for the year ending December 31, 1891, occupies 32 pages of the Twenty-fourth Annual Report of the Missouri State Board of Agriculture, and the briefness of this report as compared with that of one year ago is due solely to the fact that the force and time at the disposal of this office, while the matter was being prepared for publication was entirely inadequate to the compilation of the data at hand in a manner calculated to do justice to the amount of work performed during the year.

The weather forecasts, cold-wave and frost warnings (for flag display and whistle signal purposes) are issued from St. Louis and Kansas City, the poor telegraphic facilities of this office making such action advisable. The only forecasts issued from this office are 62 bulletins daily (Sundays and holidays excepted), which are distributed by the various trainmen to stations along the line of the Wabash Railroad from Columbia to Centralia, from Centralia west to Kansas City and east to St. Louis, and from Moberly north to Couteville. A telegram is received at this office from St. Louis, its contents set in type and printed, bulletins inclosed in envelopes, and the packages, properly arranged, delivered to the 11 a. m. train for distribution. The average time of receipt of telegram, coupled with location of this office, off the main line makes the carrying out of this work in a satisfactory manner difficult, and distributing the blank bulletins to stations now receiving them from here and sending the forecast telegram through the train dispatcher of the railroad, for copy and display at proper points, is a scheme recently recommended, and the accomplishment of which would be a decided improvement. Four stations receive the forecasts by mail, but the cold-wave and frost warnings are sent there as well as

the other stations by telegraph and at Government expense. In addition to 55 stations receiving cold-wave and frost warnings, there are 40 special frost-warning stations. This makes a total of 95 stations receiving frost warnings during the season when they are considered valuable, and the matter and method of enlarging the number is now under advisement. This material increase over last year, coupled with the attention paid by both press and public to this branch of the service, seems the best available criterion by which to attest its reliability and popularity.

The Weekly Weather Crop Bulletin is now printed in pamphlet form, and has been subject to considerable change and improvement as regards manner, form, and date of issue, the latter permitting a noticeable addition to number of copies furnished weekly papers of the State. The weekly issue is at present, in round numbers, 1,000 copies, divided as follows: Weekly State and general agricultural newspapers 350, crop correspondents 250, State weather services, grain exchanges, and private individuals, 400. Its extensive publication by the papers, thorough dissemination by the Associated Press, and receipt of numerous telegraphic requests for information derived therefrom, prove that the publication is rapidly increasing in popularity among those interested in the agricultural resources and interests of the State—a result incident to an undisputable reputation for thoroughness and reliability. As soon as the number of stations permanently established, and the available resources will permit, the issue of a normal and current weekly temperature and rainfall chart in connection therewith will be commenced, though it is hardly expected that such action will be deemed expedient during the present growing and harvesting season.

To aid in collecting the data necessary to the study of climatology and meteorology of the State, which in future years must prove of inestimable value and benefit, there are connected with this service 100 voluntary observers located at points carefully selected as regards geological formation and general topography of the State. These observers make daily observations of temperature, precipitation, prevailing wind direction, character of weather, heavy rains or snows, hailstorms, thunderstorms, and in fact all atmospheric disturbances or optical phenomena. A system for thorough and accurate collection of thunderstorm data is now being put in operation. Forty-four new stations have been established and nine old ones discontinued during the year. These changes coupled with 65 active stations of one year ago, make up the 100 mentioned above, and extra instruments now available, together with intended purchases, promise at least 125 fully equipped temperature and special rainfall stations by December 31, 1892. From the data thus collected and systematized a monthly bulletin is compiled, and 300 pamphlet copies of 20 pages each are issued for distribution to other State weather services, voluntary observers, professors in schools and colleges, and private individuals interested in the work. A most decided improvement in efficiency and number of tables, as well as other interesting data in this publication, has recently taken place, and an enlargement of the pamphlet is a matter of the near future.

The thanks of the service are due to the press of the State for the valuable assistance it has rendered in disseminating the forecasts, cold wave and frost warnings, and the information issued by this office; to the voluntary observers and crop correspondents for the interest shown and the promptness and regularity with which they have performed gratuitous labor, and to the Chief of the Weather Bureau for detail of instructed and competent men, the use of the penalty frank for mailing purposes, supplies furnished and instruments loaned, as well as other effective coöperation and assistance rendered.

MONTANA.

(E. J. Glass, Weather Bureau, director.)

This service was organized in November, 1891. The director met with considerable difficulty in getting the service organized on account of want of time to devote to State work, as he had just assumed charge of Helena station on October 24, 1891.

In December quite an addition was made to the service by a circular letter sent to post surgeons of the four military posts in Montana, inviting them to send copies of their meteorological reports to this office each month. This was soon followed by authority from the Surgeon-General to have them send their reports through this channel to Washington.

The director has endeavored to give in his monthly report a full report of the weather conditions of the State, by publishing the daily readings of the maximum and minimum thermometers, mean daily temperature, and the daily precipitation from each of the stations. This has done more to get the people of Montana interested in the reports than anything else, for by it they can see that this service is a great advertisement for the State.

The Board of Trade indorsed this service when it started, and in March presented the service with a printing outfit, so that the report could be sent East and present a nice appearance.

Crop bulletins began April 16, and are sent to each newspaper of the State, directors of other State services, and to crop correspondents and voluntary observers of Montana service. This necessitates a weekly issue of 135 bulletins.

The monthly report has a circulation of 120 per month. The typesetting, folding, and binding are all done by the director. The presswork is the only part that is done by outside parties, at a cost of \$10.50 per month. The total expense of editing the report is about \$32. To defray this expense advertisements are inserted, and the funds derived therefrom have been barely sufficient to pay the expenses.

There are several additional features which the director wishes to add to the report. The most important is having two maps engraved, the size of the page, of the State of Montana, similar in style to the maps contained in the New York monthly report; one to be used for the precipitation and the other for temperature. Maps in a report of this kind form one of the most important features, as they enable a person to see at a glance the general features of the weather for the month.

The Montana service needs a great many more observing stations established, and also crop correspondents.

If the director was so situated that he could make a tour through the country where stations are needed, he is of the opinion that quite a number of stations could be established.

It is the intention to issue in January, 1893, an annual report of the Montana weather service, which will be a complete record of all observations taken during the year of 1892. It will contain a review of the weather and crops, and if data can be obtained it will contain the number of acres that was farmed and the number of bushels of grain harvested. The annual summary for each station will be published separately, and will contain the daily maximum and minimum temperatures, precipitation, and mean daily temperature by months. For this purpose the director is having matrices taken each month of the five tables published monthly. This issue will be quite large and will be sent mostly to the World's Fair at Chicago for distribution.

There is one difficulty which is an injury to the Montana service, and that is the poor exposure some observers in this service have for their instruments. At times the variations from the true temperature is so great as to call forth remarks and doubts as to the value of observations from those stations. I therefore recommend that instrument shelters be furnished to observers of this service, so as to have the conditions the same at all stations for the thermometers.

NEBRASKA.

(Prof. Goodwin D. Swezey, director; G. A. Loveland, Weather Bureau, assistant director.)

The Nebraska State weather service has continued during the past year in the same line of work and under the same direction as in the preceding year, but with increased appreciation of, and interest in, the work by the people of the State.

The State Board of Agriculture accords the service the same cordial support and financial aid that it did last year. Doane College, in addition to the generous aid that they have always given to the service and to the study of meteorological questions affecting the interests of the State, are preparing to build an office for the central station and equip it with a full set of self-registering instruments.

The daily weather forecasts and cold-wave warnings have been furnished at Government expense to forty points for display during the year. Owing to the location of the office and the poor telegraph and mail facilities, the work of distributing the forecasts has all been performed by the observer of the Weather Bureau at Omaha.

The most popular work of the service has been the issue of the Weekly Weather Crop Bulletin during the growing season. Reporters for this bulletin have now been secured in nearly every county in the State, and several in some of the counties, the total number reporting being 175. An average weekly issue of 400 copies is distributed, principally in the State. This bulletin is published in all the leading dailies in the State and in a large and constantly increasing number of weekly newspapers. The expressed appreciation of this bulletin has far exceeded that of previous years, and the large number of requests for the bulletin testifies to its real value to the people of the State.

A monthly bulletin has been published as heretofore, the edition being 200 copies. Commencing with the issue for January, 1892, in addition to the precipitation map formerly published, a chart has been used showing the prevailing wind direction and the monthly mean temperature, and also a third chart showing the daily temperature at the central station, with the daily temperature of the past month.

There are now 85 stations rendering meteorological reports monthly. There have been 14 stations established and 4 discontinued during the past year.

NEVADA.

(Charles W. Friend, director; Ford A. Carpenter, Weather Bureau, assistant director.)

Weather forecasts have been received by telegraph during last year at five stations: Carson City, Reno, Austin, Hawthorne, and Eureka. In this city the forecasts have been of value to the ranchers and market gardeners near town, and also have been of interest to the people at large. The daily telegram is published each afternoon in the Nevada (Evening) Tribune, and in this way the information is more widely scattered. At Reno the benefits are about the same as at this place, while at Austin, Eureka, and Hawthorne the reports from the displaymen are not of an encouraging nature, all of these places being mining towns, and consequently but little attention is paid to agriculture. In a few instances the signal flags have resulted in saving some vegetables and warning orchard-owners of frost, but unfortunately there are hardly any direct results. It is hoped that the increase in agricultural pursuits during the coming year will make the forecasts of much greater value.

The Nevada State Weather Service Review has been issued regularly on or about the 15th. This report has the usual weather and crop news, with the customary tables, charts, etc., together with a precipitation map and a temperature map, also diagrams illustrating the daily precipitation and temperature at the central station. Two hundred and fifty copies of the Review comprise the monthly edition.

Seven voluntary stations have been established during the year—Stofiel, Wabuska, Belleville, Tuscarara, Wellington, McDermitt, and Empire Ranch—not including the railroad stations which have commenced issuing reports to this office during the past year. Three stations have been discontinued—Sodaville, Candelaria, and Punch Bowl—no reports having been received within the period designated for delinquent voluntary observers, and no answer being received from communications addressed them on the subject. There are 35 stations reporting to this office.

NEW JERSEY.

(E. W. McGann, Weather Bureau, director.)

This important branch of the service, since July 1, 1891, has been greatly extended through the liberality of Prof. Mark W. Harrington, Chief of the Weather Bureau, who now furnishes not only the daily weather forecasts, frost and cold-wave warnings by telegraph, but also the necessary signal flags, at the expense of his Bureau. The high percentage of verifications from these forecasts has increased the confidence of the people to such an extent that many farmers drive several miles to obtain the information conveyed by the flags displayed. While visiting the several stations I have heard only the most favorable comments regarding their great value, not only for the agriculturist, but to all engaged in any of the several walks of life. Especially is this interest manifested by teachers and children attending the public schools, and from whose school buildings the flags are displayed.

The forecasts furnished to these stations are from three sources, viz, those determined from the 8 p. m. reports from the central office, Washington, D. C., and those from the 8 a. m. by the local forecast officials in New York City and Philadelphia—the former to the central and northern portions and the latter to the southern portions. The number of display stations at the close of the fiscal year 1891 was 16. During the past year to this number 23 stations have been added, so that at the close of the present year we have 36 stations which display the daily forecasts by means of flag signals and 3 by steam whistle signals, making 39 in all. But this number does not represent all the stations displaying the forecasts, as they are received and bulletined by many of the telegraph operators at the stations of the various railroads running through the State.

In the interest of the cranberry-growers of the State 25 stations were selected by Mr. A. J. Rider, secretary of the Cranberry Growers' Association, for their especial benefit. The importance and value of these warnings are set forth in the following letter received from Mr. Rider:

"I would say that we have again had the good fortune to be exempt from killing frosts in New Jersey till the cranberry crop was nearly if not all secured. I know of but one or two cases where the crop was not secured when frost came, and in those the warnings enabled the owners to flood and protect the fruit. I beg, on behalf of the cranberry-growers, to assure you of our high appreciation of your efficient and valuable services, and although the time has not come for a striking and telling illustration of the value of these warnings, we are thankful for the feeling of safety and confidence which your service has brought us during the critical period."

The publication of the weekly weather crop bulletins for the season of 1892 was commenced on Saturday, May 6. The total number issued each week is 1,500, making the total number of copies issued during the season 30,000. The producers of the

State are especially interested in these bulletins, having learned their value from the issue of previous years in estimating the yield of the various crops and the probable effect on the price of farm products. The press of the State regard the bulletin as one of the most valuable features of their papers. At the weekly meetings of the Farmers' Alliance the bulletin is read and is the chief topic for discussion. This branch of the service has continued, as in the past, to be its most important feature. In a letter received at this office the secretary of the State Board of Agriculture says:

"I must compliment you on your weekly crop reports. They cover our State very thoroughly and give a comprehensive idea of the progress the several crops are making."

The number of stations forwarding meteorological reports to this office at the close of June, 1891, was 46. Of these 3 have been discontinued and 9 added, making a total of 52. These are now equipped with standard instruments, which greatly improve the reliability of the reports submitted. An increased interest has been manifested by all observers, and the reports received during the year show a degree of accuracy which is certainly most creditable to all concerned. These reports upon receipt are carefully examined, means determined, and printed in neat pamphlet form, of which 500 are issued monthly from this office. This branch of the service has also gained in public estimation. Prof. J. B. Smith, State entomologist, in his annual report says:

"The reports of this bureau will eventually form one of the most important factors in the determination of probabilities of insect injury. When we have sufficient data, we can say with some certainty whether climatic conditions do or do not exercise a marked effect on insect development. If they do, as is possible, the character of the season may often determine the measures to be adopted, or will enable us to decide whether it is worth while to adopt any at all."

Rev. T. S. Doolittle, D. D., vice-president of Rutgers College, in a letter received at this office, says: "Let me take this occasion to commend the work of the New Jersey State weather service. It is not only of great value to farmers, who get much knowledge from your bulletins and circulars in regard to the weather prospects and the gathering of crops, but is of interest to many others. It is this kind of accurate scientific information made productive of practical benefits that the people want and prize."

These resolutions were unanimously passed by the Burlington County Agricultural Society:

"Our board at the last meeting indorsed the weather bureau of the State, and advise appropriations by the State to insure its efficiency and continuance. As an educational organization the weather bureau stands preëminent. On the climate of a country depends its production and its habitation. Pleasant and salubrious climates and productive soils are sought after, and it is by this bureau that the information concerning the weather and crops is collected and disseminated.

"Schools and colleges are studying and making weather observations, thus training the minds of the young in weather wisdom and lore, giving to them an understanding of the physical laws under which all live and to which people owe their existence and products.

"The crop reports issued by our bureau have furnished the most valuable collection of statistics ever issued by the State. Coming with regularity and accuracy, the press and public have learned to depend upon them for information relative to the condition and prospects of the crops. They are of especial value to the farmer, for they furnish him with an approximate idea of the year's production, and thus enables him to regulate his sales to advantage. The intelligent, progressive farmer will study the crop weather report of his State and the world at large, and then sell his crops at the most opportune time.

"To railroads and merchants, and all classes of business men, they are invaluable. As agriculture is the backbone of this country, its productions affect all business enterprises; hence, nearly every citizen thus is shown the value and practical utility of the weather bureau.

"The laborer, the mechanic, the professional man, the horticulturist, viticulturist, each and all are affected by weather changes and conditions past, present, and to come."

In order to place this service on a permanent footing, and to obviate the necessity of asking for an appropriation each year, and the annoyance and uncertainty as to whether the legislature would or would not make the necessary appropriation, a bill was introduced January 18, 1892, and was unanimously passed by both branches of the State legislature early in the session, and was approved by his excellency, Governor Leon Abbett, April 7, 1892. The most important feature of this bill is, that it places the New Jersey State weather service on a permanent basis, with an annual appropriation amply sufficient to defray the expenses laid out by its board of directors.

NEW ENGLAND.

(J. Warren Smith, Weather Bureau, director.)

Up to March, 1892, the work of this service was continued under the New England Meteorological society, with the office at Cambridge, Mass. It consisted of the regular routine work of the society, as issuing monthly and weekly bulletins, correspondence, etc. In addition, the 5-year table of temperature and precipitation was completed and other work done on the annual report for 1890. The preparation of this table and of the account of the Lawrence tornado, by Prof. W. M. Davis and Messrs. Clayton and Mills, delayed the publication of that annual until May, 1892. This has hindered the work on the annual investigations for 1891, and very little has as yet been done on that. It will be printed by the society in the Annals of Harvard College Observatory, together with investigations of the thunderstorms of 1886 and 1887, as soon as the tables and summary can be prepared.

About the first of the year correspondence was carried on by the Chief of the Bureau and the director of the New England Meteorological Society relative to transferring the weather service work to the National Bureau, they to establish a New England weather service. Arrangements were finally made for the change and the office and effects were moved to the Weather Bureau office at Boston on March 29, 1892. A decided advantage has been found in being located at the center, and in connection with the local forecast official for New England. He has kindly given the use of one of his best rooms, and has extended every assistance possible, and is always ready with counsel and advice.

The several features of the work have increased in value and importance to considerable extent since the transfer and will be taken up separately:

The establishment of the display stations has gone on slowly, but gradually, and without any especial effort on the part of the service. All the information possible has been given, and whenever requests have been made, care has been taken to first learn if the proposed location was in a desirable place, and if the forecasts are desired by the people. In this way I think they have been generally situated in places where they are appreciated and are doing much good. Many are sending the forecasts to surrounding villages, and our aim is to increase that part of the work much more. Telephone lines will receive especial attention. The local and forenoon forecasts are most desired by the displaymen, and that they are greatly appreciated and generally found to be of value and importance in the daily life of those who see the flags or hear the whistles is shown by letters from the displaymen.

Considerable is being done in Maine in sending the daily forecasts by the railroad trains, and a good deal in Connecticut. The observer at New Haven deserves great credit for his efforts in this line in that State. If his plans succeed that he is now working on he will, through the railroads and the Southern New England Telephone Company, reach nearly every town in the State. But when this is accomplished all is not done. In very many cases the forecasts may be posted in the depots for days, almost, without being of any benefit to those most interested. In the busy season of harvesting the farmer does not take the time to drive several miles to read the forecasts. Some method must be urged for displaying the forecasts by flags or giving them by whistles. I believe that the grange can give the most assistance in this; and that through action of the local granges these forecasts can be taken at the depots and given to the people. The train service is good as far as it goes, but must be supplemented by something more. We hope that through the new association in New England the masters of the State granges may become interested, and thus set the local granges at work.

About a dozen frost-warning stations are now being established. We are, however, in correspondence with the president of the Tobacco Growers' Association and also of the New England Cranberry Growers' Association relative to these warnings, and both seem interested and promise to bring the matter up officially.

Reports are being received with a fair degree of regularity from 128 crop correspondents, well scattered over New England. Up to June 6 the crop bulletins were issued by the duplicating process, and about 275 copies were sent out to correspondents, newspapers, exchanges, etc.; but beginning with the following week, arrangements were completed with the Massachusetts State Board of Agriculture whereby the bulletins have been printed and the number sent out increased to over 2,200.

Through the winter months we issue an advance bulletin on the 3d or 4th of each month giving a brief summary of the weather for the previous month for publication only. It is sent to all newspapers on our list. In the summer it is considered that the weekly bulletins fill the place of the monthly. The monthly bulletin has been increased to 10 pages since the transfer, and is now issued about the 12th or 13th of the month following the one for which it is the record. The paper for the bulletin is furnished by the Bureau and the money for printing is furnished by the New England Meteorological Society, the Harvard College Observatory, the Massachusetts

State Board of Agriculture, the Massachusetts State Board of Health, the Massachusetts Agricultural Experiment Station (a small amount), the New Hampshire Agricultural Experiment Station, the Maine State Board of Agriculture. Next year we hope to have the New England association take hold of it, or else the different State agricultural experiment stations take the responsibility of printing it. We shall increase the pages as the funds for printing will admit, as there is no difficulty in finding interesting material enough to fill them.

There are now 164 voluntary observers reporting to this service, including the regular stations in New England. Of this number 18 are in Maine, 22 in New Hampshire, 14 in Vermont, 79 in Massachusetts, 11 in Rhode Island, and 21 in Connecticut.

NEW MEXICO.

(H. B. Hersey, Weather Bureau, director.)

Early in June, 1891, the observer in charge of this station called the attention of the Chief Signal Officer to the necessity of a weather service for New Mexico, but owing to the approaching transfer of the Weather Bureau to the Department of Agriculture no action was taken in the matter. Immediately after the transfer the new management gave the matter attention and the observer was instructed to organize a Territorial weather service.

The first monthly bulletin issued was for the month of August, 1891, and was based on the reports of 13 voluntary observers.

This work has steadily grown until at present reports are received from 33 voluntary observers throughout the Territory.

There have been many obstacles to overcome in organizing this service that are not met with in many of the States and Territories. A large part of the population of New Mexico are conversant with the Spanish language only. This is particularly noticeable in the outlying agricultural districts.

Another obstacle is in the poor mail facilities, making it impossible to get reports in time to issue the bulletins as early in the month as would be desirable. For this reason it was not thought advisable to issue weekly crop bulletins, but instead to issue them monthly.

The growth of the service has, I believe, been very satisfactory, under the circumstances. The Territorial press has kindly given its support from the start, and I am especially under obligation to Col. Max Frost, of the Daily Santa Fe New Mexican, whose strongest support can be relied upon in this work at all times.

Nothing has been done in the way of forecasts, flag warnings, etc., but that matter is receiving consideration at the present time.

It is believed that local forecasts would be of great benefit, and could be made with a good degree of accuracy by one familiar with the local climatic peculiarities of this country, with the aid of a sufficient number of telegraphic reports to refer to.

Two monthly bulletins are issued at the present time, a weather crop bulletin about the 3d of the month succeeding that covered by the bulletin, and is based on the weekly reports of about 30 crop correspondents. A weather bulletin is issued as soon after the close of the month as the monthly weather reports are received at this office, usually about the 12th of the month. This consists of a summary of the weather for the month, tabulated data from each station, and a map with the total precipitation and average temperature for the month charted thereon by the use of shaded areas and isotherms.

About 200 copies of each bulletin are issued monthly by the cyclostyle process, and distributed to the Territorial press and interested parties for the benefit of the public. The Territorial papers very generally publish the summary in full, and some publish the tabulated data also. Twenty voluntary observers' stations have been established during the year and 4 discontinued on account of the observers leaving the place and no other available person being found to continue the work. The general interest of the public is steadily increasing in this work, and several new stations will soon be established.

NEW YORK.

(Prof. E. A. Fuertes, director; R. M. Hardinge, Weather Bureau, assistant director.)

The work of the bureau has been carried on in the same general lines as heretofore pursued. The year closes with 77 voluntary stations (including 5 military posts) reporting on more than one element, and 34 special rainfall stations, while the reports from 6 Weather Bureau stations are also received and published in the monthly report. Endeavor has been directed rather to improving the value of reports from stations already secured than toward establishing new stations.

In September 10 anemometers, with self-registering attachments, were set up at 10 stations well distributed in the State. From 6 of these stations good records have been received, but owing to the stress of other work no use has yet been made of these valuable data.

The special thunderstorm reports are being received from about 80 observers in the State, but the discussion of these valuable reports has also been retarded.

There has been no radical change in the form of the monthly report, of which 650 copies are distributed monthly.

The Weekly Weather Crop Bulletin has steadily increased in popularity, as may be evidenced by the fact that of more than 100 applications received during the year 25 were from newspapers, and several more from the principal hay and produce exchanges in the State. The crop bulletin is that part of the service which can be directly appreciated by the public; and particular pains are taken to have the statements made in it comprehensive and unbiased. The present issue is 475 copies weekly. In general, the bulletin is published, in whole or in part, by the most influential papers in the State, particularly those treating of agricultural matters as a specialty; and many flattering notices have been received from the editors relative to the value which is attached to the publication of it by their patrons. A map of the State, charted with the weekly rainfall, is also published weekly in the New York Homestead and in the New England Homestead, and assurances have been received that it has met with very general appreciation.

Of the 75 crop correspondents 30 are regular observers, 34 special rainfall observers, and 11 report on the condition of crops alone.

Special endeavor has been directed during the year to a further dissemination of the official forecasts by the establishment of display stations. The papers were interested in the project, and with their aid and the very general distribution of circulars the proposed extension of this branch of the service was thoroughly advertised.

It was offered to furnish a limited number of flags to displaymen, and for this purpose 40 full sets and 80 cold-wave flags were purchased by the State bureau. As a result there have been established 107 full display or whistle signal stations, and 20 frost and cold-wave warning stations, during the year, making a total of 136 stations receiving the forecasts for flag display or whistle signals, and 20 frost and cold-wave warning stations in operation on June 30. Thirty-nine of these display stations were furnished flags by the United States, 58 by the State, and 59 furnish their own flags, sound the whistle signals, or post the forecasts in bulletin frames. This, however, by no means represents the total number of places in the State displaying or bulletining the forecasts. Many of the stations along the principal railway lines post the forecast message as received from the trains, while an indefinite number display the signals from press dispatches. The benefit derived from these displays is very great, especially in the grape and tobacco-growing sections and during the harvest times.

As the number of stations and the running expense of refurnishing flags increase, the need of a durable signal becomes more emphasized. A semaphoric signal, although originally more expensive than flags, would cost less in the long run.

In order to determine where the displays are properly appreciated, it is suggested that but one set of flags be furnished to the same displayman. This will have a tendency to weed out those stations where the displays are of no particular benefit to the community, but are used solely for advertising purposes.

NORTH CAROLINA.

(Dr. H. B. Battle, director; C. F. von Herrmann, Weather Bureau, assistant director.)

The work of the service during the past year has been the dissemination of forecasts, the preparation of the regular monthly and annual meteorological summaries, and the issue of the Weekly Weather Crop Bulletin. During the first half of the year 1892 efforts were directed to increasing the number of display stations and establishing a new system of frost-warning stations. A system of mailing forecasts to as many stations as could be reached the same day from the central office at Raleigh was also inaugurated.

In October, 1891, advantage was taken of the opportunity afforded by the presence of the Southern Interstate Exposition at Raleigh to popularize the work of the meteorological division, and, with the assistance of the Chief of the Weather Bureau, an exhibit was made of all the instruments employed in meteorological investigations, with many charts, pictures of typical cloud formations, etc. Complimentary tickets to the exposition were issued to all voluntary observers and displaymen, not as compensation, but as a token of appreciation of the services they have rendered the State by their voluntary labor. The exhibit was of a nature to attract attention and was viewed with great interest by many people.

The rooms occupied by the State weather service are located on the third floor of the Agricultural Building, corner of Edenton and Halifax streets, and are well lighted, large, and comfortable. The work at the central station is rapidly increasing. In April, 1892, the issue of the regular morning weather map was commenced. It is posted at 10 places in Raleigh, and mailed to 20 towns in the vicinity.

During the past year the number of stations receiving weather forecasts by telegraph has been increased from 24 to 55. The number of stations receiving frost warnings has been increased to 46. The forecasts and special warnings are disseminated by means of the regular system of flags and whistle signals used by the Weather Bureau. Stations receiving the daily forecasts are all provided with complete sets of 5 flags; those receiving frost warnings only have the cold-wave flag. The frost-warning stations are scattered chiefly in the tobacco-raising districts.

Since January 1, 1892, forecasts have been issued regularly every day (except Sundays) for a period of thirty-six hours in advance instead of for twenty-four as heretofore. This has enabled the director to establish a large number of stations, which receive the forecasts by mail from Raleigh on the same day they are issued. Small frames have been supplied and the forecasts are posted for the benefit of farmers. This system has met with marked approval. The number of stations receiving forecasts by mail is now 160.

The value of the forecasts is undisputed. It depends on the skill of the farmer in understanding and utilizing them. Many farmers who receive the frost warnings neglect to take precautions or make any effort to protect their crops, and hence suffer loss. In the spring the frost warnings are of special value in the southeastern part of the State, where early fruit (strawberries) and truck crops are raised.

The Weekly Weather Crop Bulletin has been received with increased favor. One thousand two hundred copies are printed and distributed every week. The appearance of the bulletin has been improved by a new heading and a rearrangement of the reading matter into more convenient form. The number of crop correspondents is 300, of which number 150 report with great regularity. A dozen new 3-inch rain gauges were issued in June, 1892, making the total number of correspondents who report rainfall about 36.

The change in the date of publication from Saturday to Monday has been very acceptable to the press of this State. Most of the weekly papers are published on Wednesdays, Thursdays, and Fridays, and under the new arrangement are enabled to publish the crop bulletin the same week as issued, which was formerly not the case.

As evidence of the value of the crop bulletin may be cited the fact that the substance of it is telegraphed to a number of papers; that a large number print the bulletin entirely or in part; that certain merchants at Raleigh have special lists of persons to whom they mail the bulletin at their own expense.

The monthly meteorological reports have been issued regularly during the year. An improvement in the arrangement of the matter was made at the beginning of the year 1892, the latitude and longitude, elevation, and name of observer being given for each station. The number of monthly reports issued is 600. Each report averages 16 pages in length.

The annual report of the State weather service for 1891 is nearly completed.

The edition to be printed is 4,000 copies. The report will be used as part of the exhibit of the North Carolina Department of Agriculture (State weather service) at the World's Fair.

During the years 1891 and 1892, 6 stations taking meteorological observations were established and 4 discontinued.

The total number of stations from which reports are received is 52.

NORTH DAKOTA.

(W. H. Fallon, Weather Bureau, director.)

As instructed in letter from the Chief of the Weather Bureau, dated Washington, D. C., July 23, 1891, steps were immediately taken to inaugurate a North Dakota weather service, which was finally consummated August 15. Prior to that date the work was conducted conjointly with the service of South Dakota. The number of stations then established in North Dakota, 24, served to form a splendid nucleus for a beginning. At date, monthly meteorological reports are received from 40 stations, including 4 regular stations of the Weather Bureau and 1 army post. During the year 17 voluntary stations were established and 6 discontinued. Although the above figures show but a gain of 11 stations, there was an actual increase of 14, as 3 of those transferred never rendered a report.

At time of transfer, August 15, 1891, there were 13 stations receiving daily forecasts for display of weather and temperature signals. Since then 19 additional have been established and 7 discontinued, making at date 25 in coöperation. All but 5 of this number have procured their own flags. The forecasts are supplied to all

stations through the St. Paul and Minneapolis offices, on account of their facilities for quick distribution. In addition to the above number of display stations, there have recently been established 9 stations for special warnings of frost.

The first issue of the Weekly Weather Crop Bulletin was made for the week ending April 9, 1892. Since that date an average of 250 copies have been issued weekly. The work of obtaining crop correspondents was pushed vigorously during the first two months of the present calendar year, and every opportunity taken since to secure additional ones. At date 110 names are on the list as correspondents, representing every county in the State under cultivation. On an average, 75 of the correspondents render a report weekly. The bulletins are printed in full every week by at least 5 dailies and 5 weeklies, and occasionally by 4 dailies (two in Minnesota) and 15 weeklies. In such a thinly populated State as North Dakota this fact alone shows the interest taken in the work. In fact, this branch of the State service is the most important feature of all, and it is safe to assert that at least three-fourths of the intelligent farmers of the State read the reports. Many commendatory expressions have been made and received.

For the first half of the fiscal year the monthly bulletin was an extremely condensed, crude affair. Since March it has steadily improved in appearance and increased in size, and to-day it contains as much important climatic data as any similar publication received from the other State services. This improvement in the bulletin and increase in its edition was brought about, firstly, by the assignment to duty at this station of an assistant, and, secondly, through the aid received from the Bismarck Chamber of Commerce in printing, at its own expense, the bulletins in pamphlet form. The number of bulletins issued monthly has increased gradually from 100 in August to 200 in June, making an average issue of 150 copies.

No aid is at present received from the State for prosecuting this work; but such aid is practically assured from the next legislature, in January. The Bismarck Chamber of Commerce has obligated itself to bear the expense of printing the bulletins and providing an additional office room until aid is received from the State, which fact alone will cause its members to work hard for the legislation. The subject was also broached to a large number of the legislators during a late special session and met with much favor and promises of help.

In reviewing the work accomplished by this service during the past year, it is respectfully requested that the Chief of the Weather Bureau consider that the entire population of the State is less than 200,000; that an extremely large number of this population are foreigners, unable to speak or read English; and that, excepting along the lines of the Northern Pacific and Great Northern Railroads, the western half of the State is practically unsettled, making it extremely difficult to obtain but a few voluntary observers in that section.

OHIO.

(L. N. Bonham, director; C. M. Strong, Weather Bureau, assistant director.)

During the last half of the year 1891 the general work of the service was carried on as in preceding years, reports being received and published monthly. The same plan was carried out until, by an act of the legislature on April 12, 1892, the Ohio meteorological bureau was abolished and a "State weather and crop service," under the auspices of the State Board of Agriculture, was established. The duties to be performed by the old service were strictly the reception and printing of reports from voluntary observers; under the new law the duties are enlarged, not only to include those of the old service, but also adding thereto the publishing of a weekly weather crop bulletin, the issuance and distribution of weather forecasts, frost, cold wave, and flood warnings, and all other matters pertaining to the climatology and meteorology of the State. The law also created the offices of director, assistant director, and one or more local experts; the director and local experts to be appointed by the State Board of Agriculture.

The distribution of forecasts of weather and temperature, cold-wave and frost warnings from Washington, Cincinnati, and Cleveland was conducted through the local service during the year. At the opening of the year 25 points displayed these signals, but through the efforts of the service and the generous cooperation of the Chief of the Weather Bureau the number of points has been increased to 88 at the close of the year. Besides these, 6 points receive frost warnings only. The messages from Cincinnati and Cleveland are prepared by the local forecast officials at those points from the morning weather maps and telegraphed to the central office at Columbus; they are then distributed to points over the northern and southern sections of the State to which they apply. These messages cover the weather conditions for the thirty-six hours following. At the points receiving these messages they are either displayed by means of flags or sounded by means of whistles for the benefit of the surrounding communities. Of the two methods the latter is proving by far the most successful, as the signals can be heard by means of powerful whistles for miles away from the point of dissemination. The resulting benefits to all classes

from the present wide distribution of these daily weather messages are proving to be very great. Thousands of farmers are enabled to obtain this information and act accordingly during the season of cultivation and harvesting, and have been enabled to carry their operations to a more successful issue than they were capable of doing before this information was at hand. Merchants are using it in their shipments, builders in building operations, and hundreds of others benefit by it in the common walks of life. The cold-wave warnings during the past winter were very successful, and were highly commended by the people in the different parts of the State. The local newspapers of the different communities have taken great interest in this branch of the work, and publish in each issue the weather forecast and such other information obtainable for the benefit of their readers. At all points where the messages are received they are regarded as indispensable, and are eagerly watched for and acted upon. It is the intention to carry this information to every community in the State that desires to receive it, as it is one of constant benefit and should be enjoyed by all.

The first issue of the Weekly Weather Crop Bulletin was made April 9, 1892, consisting of 1,500 copies; this number was increased to 2,000 copies weekly April 15, and to 3,500 copies June 13, 1892. Requests are received daily for the report, and the issue will have to be further increased before the close of the current season. The numerous applications for the report are satisfactory evidence of its value and popularity with the people, and the agricultural class in particular. It is eagerly sought after and published by the newspapers of the State at large, and by their means carried to thousands whom the service could not reach otherwise and supply with the information in the bulletins. Over 700 daily and weekly newspapers of the State are supplied with this report on the day of issue and publish the data in full or in part. The number of crop correspondents now exceeds 700; of these, on an average, 500 report weekly, and at times reports are received from the full list; the number of reports varying as the press of work permits the correspondents to meet the demands on their time; uniformly, however, the duty of reporting promptly is attended to, and sufficient reports are received from all counties to give an accurate and fair statement of the prevalent conditions. The correspondents are all men who make agriculture their business, and are to be depended upon for the reliability of the statements forwarded to this office. In connection with this work the establishment of rainfall stations reporting maximum and minimum temperature readings and amount of rainfall has been commenced, and 50 correspondents have been supplied with these instruments in different parts of the State during the month of June. It is the intention, as the means at hand permit, to supply all correspondents and thus render their reports of direct value as to statements in regard to temperature and rainfall in connection with the crop condition.

Reports were received during the year from 5 Weather Bureau stations and 71 voluntary stations. Fifty rainfall stations were established at the close of June.

Much more effective service could be secured in the distribution of the local weather forecasts if the local forecast official was stationed at the State central office, or by the distribution of the forecasts directly from the office where they are made. A great deal of valuable time is lost through the transfer of the message, averaging over an hour each day. A great increase in the distribution of these messages could also be secured by supplying each displayman with cards to send copies of the messages through the mails to surrounding towns and to persons who will be benefited by the information.

In this connection I desire to say that great credit is due to the voluntary observers of this State for their uniform willingness and promptness in rendering reports. At no time during the year has any complaint been made in the performance of the arduous duties imposed necessarily for a proper performance of the work. Very few reports are missing from the records, and their value is correspondingly increased by their continuity.

To further increase the efficiency of the local service, the suggestion is offered that it would be advisable to include the crop correspondents on the list of persons to whom the reports of the Department of Agriculture and the general Weather Bureau are sent.

The director desires to express to the Chief of the Weather Bureau the thanks of the service for his generous cooperation and assistance rendered during the year, without which the local service would have been seriously crippled and unable to have carried on the work so successfully.

OKLAHOMA.

(Louis Dorman, Weather Bureau, director.)

On July 23, 1891, the observer at Oklahoma City was instructed by the Chief of the Weather Bureau to take steps toward the establishment of a State Weather Service for Oklahoma Territory, and was at the same time appointed director of it.

Circulars were accordingly sent throughout the Territory, calling for voluntary observers, but it proved a difficult task to secure them, due in part to the recent settlement of this Territory and the unsettled condition of affairs in general at that time, and partly to the fact that everybody was intent on the opening of the new lands. No pains were spared, however, and the efforts of this office continued until at the present writing there are in active operation 20 stations of observation besides 2 stations which report rainfall only. The service is now established on a solid basis and will expand as the new counties lately opened are more densely populated and better mail facilities are provided. During the year 9 weather forecast and special frost and cold-wave stations have been established in the two Territories. The necessary flags have been furnished by the Government and the telegraph messages are sent to the different stations from Kansas City at Government expense. Although considerable benefit has been derived from these messages by the public, it has not been so great as it would have been had the a. m. forecasts been telegraphed instead of the p. m., as has been the case. At present the former are sent and the increased benefits are quite perceptible and the forecasts give much greater satisfaction to the general public.

The weekly issues of the national and State weather crop bulletins were resumed on April 9, 1892. Two hundred bulletins are issued at this station every week, printed in column size on sheets 10 by 15. A remarkable interest is taken by the farmers at large in these weekly crop reports and the local press comments very favorably on the same.

Fifty-seven crop correspondents report to this office.

The Evening Gazette prints the editorial portion and the rainfall report on Tuesday afternoon, the day of issue, and the whole report in the weekly edition on the following Friday. The Times-Journal prints the report in its entirety in the Wednesday morning issue and also in the weekly paper.

Sixty monthly reports are printed at this station. They contain meteorological data from 23 stations, comprising daily maxima, daily minima, and daily mean temperatures, daily rainfall, and a summary of miscellaneous data.

Twenty-two stations are in operation. Fourteen stations have been established during the year. One station (Chandler) was abandoned by reason of inability to secure an observer. One station (Sae and Fox Agency) was established in its place.

Six counties in the western portion of the Territory, opened to settlement on April 22 last, are not yet represented on the monthly reports. It is recommended that stations be established at each county seat of those counties as soon as mail lines will have been established, which will probably be done during the next six months.

OREGON.

(H. E. Hayes, director; B. S. Fague, Weather Bureau, assistant director.)

There has been an increase in the number of weather forecasts of from six displaymen in 1890-'91 to thirty-one displaymen on June 30, 1892. During the year special display stations have been established in the city of Portland, the forecasts being delivered by messenger. There has also been established a very complete system of railway train bulletins, covering 700 miles, representing 149 stations on the Northern, Union, and Southern Pacific railways, the Oregon and California Railway, and the "Oregonian Railway." This is the first year of general dissemination of forecasts in Oregon, and they meet, with popular favor. There have been words of praise for the forecasts from every section of the State, but owing to the newness of the service the people have not learned to appreciate them and depend upon them as when they are more fully understood. Then, too, there is not that interest in the forecasts in Oregon at the present time that there is in other States, owing to the regularity of the climate and the fact of few interests to be affected. I am pleased to say, however, that where the forecasts are displayed the people appreciate them and would not wish to see them discontinued. By an extension of the forecasts to the more rural section, together with continuous and good service, there will be greater benefits and popularity will ensue.

The weekly crop weather reports have been the great feature of the service, and they have received commendation from the press and people of the State. Being issued with regularity, representing every county and almost every election precinct in the State, there has been most accurate and trustworthy information laid before the people. All reports are issued at the same time so as to prevent any sign of favor in their distribution and every newspaper is furnished with a copy.

The leading papers of the State base their editorial opinions relative to the crops on the weekly reports, and many papers rely entirely on the bulletins for their information as to the growing crops. In the editorial part of the weekly bulletins special attention is paid to the general development of the crops, conditions that

will prove favorable to them, the general outlook and prospects; and in the four years of the service in Oregon the reports have proved to be accurate, and the outlined prospects as published have proven to be correct, hence the reports have a reliability for accuracy and are appreciated. There are 225 bulletins issued each week, mailed principally to the Oregon papers, and they are published in over 120 newspapers, sometimes as a whole, sometimes part, and then paragraphs are extracted and made as "locals." There are 285 crop weather correspondents. The monthly reports embody climatic matter, original articles on subjects pertinent thereto, and tables giving general meteorological data. They are printed by the State of Oregon in the State printing office; 2,000 copies are issued each month, and average from 25 to 35 pages.

The number of reporting stations has been increased from 53 to 65 during the year, and 90 per cent of the reports are regular, complete, and accurate. There were 3 discontinued during the year on account of the number of instruments broken and neglect of work.

Soil observations have been continued during the year at Pendleton and Corvallis.

Barograph and thermograph records are made at 4 stations.

The funds of the service, appropriated by the State, are expended for instruments and equipments. By the State constitution the printing is done by the State printer. The State has so far given the service admirable support, and judging from the interest taken in the service by the press and public, it is appreciated.

By cooperation with the Oregon Agricultural College a systematic study of the effects of the various climatic conditions on the growing crops is being carried on. The hot, dryings winds of May and June do the damage to the wheat crop, and this is especially the point for valuable study.

From personal experience I have found that the best thing for the service is to visit the various voluntary observers, become acquainted with the people, study their surroundings and occupations, attend the meetings of the agricultural societies, farmers' institutes, horticultural society meetings, grange meetings, etc., read prepared papers on subjects pertaining to the Weather Bureau and its relation to the people.

PENNSYLVANIA.

(W. P. Tatham, director; H. L. Ball, Weather Bureau, assistant director.)

During the year the work of the service has increased steadily, both in the accumulation and distribution of meteorological data. Special attention has been given to improving the system of disseminating the forecasts and warnings. To this end cooperation of the principal railroads was invited, and circular letters were sent to principal newspapers in the State, informing the public that display stations would be established wherever the needs of the community demanded such a display. The result of this has been a revival of the railroad bulletin system and the establishment of many stations at points where the forecasts were never before displayed.

On the Pennsylvania Railroad system bulletins are displayed daily at 133 stations. On the Frederick division of this road the signals are displayed from the baggage car on two trains.

The Philadelphia and Reading Railroad display bulletins twice a day at 333 stations. In addition, 250 flag-display stations are in operation on this road.

Forecasts, cold-wave, and frost warnings are sent from Philadelphia, Pittsburg, and New York City to about 50 persons, who display them by flags or by steam whistles.

About 15 stations display flags from forecasts received from the railroad office without expense to the United States.

Other and important means of disseminating the forecasts are through the efforts of the voluntary observers. Some of them are centers from which bulletins and messages are sent to inland towns which would otherwise be deprived of the forecasts, being cut off from telegraphic communication or without means of obtaining the daily papers in time to make the forecasts of value. The observer at Phenixville has six towns to which he telephones the forecasts. At Selins Grove the observer sends messages to three towns about 5 miles distant from his station.

At Johnstown bulletins are prepared and sent to about 30 stations on the Baltimore and Ohio, and Pennsylvania railroads.

I was surprised to learn while conversing with the voluntary observers of the great interest shown by the farmers of their neighborhood. They said that often farmers, whom they had never seen before, would call upon them for information in regard to the weather, and that they were frequently consulted by men of other occupations, as tin-roofing, plumbing, house-painting, etc., before entering upon work that would extend over several days. The constant and increasing demand for data furnished by the State service and the Weather Bureau best shows in what esteem and of what value their work is to the public.

Many letters have been received from men who may be considered to stand in such relation to the public as to voice its sentiment. The following is from the observer at Wilkesbarre, Dr. A. W. Betterly, and is but one of many: "Our farmers are deriving great advantages from the labors of the Weather Bureau. They are learning to consult the weekly bulletins which are being published in our local newspapers, from which they learn that like produces like. The wide publication of these crop bulletins is stimulating extra efforts among our cultivators to show their proficiency as compared with their brother farmers throughout the county; and notwithstanding their recognized intelligence and observing faculties, this general awakening has inspired a desire to still further advance in their methods to overcome the perplexities which arise from our varied seasons. Even those 'away back,' who once declared that education was not essential in their business, now admit that a knowledge of the changing seasons and disturbed elements surrounding them, is necessary for the intelligent and successful cultivation of their land. Truly the labor of the Weather Bureau is resulting in great improvements in agriculture."

In Pennsylvania most of the crops are safely housed before time of frost, unless the frost is unusually early. Tobacco is most exposed, and attempts were made to establish a system of stations from which warnings could be given to the growers. This crop is raised principally on a small scale—that is, fields of from 1 to 5 acres on a farm. Hence it would be difficult to establish a sufficient number of stations to make the warnings of benefit to many; but, as quoted from the foregoing letter, the farmers are awakening to a realization of the value of these warnings, and strenuous efforts will be made to establish a complete system for these warnings.

To do this, certain points must be selected as centers from which the warnings can be sent to inland towns and villages. This plan has already been started and will be followed up wherever practicable.

The Weekly Weather Crop Bulletin continues to be one of the most valuable features of the State service.

On an average 340 are issued weekly by duplicating process. These are widely distributed through the city and State, and are regularly published by a large number of daily and weekly newspapers. The number issued being limited by reason of having to use a duplicating process, we used strenuous efforts to make the bulletins of such interest as to attract the attention of the press throughout the State, and in this way many thousands can be reached who would never see the bulletins if printed and circulated by mail. Seventy-five correspondents furnish the data from which the bulletin is made. The correspondents are zealous in the work, and send reports from every section of their county.

I know of no way in which to express the value of these bulletins other than to say that they are highly praised by all, and judging from their extensive publication, they meet a long-felt want in giving accurate data to the public at regular and short intervals.

One hundred and forty copies of the monthly reports are issued by duplicating process. Great care is taken to make these bulletins accurate and attractive. These are regularly printed in full in the annual report of the Secretary of Internal Affairs, and of the Board of Health of Pennsylvania.

Fifty-eight voluntary meteorological stations are in regular operation. Some few are located at schools which close during the summer months.

The voluntary observers, as a whole, are deeply interested in their work, and are extending in many ways the usefulness of the service.

Most of them regularly furnish their local papers with meteorological data and with crop bulletins.

Nine voluntary stations have been established during the year, of which all but one were furnished with instruments belonging to the State; and two stations have been discontinued.

When appropriations are obtained from the State, each station will be visited at least once in each year.

About one-third of the stations were visited during March, and the resulting good was at once apparent.

By these inspections it is believed that many local improvements may be made in the way of disseminating the work both of the State service and of the Weather Bureau.

SOUTH CAROLINA.

(A. P. Butler, Weather Bureau, director.)

The service has been to some extent restricted in consequence of the State making no appropriation of funds to supplement the amount appropriated by Congress to enlarge and carry on the work.

Previous to 1891, the weather bureau was run as a branch of the work of the State Department of Agriculture, and had both the encouragement and assistance

of the commissioner, as well as liberal financial support. The legislature refused to grant the amount asked for, thereby crippling the extension of the service.

The correspondents have responded to the call made upon them, and have generously contributed to the success of the crop reports which have been appreciated by the public. These reports have been condensed and published in the daily local papers immediately after issue from the central office, and is furnished to all of the State dailies and to 82 country papers; to correspondents, as well as to a number of stations, individuals, and daily papers in other States.

From the date of the last annual report to the 30th of June, 1892, there were 24 stations receiving the daily weather indications and cold-wave warnings, and displaying the proper signal flags to the public, and many more could have been added if the flags could have been furnished to parties who were anxious to display them.

There are at present 21 stations which furnish this office with miscellaneous data, temperature, rainfall, sunshine, and other phenomena. The data is collected and summarized and sent to the Chief of the Weather Bureau and published in a daily paper of this city.

SOUTH DAKOTA.

(Sam. W. Glenn, Weather Bureau, director.)

Under instructions from the Chief of the Weather Bureau dated August 18, 1891, all property, etc., relating to North Dakota was transferred to Bismarek, N. Dak. Since that time only the South Dakota service has been under my charge.

I feel justified in saying that the improvement in the service has been marked, and the benefits to the people, and their appreciation of them far greater than in former years. The aims of the service have become more widely known and better understood, and the reports issued from the central office are looked upon as more accurate and reliable.

There is, also, more care evinced by persons coöperating in the work. One of the most marked indications of growing influence is the number of visitors to the office from this and other States through local or scientific interest. The presidents of the several important educational institutions in the State have called upon the director and found great interest in his work. Members of the several faculties and superintendents of public schools have also found time and occasion to examine the work and be instructed in the working of the instruments at this station.

In the Huron schools a class in meteorology was formed, before whom the director read a paper on "practical meteorology." This class visited the office and received instruction in the practical work of meteorological observations, and had the mechanism and operation of the instruments in use explained to them. It is the intention of the principal to greatly increase the facilities for instruction in this science during the coming scholastic year, in which work the director, by request, will coöperate by practical instruction and lectures.

There is also a class in meteorology in the State Agricultural College, and the president, Prof. L. McLouth, speaks very highly of the weather chart as an aid in their instruction. Prof. Mauck, president State Institute, Vermillion, has several times expressed his appreciation of and interest in the work, and Prof. Akely, of the faculty of the same institution, expresses a high appreciation of the work and the value of the weather charts as aids to the study of meteorology.

Farmers are beginning to look upon this office as a bureau of information for their benefit, and there is hardly a day when several do not call. Prospective settlers are very frequent visitors.

Information requested by letter is always promptly furnished, and in this way the work is becoming widely known.

All but 4 of the stations now receiving forecasts have been established since July 1, 1891. Nine have been discontinued during the year—1 because displayman removed from the town, 1 temporarily, and 7 because of continued failure of displaymen to comply with the requirements.

There are now in operation in the State, outside of regular weather bureau offices, 63 stations receiving the forecasts.

It is believed that the forecast service in the State, as a whole, is very satisfactory, and that confidence in the daily forecasts and warnings is growing. It is found that the longer a station can be kept in operation the more the people appreciate the forecasts, although the displayman may occasionally lapse in his attention to the display.

Whenever it is convenient interested persons prefer inspection of the forecasts to depending alone upon the displays, especially with regard to thirty-six-hour forecasts.

In response to a circular letter relative thereto, it is found that at most points the service is highly appreciated, and, while of value to all classes and industries, the

farmers are undoubtedly the most benefited, especially by frost and cold wave warnings.

During the autumn of 1891 and spring of 1892 frost warnings were disseminated by mail to all points that could be reached in season to be of value, and telegraphed to Rapid City and Pierre. They were generally heeded, and were utilized by farmers and "truck" gardeners.

The observer at Rapid City reports that the cold-wave warnings based on the p. m. charts would have been of more value had they been transmitted to him from Omaha immediately after he had filed his a. m. signals, which was possible by his office being connected with the main line by "loop." The forecasts are published daily in the Black Hills by the Deadwood Times and the Spearfish Bulletin, with appropriate symbols.

The Weekly Weather Crop Bulletin continues to be a very important and highly appreciated feature of State service work, and is in demand.

Through an arrangement with local newspaper publishers, it now appears in printed form, with a neat heading, and thereby attracts more attention than formerly, and is much more easily read.

The average weekly issue is 300 copies, for actual demand, while 25 copies are made as a reserve supply from which to draw for needs subsequent to the day of issue.

In seeking reporters for the bulletins of the present season, care was taken to obtain practical and responsible men, engaged in, or closely related to agricultural pursuits; consequently the editorial portion of the bulletin presents more closely the actual facts than formerly and gives more general satisfaction. In order to accommodate the bulletin to the limited space available for its publication in most of the newspapers, it is condensed as much as possible.

It is published in two daily papers issued from Huron; two at Pierre; one at Sioux City; three at Minneapolis; three at St. Paul; four at Chicago, and four weekly issued from Huron.

Through an arrangement made with the Publishers' Printing Company, Aberdeen, S. Dak., they use it in their ready prints, and, according to a list just furnished to this office by the manager by this means, it appears in 48 weekly papers published in South Dakota.

There are 125 correspondents, and the number is increasing as fast as the proper men can be found.

A monthly meteorological summary is issued, embodying all of the data contributed by the voluntary observers, also showing in charted form the conditions of temperature, precipitation and wind, and the normal temperature and departures therefrom. In addition, advance normal data for the State is exhibited, and comparative data from the records at this station.

The monthly summary is attracting much favorable attention, and has served to stimulate the voluntary observers in their work. It is looked for with interest, and this office is soon informed if one miscarries. Many of the recipients file them away carefully.

A carefully transcribed and compared copy of all data appearing on the reports from the several stations is preserved at this office for use in future reviews and essays, and for reference and the information of the people in individual cases of inquiry.

One hundred and sixty copies of the summary are now issued for actual demand, and 15 kept for occasions of need.

During the year 16 stations reporting temperature, precipitation, etc., and 14 reporting precipitation only, have been established, while 8 others, where unreliable private, or only "dry" W. B. thermometers were in use, have been equipped with W. B. self-registering instruments.

There are now in operation 44 stations reporting temperature, precipitation, etc., and 14 now, or will soon be, reporting precipitation only.

It is believed that most of the latter can be established as full reporting stations at the pleasure of the Chief of the Weather Bureau, as all of the observers are men who appear to take interest in their work.

Under authority of the Chief of the Weather Bureau (S. W. S., Div. 2-27-92) a limited number of gauges of exact dimensions and proportions of the standard W. B. gauge, made of tin and galvanized iron, were manufactured here, and sold to persons at certain selected points in the State at a merely nominal sum, in order to induce them to cooperate in the work as special rainfall reporters. Fifteen of these gauges have been located (limit 20) and doubtless good results will follow.

I beg to submit, that could the Bureau supply the voluntary observers with instrument shelters, it is believed much improvement would be seen in the records. While very many have constructed shelters, some very rude, and some good ones, there are doubtless some instruments exposed to danger of injury from storms and unauthorized persons.

I have reason to believe that could all stations in the State receiving forecasts be supplied with Government flags, more attention would be given by the displaymen to the prompt and continuous display of the signals.

TENNESSEE.

(J. B. Marbury, Weather Bureau, director.)

This service was known as the Meteorological Department of the State Board of Health, and its work was done under its supervision, with Dr. J. P. Plunkett as director, until October 16, 1891, when the State weather service was organized.

On December 16, 1891, as per instructions from your office, the title was changed to the Tennessee Weather Crop Service.

The changes in the list of voluntary observers since the last report have been comparatively few.

As a rule, the reports now received from observers are much more complete and accurate than they were one year ago. This improvement is due to a great extent to the numerous letters of instruction sent out during the year. The close of the year finds a very efficient corps of observers who report regularly to this office each month. They deserve a great deal of credit for giving their time and energy to this work, with no pecuniary returns. This is additional evidence of the growing interest in this branch of the general Government.

The number of unbroken records of rainfall is now sufficient to arrive at a reasonably correct normal for the State for each day of each month during the period of ten years. This data is now being tabulated in convenient form which, as soon as completed, will form a valuable addition to the records of this service.

It is also intended to work up the temperature, etc., in a similar manner, as soon as possible.

Immediately after organizing the Tennessee Weather Crop Service the director made strenuous efforts to obtain the cooperation of the department of agriculture of this State, so that the monthly reports of this service could be published in connection with those of this Bureau, but failed.

In order that these reports might have a wider circulation and be presented to the public in a better manner, I arranged for the publication of a monthly journal, the expense to be met by the money received from advertisements. This I am glad to say has proved successful, and on December 16, 1891, was issued the first number of the "Tennessee Journal of Meteorology," which has made its appearance regularly each month since. Through the liberal patronage of its advertisers and the friends of the service, I have been enabled to gradually improve each number, and the last issue is a marked improvement over the first. I have reason to think that I can make still greater improvements in this feature, as well as the general service during the ensuing year. The "Journal" now has a circulation of 1,000.

The most important of this service is the issuance of the weekly weather crop bulletin from the 1st of March to the 1st of November. Five hundred of these bulletins are printed by the milligraph process each Tuesday, and immediately mailed to the various State weather services, the press of this city and State, crop reporters, and others.

The daily forecasts, frost, and cold-wave warnings have been sent regularly to various persons throughout the State. The interest in these is on the increase, and more confidence is now felt in them than ever before. Many others could be furnished with these reports did the time of departure of mails admit of their reaching their destination in time to be of benefit.

Data collected by this bureau has been furnished the press, colleges, and railroads, during the year, and has been of much value.

It is earnestly hoped that during the coming year several new stations may be organized and equipped with a full set of instruments, and some that are now using their own instruments, many of which are of an inferior quality, be furnished a standard set.

TEXAS.

(D. D. Bryan, director; Dr. I. M. Cline, Weather Bureau, assistant director.)

The Texas weather service is a local organization receiving no aid whatever from the State. It is operated by the National Weather Service cooperating with the Galveston Cotton Exchange. The national service furnished the necessary instruments and the force at the central office for managing the business and handling the reports. The Galveston Cotton Exchange has appropriated \$400 per annum, to be expended in publishing bulletins and reports, and for collecting any special data which may be desired in the interests of the service,

While the number of new stations opened during the year has been small, there has been a marked improvement and an increased interest in the work of the service on the part of the voluntary observers. There are 71 voluntary observers, 6 post surgeons, and 7 regular observers, who render reports to this office monthly, making a total of 84 stations which are fairly well distributed over the State, although additional stations are desired, and application will soon be made for some new ones; 80 stations were discontinued during the year and 11 new ones established. The voluntary records are upon their receipt at this office, carefully examined and corrected, and the daily temperatures, maxima and minima, together with the daily precipitation, are published in the monthly bulletin, 500 copies of which are distributed free each month.

A weekly bulletin is issued by the typo-stencil duplicating process each week in the year, and the already marked popularity of this feature of the service was greatly augmented at the opening of the present growing season by the issue of a supplementary shaded chart (shaded by the Dey shading apparatus) showing the distribution of precipitation over the State. This chart has been prepared by the duplicating process up to the present, but the interest in this feature has become so great that the Cotton Exchange has authorized an additional expenditure for county maps of the State on which to exhibit the precipitation by shades, both weekly and monthly. Three hundred and fifty weekly bulletins are issued and distributed each week. This bulletin is telegraphed on the date of its issue to the following daily papers in Texas, outside of Galveston, which publish it in full: Dallas News, Fort Worth Gazette, Austin Statesman, Waco Day, San Antonio Times, and Houston Post. The substance of the bulletin is telegraphed to a large number of daily papers outside of the State. Special reporters have been secured in about two hundred counties, and these men display an interest which is deserving of very high commendation.

Weather forecasts and special warnings are sent to 36 places by telegraph at Government expense, and are furnished with the p. m. map to about 30 towns which are reached early the following morning. All communities receiving the forecasts express themselves as highly gratified, and state that they are of great value. It is hoped that this feature of the service may be considerably extended during the coming year.

The assistant director has continued the collection of data during the year relative to indigenous plants growing in different sections of the State with particular reference to the time of germination, flowering or fruiting, and ripening the fruit, for use in making a study of the agricultural climatology of the State. The extensive area covered by this State (nearly one-eleventh of the area of the United States, Alaska included), its varied topography, and elevation, ranging from sea-level to about 6,000 feet above, give it a diversity of climatic characteristics, and these call for a diversity in agricultural pursuits which is attracting considerable attention, but of which very little has yet been learned. It is believed that a carefully compiled report giving statistics bearing on the above subject will result in great benefits to the agricultural interests of the State generally.

With a view of improving forecasts issued from this office, the collection of information relative to thunderstorms was commenced in May, and special reports of each separate storm are received from about 200 counties, which will be studied to the best advantage possible by the assistant director.

In closing this report I desire to say that the generosity of the Chief of the Weather Bureau in extending and supporting this service is highly appreciated by the public generally.

UTAH.

(George N. Salisbury, Weather Bureau, director.)

During August, 1891, in obedience to directions, effort was made to establish a service, the first circular being issued on August 12 to the press of the Territory and others likely to be interested, and to aid in developing the service. Not enough interest was thus awakened to be encouraging, as no party or corporation decided upon the purchase of instruments or flags, though there were some responses, chiefly applications for the position of observer by those who thought there might be "something in it."

In September the Utah service was organized by the transfer of the voluntary observers of the national service in Utah to the charge of the director of the Utah service at Salt Lake City. Of these, all but 3 stations were supplied with Weather Bureau instruments. Since then 5 stations have been established, equipped with instruments supplied by the Bureau.

On the 23d of September the forecast official at San Francisco began to telegraph a forecast for Utah to the observer at Salt Lake City, but before the service was

fairly organized, it was announced in letters from the Chief of the Bureau that no more funds were available for telegraphing forecasts at Government expense, and no more flags available for issue to display stations. As the forecast was at first an experiment, it was necessary to wait some time to learn if it would apply to a greater part of Utah as well as to Salt Lake and vicinity. Although the community, in circulars and bulletins was urged to do so, no party or place agreed to purchase flags or pay for telegraphing predictions. In November the Rocky Mountain Bell Telephone Company began transmitting the daily forecast to their stations, viz, Alta, Bingham, Logan, Ogden, Park City, Provo, Stockton. In January the Rio Grande Western Railway began telegraphing the forecast to their agents at Springville, Pleasant Valley Junction, and Green River, for display in bulletin frames. No special warnings have been made for the agricultural interests. It is not known that there have been any decided benefits from the dissemination of forecasts. Warnings during the periods when frost affects the young crops in spring and the unmaturing crops in fall, would be of decided benefit, if timely and well displayed.

The weather-crop bulletin service was organized, in a tentative way, during last spring, and the first bulletin issued for the first week in April. Since then it has been issued weekly; average number of copies 60, which gives a copy to each correspondent, and to the press of the Territory, and various other parties. Its value has not been well determined; it has been published by the weeklies of the Territory, and the dailies of this city; it appears to be appreciated by the recipients. There are 27 regular correspondents representing 20 counties; 6 counties are unrepresented, 5 of which have almost absolutely no agricultural interests.

A monthly meteorological report has been issued since September; its readable summary has been much copied by the newspapers, and the report is apparently read with interest. Facilities for its preparation have been very poor, and with the present state of the mails it can not be prepared before the 15th of the month succeeding that for which it is the record; some interest in it is manifestly thus lost. Every reasonable effort will be made toward its improvement. The average issue has been 75 copies.

Twenty-nine voluntary stations are in active operation at date. They have all been established during the year; 24 of them were transferred from the national service; 3 stations are delinquent and practically "dead;" 4 have been discontinued.

The work of the service in this Territory has been experimental, as I have suggested above, and also frequently in letters, and it must of necessity be so. I do not know whether I have done so or can make perfectly plain the conditions that exist. In the first place, farming is carried on only in narrow, scattered valleys, and by means of irrigation only, scarcely any rain falling during the summer months; hence the advantage of weather knowledge is not so self-evident as in most of the States and Territories. Then, too, communication by mail is slow, and the telegraph is not sufficiently extended. The "Deseret" telegraph line is the only one available for reaching many of the southern communities.

VIRGINIA.

(Dr. E. A. Craighill, director; J. N. Ryker, Weather Bureau, assistant director.)

On April 15, 1891, the Virginia State Board of Agriculture passed resolutions providing for the establishment of the Virginia weather service, and authorized the expenditure of \$15 per month for the publication of reports, to be made up from the reports of the voluntary observers in the State.

Of the 21 voluntary observers of this State who previous to the establishment of the State weather service had been reporting to the central office at Washington, D. C., 19 agreed to continue to furnish monthly reports through this office. The first number of the regular monthly bulletin of the Virginia weather service was issued on September 24, 1891, for the month of July, 1891, and consisted of an edition of 250 copies of an 8-page pamphlet containing 2 pages of summary and 5 pages of tabulated reports; the August and September numbers were issued on October 7 and November 7, respectively, and since that time each number has consisted of an edition of 250 copies, and published about the 25th to 30th of the month succeeding that for which it is a report. Copies are furnished to all the State officers, members of the Board of Agriculture, all State schools and institutions, superintendents of high schools, etc., and directors of other State weather services. During the year 11 additional voluntary observers have been appointed and 6 have been discontinued; 24 voluntary observation stations were in operation on June 30, 1892; 15 of which are equipped wholly or in part with Government instruments and 9 with private instruments of good quality.

Weekly weather crop bulletins were continued until October 3, 1891, and resumed March 19, 1892; the average weekly issue is now 165, and much interest seems to be

manifested in them by the general public, and they are published as a whole or in part by the leading daily and weekly newspapers of the State, while the Richmond Times, Richmond Dispatch, and Atlanta Constitution have them telegraphed at their expense. Beginning with June 7, 1892, the date of issue was changed from Saturday to Tuesday; this is resulting in an increase of their publication in the weekly newspapers of the State, and seem to be acceptable to all interests. Thirty correspondents send weekly reports to this office.

Regular weather forecasts are sent direct from the chief office, Washington, D. C., to 23 displaymen in the State, 21 of whom display flag signals, and two use whistle signals, while the chief train dispatcher of the Atlantic and Danville Railroad at Lawrenceville, Va., repeats the p. m. forecast messages over the company's wires to 25 other stations along that railroad, and the displayman at Bedford City repeats the a. m. forecast by mail to Peaksville, Va. In December, 1891, steps were taken looking to the distribution of p. m. forecasts by bulletin to be sent out by train and mail service, which resulted in the same being established, beginning with April 1, 1892; said bulletins are being distributed by mail to four points and by train service to 151 regular railroad stations; all the roads radiating from Lynchburg, (viz, N. & W., L. & D., C. & O., and H. & D. systems) have taken up the work, and I am informed that it is highly approved and appreciated by the public.

Cold-wave and frost warnings were also issued, as occasion justified, to the regular displaymen and to a number of other points. During the coming frost and cold-wave season it is expected to increase the distribution of the same by telegraph, while if such warnings can be issued along with the p. m. forecasts, they can be included in the bulletins issued by train and mail service.

We hope to be able to make arrangements whereby the p. m. forecast bulletins will also be distributed on some of the railroad lines intersecting the lines out from Lynchburg.

If a uniform style of instrument shelter could be furnished to all the voluntary observers, additional observers could be more easily secured in sections not now represented, and records would be more absolutely correct.

During the last session of the Virginia legislature, beginning in January, 1892, a bill was introduced which provided for an appropriation to furnish instruments and instrument shelters for additional voluntary observers, and to increase the size and issue of the monthly reports of the State service; it passed one branch of the legislature, but it failed of final action in the other branch. This delays for another two years any additional aid from the State, but the board of agriculture have continued, and will continue its monthly allowance of \$15 per month for publication of the regular monthly reports.

The interest in the reports of the National and State weather services is increasing throughout the State, and this will no doubt help to enlarge the work during the coming fiscal year.

WEST VIRGINIA.

(W. W. Dent, Weather Bureau, director.)

The work of establishing a State weather service in West Virginia was begun October 1, 1891. On account of the many difficulties met with the service has not attained that degree of usefulness throughout the entire State which is desired. The telegraph, telephone, and postal facilities are not as yet complete, but with the building of new railroads the sections of the State which do not now possess these facilities will be able to partake of the benefits to be derived from the work of the Weather Bureau.

On July 23, 1891, the Chief of the Weather Bureau informed the observer at Parkersburg that it was his desire to organize a State weather service for West Virginia, and pursuant to instructions contained in that letter the observer entered into communication with persons in various parts of the State relative to the establishment of such a service. In the progress which has been made in this work the director has been given valuable assistance by Hon. A. B. White, Messrs. W. M. Cox, and A. C. Love, and the State Journal of Parkersburg. By invitation of the State Board of Agriculture of September 28, 1891, the director went to Morgantown, W. Va., to consult with them relative to the contemplated organization of the State weather service. At this conference the board promised active coöperation in the work, and accepted a proposition to print the monthly meteorological reports of the State service, and to furnish a list of crop correspondents, etc. The first monthly report was issued on October 1, 1891.

In March arrangements were made for the issue of the Weekly Weather Crop Bulletin, and the first number of that bulletin was issued on April 9, 1892. The number of crop reporters has been constantly increasing, and at present these reports are received from thirty-five counties. The expense of printing the crop bulletin is also borne by the State Board of Agriculture.

Monthly reports are received from 35 stations, to which the Weather Bureau has furnished maximum and minimum thermometers and rain gauges; 10 stations report rainfall only; 25 stations display weather signal flags; 28 stations receive cold-wave and frost warnings.

The voluntary observers give close attention to their work, and interest generally in the State weather service is increasing.

WISCONSIN.

(Willis L. Moore, Weather Bureau, director.)

On July 20, 1891, the present official assumed charge. With the narrow field of action prescribed by the Signal Service and the numerous restrictions thrown around the observer in charge, it is probable that as thorough a service was then in operation as it was possible to establish, and my predecessor had blazed the way for much valuable work, which was strictly in the line of the progressive policy adopted by the Agricultural Department Weather Bureau. There is no question about the popularity of the service in this State to-day. By carrying out the directions of the chief its usefulness has been so extended that it is safe to say that hundreds are now receiving substantial benefit from our work who never before had given a thought to the subject.

One hundred and seventy weather display stations are now in operation against 42 on the previous July. Of these 153 receive their forecasts by telegraph daily from Milwaukee. In the majority of cases the display station is the nucleus of a thrifty farming settlement, and, owing to the contour of the country, the flags are usually visible from a radius of several miles. In former years the rule was to establish these stations only in large towns or cities. That this effort of the bureau to reach the agricultural interests is appreciated is evidenced by the fact that the expense of equipping these stations with flags, halliards, etc., and attending to the displays has been borne either by appropriation of the town councils or by popular subscription; and many places are now anxiously awaiting vacancies on our telegraphic forecast list.

It is hoped that it may be found consistent to authorize this office to establish 25 more display stations at such towns as apply for the same.

The authority given the local forecast official director to make forecasts for the State and issue frost warnings for the benefit of the cranberry and tobacco growers has resulted in greatly enhancing the value of the work of the Weather Bureau. One hundred and seventy display stations receive forecasts and frost-warning messages, 19 of which receive frost messages only. Four railroads carry frost signals; the M. L. S. & W. send all forecasts to their agents, and the C. M. and St. Paul send special information to their agents.

Forecasts now reach displaymen fully two hours earlier than was possible when they were sent from Washington, the a. m. forecast reaching displaymen nearly as early as the Washington p. m. can. It is also believed that a higher degree of accuracy has been obtained in the making of these forecasts than was possible where the official is compelled to predict for the whole country with a limited period of time allowable to consider the local characteristics of each State.

The frost forecasts of 1891 were completely verified in nearly every instance, and added greatly to the public estimation of the value of the work. In this connection it is respectfully recommended that the authority to telegraph warnings to frost display stations be changed so as to begin May 15 instead of May 1. The water is not drawn from the cranberry marshes or tobacco plants set out until between May 15 and June 1. It was stated by the press and interested parties that the frost warnings issued from this office between August 24 and September 4, 1891, alone resulted in a saving of one-third of the cranberry crop, estimated at \$125,000.

Cold-wave warnings have been of immense benefit to commission men, railroad lines, farmers, and others having perishable goods to ship. Not an unfavorable criticism has appeared in print or been received from any quarter. Several times the papers have commented on the timely arrival of the cold waves predicted. There is such confidence placed in these predictions that I feel justified in saying that not a carload of perishable freight leaves this city during the display of the flag.

The issue of the weather map has been increased from 67 to 252 daily. The total number printed during the year was 55,000 against 18,000 the year before. Success has attended the efforts of the office in inducing teachers to make a daily study of the weather, and to instruct their pupils in its general principles. The director was urgently invited to address the annual meeting of the Southeastern Wisconsin Teachers' Association on this subject. This he did on April 9, at the normal school building at Whitewater. The presentation of the subject was received with so much favor that he is encouraged to continue such line of work whenever occasion offer and the numerous demands on his time will permit.

Including this station and the 6 regular Weather Bureau stations in or on the

borders of the State, the Wisconsin State weather service consists of 77 observation stations. The monthly meteorological tables for the three months past has contained reports from 61 stations. Eight stations have been discontinued and 10 established during the year.

Special efforts have been made to promptly reach the lake captains with warnings by special messenger in case of severe storms, and the produce and commission dealers in case of cold waves. No severe storms have passed over the lake during the past year without special bulletins announcing its approach from twelve to twenty-four hours in advance, being placed in the hands of interested parties. The reports are fully appreciated. The lake captains daily visit the office during stormy seasons and place great reliance in the information given. Large shippers are making far more use of the office than ever before. It is a frequent occurrence to have practically all shipments of perishable goods from this city held for several days until notified that it is safe to forward.

Publication has been made in State papers that this office would cheerfully furnish to the agricultural, commercial, maritime, scientific, or professional interests any information in our possession that would be of interest or value to them, and special directions given as to the particular interests which would be likely to profit most by such knowledge. The result has been numerous applications by letter, telephone, and in person—from persons in all walks of life. In nearly every case it has been practicable to furnish information fully covering the needs of each particular applicant. Invalids, tourists, physicians, engineering and claim departments of all railroads in the State, vessel-owners, lawyers, courts of justice, and many others comprise the list. The opinion of employes who have been in the office during the past two years, as well as the office records, bear out the statement that fully three times as much special information was given out as during any previous year. The station force has been worked to its fullest capacity in meeting the demands made upon it.

On January 1, 1892, was begun the publication of the Wisconsin Weather Crop Journal. It is supported entirely by advertising and subscriptions. It has been a most acceptable medium through which the work of the State service can be presented to the public. Sufficient advertising contracts were secured to cover the cost of printing and mailing; no special efforts have been made beyond making it self-sustaining. It required an expenditure of \$300 by the director before this was attained. It may be considered as successfully established to-day.

The Weekly Weather Crop Bulletin has steadily grown in favor until there are now 160 papers on the exchange list of this office. About fifty clippings are made each week of the published bulletin. This feature of the work is highly appreciated by the State press. Five hundred copies are issued weekly.

Ninety thunderstorm reporters have been supplied with cards on which to report the occurrence of these storms. This data is being summarized, and will unquestionably furnish the means for more comprehensive study of this important subject. A few weeks ago arrangements were made to issue special thunderstorm forecasts, but sufficient opportunity has not been had to test the efficacy of the work.

From the editors of the principal papers an honest criticism of the work of the bureau has been invited, and assurance given that their suggestions as to methods of improvement would be given thoughtful consideration. The most cordial relations exist between the official in charge and the principal newspaper men in the vicinity, and as an evidence that our work is appreciated by them and that the bureau enjoys their hearty good will, the fact is cited that but one adverse criticism has appeared in print during the year, while many papers have highly commended the department for the character of its work, both in their news and editorial columns.

If it is considered advisable to allow additional instruments for this service, effort will be made to establish more stations in the northern part of the State.

COMMENTS ON THE WORKING OF THE BUREAU.

Mr. L. C. Whitney, general western agent of the Flint and Pere Marquette Railroad, says, in a recent letter to this office: "The masters of our fleet of five steamers have come to place implicit reliance in your bulletins, and they communicate with your office for special information when in doubt with a confidence hitherto unknown. A marked improvement, and one most gratefully appreciated, is your thoughtfulness in giving out special bulletins on the approach of storms of unusual severity, thus enabling me to warn all our steamers, during the winter months, at points having no weather service during closed navigation."

G. Hurson, general traffic manager, Goodrich Transportation Company, says: "I desire to express my gratification for the benefits that our company has received from the weather office in this city. It is my opinion that the weather reports have been

more accurate during the past year than at any time during the twenty years that I have been here. Your official in charge here gave us timely warning of severe gales, and in no case has he been very wide of the mark; we appreciate the excellent work of your bureau."

A. Grossenbach & Co., commission merchants, say: "We are pleased to add our testimonial to the very efficient service you have rendered us in our business during the past year. In shipping fruits and other perishable goods it is necessary for us to make calculations as to the weather, and in this you have furnished us an invaluable service. By relying upon your predictions we have come out pretty near correct, and we depend largely upon your knowledge of the elements to aid us in our business. We thank you for uniform courtesies extended to us."

Thurston, Russell & Co., oyster packers: "The weather reports at this station have been a great benefit to us in our line of business. We found them more reliable than in former years, and they have saved us many dollars."

The Diamond Ink Company: "During the past year we have been guided largely by your forecasts in shipping freezable goods, and were more successful in avoiding loss from freezing than formerly."

George Hiles, Dexterville, Wis.: "These frost warnings are of inestimable value to us, especially during the cranberry growing season. We thank you for the good work you are doing in this matter."

Anson Brothers, wholesale grocers: "The reports have been a material benefit to us, and we have come to rely largely upon them. We regard them more reliable than formerly and believe them most beneficial to a large class in all branches of industry."

R. Stafford Company, wholesale fruits: During the winter months we are greatly benefited by these reports as the greater part of our business is in green fruits. Our shipments are governed by your reports, which in the main, during the winter of 1891-'92, were accurate; in following them we had but few complaints from our customers that their fruits arrived frozen."

Jon. Schlitz Brewing Company: "The timely information of a coming cold wave has frequently caused us to keep back shipments which would otherwise have suffered by frosts."

Mr. H. Shackell, agent D. G. H. & M. Ry., and G. H. & M. Trs. Co.: "Our captains speak very favorably of the weather reports. They make numerous inquiries of your office during the winter months and express themselves as finding the information very reliable, and of good service to them."

A. J. W. Pierce & Co., wholesale produce and fancy grocers: "The Milwaukee weather bureau has been of great benefit to us during the past season. We consider that we have been saved from loss in many instances through your advice. We wish to thank you for the careful and courteous manner in which all our special inquiries were answered by your office."

WYOMING.

(E. M. Ravenscraft, Weather Bureau, director.)

The only warnings furnished this State are the cold-wave warnings, and they are only furnished the observer, Weather Bureau, Cheyenne, and O. K. Garvey, Casper, and there seems to be no desire on the part of the public in other portions of the State to avail themselves of the opportunity to receive the warnings. As this is principally a grazing State there can be little said of the benefit derived from the warnings other than that of the sheltering of stock where possible.

The average issue of the Weekly Crop Bulletin is about 100. There is not as much value placed upon them as should be, but the interest is gradually increasing, and would increase more rapidly but for the condition of local affairs in this State that have tended to obliterate all other public affairs without regard to their origin or purpose.

There are at present about 20 regular correspondents.

There are about 100 copies of the monthly bulletin issued, and the number is constantly increasing.

There are at present about 16 voluntary stations in operation including those of the State Agricultural College and the military posts. There were 7 voluntary stations at the beginning of the year and 7 others have been furnished with instruments, but part of these have failed to report and have ignored all communications regarding reports or instruments. Several hundred circular letters have been sent out during the year in the endeavor to secure observers; also the names of reliable parties have been secured and personal letters written with the hope of securing observers, but with the State affairs in the condition they now are a move in this direction could hardly be expected, but it is hoped that a few months will see a marked change in the working of the weather service in this State.

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