

TABLE D.—Monthly and annual departures of average cloudiness from the normal, 1898.

Districts.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
New England.....	-0.2	+0.5	-0.2	+1.1	+1.1	+0.8	+0.6	+0.8	-0.5	+0.4	+0.7	+0.1	+0.4
Middle Atlantic.....	+0.6	-0.8	+0.9	+0.6	+1.0	-0.3	-0.4	+0.1	-1.0	+0.5	+0.6	+0.1	+0.2
South Atlantic.....	-0.5	-1.5	+0.7	-0.2	-0.8	-0.8	-0.8	+0.9	0.0	+0.8	+0.6	+0.8	+0.1
Florida Peninsula.....	-1.4	-1.1	-0.5	-0.9	-2.1	-2.4	-0.6	-0.6	-1.2	+0.5	+0.4	+0.4	-0.8
East Gulf.....	+0.1	-2.0	+0.9	-0.6	-1.4	+0.2	+0.4	+1.4	+1.4	-0.5	+0.6	+0.4	+0.1
West Gulf.....	-0.5	-1.7	+1.3	-0.6	-0.2	+1.1	+0.5	+0.2	0.0	-0.6	+0.7	-0.2	+0.1
Ohio Valley and Tennessee.....	+0.4	-0.1	+0.5	0.0	-0.4	-0.9	+0.4	0.0	-0.1	+1.1	+0.1	-0.6	0.0
Lower Lake.....	+0.5	+1.2	-0.5	+0.2	+1.0	-0.1	-0.3	+1.2	-0.4	+1.0	0.0	+0.4	+0.4
Upper Lake.....	0.0	+0.9	-0.2	-0.6	-0.3	+0.3	-0.9	+0.3	-0.4	+1.3	-0.3	-0.6	0.0
North Dakota.....	-0.7	-0.4	-0.3	-1.2	-0.9	0.0	-0.6	-0.6	-0.2	+1.4	-0.5	-1.1	-0.4
Upper Mississippi Valley.....	+0.2	+0.4	+0.1	-0.4	+0.4	-0.1	-0.6	+0.2	+0.1	+2.1	-0.4	-1.2	+0.1
Missouri Valley.....	-0.1	-0.7	-0.3	-0.4	+0.8	+0.1	-0.4	-0.8	-0.1	+1.9	-0.2	-0.6	-0.1
Northern Slope.....	-0.3	+0.1	+0.5	-0.3	+1.1	-0.4	-0.1	-0.1	-0.3	+0.6	0.0	-0.1	+0.1
Middle Slope.....	+1.1	-0.7	+0.7	+0.3	+0.6	+0.3	-0.3	-1.1	0.0	+0.6	+0.4	-0.4	+0.1
Southern Slope.....	+0.8	-2.1	+0.8	0.0	-0.5	-0.6	-0.2	-1.6	-0.4	-0.6	+0.6	-0.8	-0.4
Southern Plateau.....	+0.9	-0.7	-0.1	+0.2	+0.4	+0.3	+0.2	-0.1	-0.9	-0.6	-0.4	+0.2	0.0
Middle Plateau.....	+0.1	+1.1	+0.3	-0.9	+2.2	+0.2	+0.1	+1.1	+0.1	+1.0	+1.2	-0.7	+0.5
Northern Plateau.....	-0.5	+0.2	-0.9	-1.4	-0.4	-0.6	+0.6	-0.3	-1.1	-0.2	+1.2	-0.6	-0.4
North Pacific Coast.....	+0.4	+1.0	-0.8	-0.7	-0.6	-0.7	-1.0	+0.9	+0.3	+0.3	+0.6	-0.6	-0.1
Middle Pacific Coast.....	-0.3	+1.4	-1.2	-0.5	+1.2	+0.4	-0.1	+1.0	+1.0	+1.0	+0.5	-0.7	+0.3
South Pacific Coast.....	+0.5	-0.1	-1.3	-0.8	-0.2	-0.6	-0.7	0.0	-0.5	-0.6	-0.9	-0.6	-0.5

STORMS OF THE YEAR.

In classifying the storms of the year according to their natural differences it is convenient to recognize three main classes. The first class may properly include all disturbances, such as a thunderstorm or tornado, whose sphere of action is restricted to a single locality or neighborhood, or to a narrow path 25 to 30 miles long, and we may designate disturbances of this class as *violent local storms*. For the second class we may properly choose storms which extend over greater areas than those of the first class. To this class belong tropical or West Indian hurricanes. Finally, for the third class, we have the general storms of the middle latitudes whose distinguishing characteristics are very great horizontal extension and comparatively light winds around the outer margins, becoming violent as the center of the disturbance is approached. Storms of the last-named class reach their greatest development in winter and the transition periods of spring and autumn.

The general history of all storms that were reported to the Bureau during the year has been given in the successive MONTHLY WEATHER REVIEWS. It is not the purpose of this summary to repeat the details already published, but to bring together for future reference and as a matter of climatic history, the main facts concerning noteworthy storms of the year.

Violent local storms.—The frequency of thunderstorm days in the different months and in the several States and Territories is shown approximately by the figures of Tables V and VI. This first-named table has been prepared from reports of regular and voluntary observers in the several States and Territories. The figures set opposite the stations and shown graphically on Chart V, represent the number of thunderstorm days in each month in the immediate neighborhood of the stations named.

The figures of Table VI were obtained from the monthly registers of voluntary observers in each State and Territory. In order to ascertain the relative frequency of thunderstorms with a high degree of accuracy, it would be necessary to increase the number of reporting stations and to rearrange those now in operation. The figures of Table VI do not accurately represent the frequency of thunderstorms in all cases. This is due to several facts, among which we may mention (1), the failure of the great majority of voluntary observers to report thunderstorms; (2), many do not report consistently during the year, that is to say, they report in some months and not in others, and (3), in some States a greater proportion of ob-

servers report than in others. There should, however, be some sort of agreement between the figures of Tables V and VI.

As a means of testing the agreement or disagreement between the data of Tables V and VI, two sets of figures have been entered on Chart V, viz, the red figures which indicate the total thunderstorm days as given by Table VI, and the black figures which stand for the total thunderstorm days recorded at individual stations in the several States and Territories as shown by Table V.

It is obvious from an inspection of Chart V, that so far as determining the relative frequency of thunderstorms is concerned, the figures of either Table V or VI may be used. But if we desire to ascertain the absolute number of storms in any single neighborhood, the use of the figures giving the total number of thunderstorms per year per state would lead to erroneous conclusions because the local variations peculiar to some of the larger states are obscured; and also because the method of obtaining the totals for the states necessarily gives the same weight to a single isolated storm that would be given to a group of storms covering a comparatively large area. For these and other reasons we are inclined to give the greater weight to the totals for individual stations.

The results for 1898 show a decided maximum of thunderstorms in the lower Mississippi Valley and Missouri, with secondary maxima in Georgia, South Carolina, Florida, the Valley of Virginia, and portions of New Mexico and Arizona. In the last-named regions the storms are almost wholly confined to the months of July and August. The number of thunderstorms as a rule is least west of the Rocky Mountains and in northern New England. A secondary minimum occurs on the middle Atlantic coast north of Hatteras. South of the last-named point the number of storms on the coast and the regions adjacent thereto increases quite sharply.

Following is a brief account of the principal tornadoes of the year:

The Fort Smith, Ark., tornado.—Occurred at 12:42 a. m. (local time), January 12. Persons killed, 52; injured, 73; property loss estimated at \$450,000. This was not an unusually severe tornado. The large loss of life is accounted for by the fact that it came at the dead of night when there was no opportunity to seek places of safety.

The Iowa and Nebraska tornadoes of April 30.—Six persons killed and as many more injured. Several independent tornadoes appear to have formed in northeastern Nebraska, and moved in parallel paths northeastward into Iowa where they disappeared about 6:30 p. m., central time.

The tornadoes of May 17-20.—This was a period of unusual tornadic development. On the 17th tornadoes occurred in Oklahoma, Kansas, Nebraska, Iowa, and Missouri, at various hours. Thirteen persons were injured with a property loss estimated at \$88,000. On the 18th tornadoes of unusual severity occurred in Iowa, Illinois, and Wisconsin. Forty-seven persons were killed and upward of 100 injured, while the property loss at a low estimate was \$700,000.

On the 19th tornadoes occurred in Indian Territory. Only one person killed; property loss small.

On the 20th tornadoes occurred at widely separated points in Texas, Arkansas, Missouri, Illinois, and Kansas. Three persons killed and 25 injured. Property loss about \$43,000.

The tornadoes of northwestern Missouri on July 29.—Twenty persons injured, two of whom died of their injuries. Property loss estimated at \$150,000.

The Niagara Peninsula tornado of September 26.—Five persons killed and 18 or 20 injured; property loss estimated at \$370,000.

A complete list of all tornadoes reported during 1898 will appear in the Annual Report of the Chief of Weather Bureau, 1898-99.

The total casualties by wind and tornado were: killed, 158; injured, 364. The property loss was in the neighborhood of \$2,358,000.

Tropical hurricanes.—The most severe hurricane of the year struck the Florida coast about midway between Jacksonville and Savannah on the forenoon of October 2. The damage in the States of Florida and Georgia, due to this storm, was very great. Other hurricanes of less violence occurred

on August 2-3 and 30-31, the regions affected being western Florida and the country about Savannah, respectively. Except in case of the hurricane first named these storms did not advance far inland but persisted for several days, giving torrential rains meanwhile in the neighborhood of the coast.

General storms.—Among the storms of this class were some that, owing to the strength of the wind and the attendant weather conditions, caused great havoc on the New England and Middle Atlantic coasts and the Lake region. The particularly severe storms were as follows:

January 31-February 1.—In eastern New York and New England. Formed by the junction of two depressions on the southern New England coast on the night of the 31st of January. High winds and heavy snow caused great destruction of shipping and damage to railroad, telegraph, and telephone lines.

November 21-22.—On the upper Lakes. This storm followed a rather unusual path, viz, from northwestern Illinois to western Lake Superior where it abated and gradually passed away.

Severe storms also occurred in the Lake region on October 26-27.

November 26-27.—In New England. This storm, like the one of January 31-February 1, was formed by the junction of two depressions off the New Jersey coast, whence the storm moved to the southern coast of New England with greatly increased severity. The havoc created by this storm stands without a parallel in recent years.

For a history of all storms, cold waves, etc., the reader is referred to the MONTHLY WEATHER REVIEWS, January to December, 1898.