SPECIAL CONTRIBUTIONS.

MONTHLY STATEMENT OF AVERAGE WEATHER CONDITIONS FOR NOVEMBER.

By Prof. E. B. GARRIOTT.

The following statements are based on average weather conditions for November, as determined by long series of observations. As the weather of any given November does not conform strictly to the average conditions the statements can not be considered as forecasts:

In its general character November weather forms a mean between the heat of late summer and early fall and the cold of winter, and, in marked contrast to the severe storms of August, September, and October, the weather in the tropical and subtropical regions of the Atlantic Ocean is usually settled and fine. In the Pacific Ocean and on the southeastern coasts of Asia the typhoon season is nearing its end. In the middle latitudes of the oceans the winds become stronger and blow more steadily from the northwest, shifting to west, southwest, and south, as a given parallel is followed from their western to their eastern shores. The storms encountered in the middle latitudes are not as strong as the tropical bred storms of the preceding month, nor the storms which occur during the winter season. The southward flow of arctic ice in the Atlantic has ceased, and but little fog is encountered in the transatlantic steamship routes near Newfoundland.

In the United States the Pacific coast wet season begins in October, and the rainfall increases until December. Over the middle and northern Plateau regions there is an increase in rainfall as compared with the summer and early fall months, except in Utah, where the rainfall is less than in October. In Arizona and New Mexico November is dry as compared with the summer months. In Montana November is one of the driest months of the year. In the great corn and wheat growing districts of the central valleys there is a gradual diminution in rainfall from summer to midwinter. In the east Gulf and South Atlantic States November rainfalls are commonly light, and in the west Gulf districts they fall short of the summer average. From the Lake region and Ohio Valley, over the Middle Atlantic and New England States there is a general, though not well-marked, decrease in rainfall from midsummer to midwinter.

In the interior of the Gulf and South Atlantic States garden truck is subject to damage by frost, and damaging frost is likely to occur in central and northern Florida in November.

RAINFALL FROM CONVECTIONAL CURRENTS.

By H. H. KIMBALL, U. S. Weather Bureau.

A great deal of popular as well as scientific interest attaches to the excessively rapid rates of rainfall that are occasionally experienced in the United States, not only because of their effects, which are often disastrous, but also because they are manifestations of the tremendous amount of latent energy that nature has at her command.

TABLE 1.

Stations.	Rate per hour in inches for—		
	5 minutes.	10 minutes.	60 minutes.
Bismarck, N. Dak	9.00	6.00	2.00
Jacksonville, Fla..	7.44	7.08	2.20
Galveston, Tex	6.48	5.58	2.55

In Weather Bureau Bulletin D, Rainfall of the United States, Prof. Alfred J. Henry gives the foregoing as the maximum rates of rainfall that have been recorded at Weather Bureau stations, and in the MONTHLY WEATHER REVIEW for September, 1898, he has shown that one inch of rainfall is equivalent to 27,154 gallons, or 226,000 pounds of water per acre, the gallon containing 231 cubic inches, and a cubic inch of water weighing 252.286 grains. Rainfall at the rate of 9 inches per hour therefore represents a fall of 33,900 pounds, or 4,073.1 gallons per acre each minute, and in five minutes over an area of 4 square miles represents a fall of 51,000,000 gallons, an amount considerably in excess of the daily water supply and consumption of Washington, D. C.

What is the source whence the vast amount of water indicated by the above rates of precipitation is derived?

In the Smithsonian Report for 1888, page 410, Prof. Cleveland Abbe gives the water equivalent of the aqueous vapor in air for columns of different heights for various surface conditions. His table is here reproduced.

TABLE 2.—*Depths of water in the atmosphere corresponding to various dew-points at the earth's surface.*

Height of column of air.	Dew-point.			
	80°	70°	60°	50°
Feet.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
6,000.....	1.3	1.0	0.7	0.5
12,000.....	2.1	1.5	1.1	0 8
18,000.....	2.5	1.8	1.3	0.9
24,000.....	2.7	2.0	1.4	1.0
30,000.....	2.8	2.1	1.5	1.1

It is evident from this table that there may be contained in the air column immediately above us, in the form of invisible vapor, sufficient moisture to produce over 2 inches of rainfall if it could all be precipitated, and if this column could be renewed each hour a rate of rainfall equal to any on record could be maintained.

It is not the purpose of this paper to discuss the various methods by which the vapor of water in the atmosphere may be precipitated, but rather to consider the condensation and precipitation that may result from ascending, or convectional currents.

We will first consider the nature of atmospheric moisture.

As is well known the atmosphere is not a simple gas like hydrogen or oxygen, but consists of a mechanical mixture of gases and vapors, the most important of which are nitrogen, oxygen, and aqueous vapor.

Gases are perfectly elastic, and the amount of gas a given space will contain varies directly with the pressure, and is inversely proportional to the temperature. If we diminish the pressure on a gas and allow it to expand against a lower pressure, work is done at the expense of the temperature of the gas and the gas cools off. Conversely, if the gas is compressed it becomes warmer.

The term vapor applies more properly to a gas near its temperature of condensaton. Near this point the gas ceases to be perfectly elastic, and either the cooling or the compression of the vapor may be carried to such an extreme that the space occupied can contain no more of it. The space is then said to be saturated. If the compression or cooling is continued beyond this point, some of the vapor will be converted into a liquid.

The oxygen and nitrogen of the air can be liquified only under a combination of extremely high pressures and very low temperatures, but the aqueous vapor, if present in any