No precipitation at all occurred from the lows originating in Manitoba and the Missouri Valley.

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It appears that at times precipitation will be caused in Missouri, usually within twenty-four hours, by high areas, mostly of decided character, in the Slope or Plateau regions. The pressure is generally above the normal over the remainder of the country, although there are sometimes lows of slight intensity moving across the Gulf of Mexico, or else over the extreme north, particularly in the winter. In nearly all the cases the amounts of precipitation were light, and, except in summer, were evidently caused by condensation by the low temperatures accompanying the highs. In the summer the conditions were generally unsettled and somewhat confused, causing local showers, principally thunderstorms.

It is worthy of note that the highs rarely moved across the Mississippi River, except with greatly decreased energy. Many were dissipated west of the river, normal equilibrium evidently having been restored by the precipitation.

The following conditions usually precede precipitation from high areas:

(*a*) High of decided character in the northern or middle Slope or middle Plateau, and elsewhere pressure normal or above.

(*b*) Cold wave covering the central valleys and West except in summer.

(*c*) Isothermal gradients usually quite steep, about 10° per 100 miles (except in summer), either in southeast Nebraska and southwest Iowa, or in Missouri, or in western Kentucky and western Tennessee, and less than one-half as steep to the northwestward, with the isotherms extending in a northeasterly direction.

(*d*) Frequently in winter a low of slight intensity over the Gulf of Mexico, and sometimes over the extreme north, although these latter lows do not appear to have any effect on the result.

(*e*) Northeasterly winds, shifting later to easterly and southeasterly. One peculiar form of high pressure area, with conditions somewhat different from the above, caused precipitation in Missouri in about 83 per cent of the cases investigated. The pressure was generally high over the whole country east of the Rocky Mountains, but the belt of highest pressure extended in oval form over the States immediately north of Missouri, sometimes reaching farther west to Nebraska and as far east as West Virginia, but with the highest belt extending from eastern Nebraska to western Illinois. The weather was cloudy, with northerly winds, and the temperatures ranged from 30° to 40° within the State of Missouri, although much lower in one case. The isotherms extended across the State in a horizonal direction parallel to the long axes of the oval isobars above mentioned. Precipitation from high areas always followed in twenty-four hours and was usually light in amount.

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TEMPERATURE.

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The following general conclusions were deduced from a study of the origin and progress of cold waves:

I.—The severity of the cold wave depends largely upon the lowest reading of the barometer, the proximity of the center of the low to the State, its position with reference to the State, and the intensity of the succeeding high.

II.—Owing to the latitude of Missouri and the rapid easterly movement of the lows from November to April inclusive, nearly all the cold waves are of comparatively short duration.

III.—"The most marked cold waves occur with a low in Missouri and a high in Montana or North Dakota." (Hammon.)

IV.—When a low passes to the southeast west of Missouri there will be no marked fall in temperature, as the winds will blow from some northerly direction in advance of the low, and there will not be much rise in temperature. In cases of this sort it is perhaps better to forecast colder in twenty-four hours, followed by warmer within twelve hours after that, as the high following the low will cause warmer southerly winds without regard to the intensity of the former, and the extent of the cold wave in the West and Northwest.

V.—"A low in Missouri and a high in Minnesota affect eastern Missouri, but not materially western Missouri." (Hammon.)

VI.—A Mexican low passing through Missouri produces a severe cold wave lasting at least from thirty-six to forty-eight hours.

VII.—A low in Colorado moving rapidly eastward, e. g., to the upper Lakes in twenty-four hours, causes a decided cold wave of short duration in about thirty-six hours. A considerable rise in temperature may be expected within thirty-six hours after, unless the high is reinforced by another coming down from the extreme north, in which case the low temperature will persist for a day or two longer.

VIII.—When a low moves across the extreme north the fall in temperature in Missouri will not be very great, but if the temperature is already comparatively high, the fall is likely to be sufficient to justify a cold wave warning. These cold waves are in all cases of very short duration.

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NOTES BY THE EDITOR.

THE VALUE OF WEATHER BUREAU FORECASTS.

With respect to the value of the Weather Bureau forecasts Dr. Isaac M. Cline writes in the Monthly Bulletin of the Texas Weather Service for August, as follows:

A West Indian hurricane touched the Texas coast country on August 29, when gales were reported from Port Lavaca westward to Brownsville, extending into the interior as far north as Rio Grande City, where much damage was done by the wind. Boats in port were damaged to some extent at Brownsville and Corpus Christi, and several houses were blown down at Rio Grande City and Brownsville. Forecasts showing the location of this storm were received from the chief office at Washington for three or four days before the storm reached the coast. These forecasts were given wide distribution and everybody kept well informed in regard to the progress of the storm. It is reported from Brownsville that had not these warnings been given much damage would have been done, which was avoided by the timely preparations. This was the case generally all along the coast, as the warnings caused many vessels to remain in port until all danger was over. High tides were reported from all along the coast and the sea swells at Galveston, Tex., at 8 a. m. on the 29th were the highest which have occurred since July 5, 1891. There was no material damage done at this place, except there was slight erosion on the beach and some jetty piling washed off. The exact damage done by this storm along the west gulf is not definitely known.

THE GREAT DROUGHT OF 1845 IN NORTHERN OHIO.

This drought is described by Mr. Seabury Ford in a letter to S. P. Hildreth, as published in the American Journal of Science, March, 1846, (2), Vol. I, p. 207, as follows:

The district of country which suffered the most was about 100 miles in length, and 50 or 60 in width, extending nearly east and west parallel with Lake Erie, and in some places directly bordering on the shore of this great inland sea. There was no rain from the last of March or the first of April until the 10th of June, when there fell a little rain for one day, but no more until the 2d of July, when there probably fell half an inch, as it made the roads a little muddy. From this time no more rain fell until early in September. This long-continued drought reduced the streams of water to mere rills, and many springs and wells heretofore unfailing became dry, or nearly so. The grass crop entirely failed, and through several counties the pasture grounds in places were so dry that in walking across them the dust would rise under the feet, as in the highways. So dry was the grass in meadows that fires, when accidentally kindled, would run over them as over a stubble field, and great caution was required to prevent damage from them. The crop of oats and corn was nearly destroyed. Many fields of wheat so perished that no attempt was made to harvest them. Scions set in the nursery dried up for lack of sap in the stocks, and many of the forest trees withered, and all shed their leaves much earlier than usual. The health of the inhabitants was not materially affected, although much sickness was anticipated. Grasshoppers were multiplied exceedingly in many places, and destroyed every green thing that the drought had spared, even to the thistles and elder tops by the roadside.

The late frosts and cold drying winds of the spring months cut off nearly all the fruit, and what few apples remained were defective at the core and decayed soon after being gathered in the fall. Many of the farmers sowed fields of turnips in August and September, hoping to raise winter food for their cattle, but the seed generally failed to vegetate for lack of moisture. So great was the scarcity of food for the domestic animals that early in autumn large droves of cattle were sent into the valleys of the Sciota, where the crops were more abundant, to pass the winter, while others were sent eastward into the borders of Pennsylvania. This region of country abounds in grasses, and one of the staple commodities is the produce of the dairy. Many stocks of dairy cows were broken up and dispersed, selling for only four or five dollars a head, as the cost of wintering would be more than their worth in the spring. Such great losses and suffering from the effects of drought have not been experienced in that portion of Ohio for many years, if at all since the settlement of the country. As the lands become more completely cleared of the forest trees dry summers will doubtless be more frequent. In a region so near a large body of water we should expect more rain than in one at a distance. The sky in that district is, nevertheless, much oftener covered with clouds than in the southern portion of the State, where rains are more abundant; but the dividing ridge or height of land between Lake Erie and the waters of the Ohio lacks a range of high hills to attract moisture from the clouds and cause it to descend in showers of rain.

[NOTE.—The above prediction that the frequency of dry summers will doubtless increase "as the lands become more completely cleared" has not as yet been verified, although the forests have been greatly reduced and the rainfall records greatly multiplied. Undoubtedly the dryness of the surface soil has been increased by sunshine and winds and plowing and draining, but the cloudiness and rainfall and snow, which are the true meteorological phenomena, do not seem to have been appreciably affected by the increase of the population and the cultivation of the land. Our knowledge of atmospheric motions attending rain leads us to conclude that extensive areas of cloudless sky and no rain must be due to the presence of slowly-descending air; the dryness and heat observed in the lower atmosphere are the outcome of three influences, viz: the compression of descending air, the nocturnal radiation and the daily insolation. The evaporation from soils and plants, oceans and lakes, is in general carried far away before it falls as rain. If it be true, as above stated, that in a region so near Lake Erie as is the State of Ohio "we should expect more rain," still it is equally true that the rainfall of Ohio is *not* appreciably increased by the presence of Lake Erie except along the immediate coast, and we must look to some other influence as the origin and cause of its rainfall. Evaporation adds moisture to the air, but what brings it down? Experience shows that rain occurs in three classes of localities: (1) Where the winds push up over highlands; (2) where cool air underruns and lifts up warmer air; (3) where overheated surface air rises to let the surrounding heavier air take its place. All three of these are summed up in the one expression "rain falls from masses of air that have been raised high enough to cool, by expansion, decidedly below the dew-point." How far this cooling must go or what other factors come into play is still a subject for further discussion, but it seems certain that the primary essential is the ascension of a large mass of moist air, and when this feature is absent there will be no considerable rain.]

A REGION OF HEAVY RAINFALL.

The following is taken from the monthly meteorological report of the North Carolina State Weather Service for August, 1895, p. 135.

Mr. B. C. Hawkins, voluntary observer at Horse Cove, Macon County, in western North Carolina (near the boundary between North Carolina and Georgia, N. 35°, W. 83° 10′), writes:

Owing to the system of mountain and valley winds on the southeast slope of the mountains the tendency at this station is for northeast winds at night and southeast winds in the daytime. Very often the winds are northeast at sunrise, but by 9 a. m. are fresh from the southeast. Sometimes the night winds are from the northwest or north, the day winds from the south or southwest, but the northeast night and southeast day winds are the most marked. These winds are broken up by the passage of highs and lows of marked intensity. I believe this system extends over many adjacent counties, and that these winds are one cause of the local heavy precipitation which occurs in northern Georgia, northwestern South Carolina, and the western portion of North Carolina. Would not such winds have a tendency to force large volumes of moist air up the Blue Ridge? When a cyclone appears in the west the natural direction of the wind here would be southeast, but the diurnal winds would increase the amount of air in motion. * * * Heat action on the slopes of the mountains would probably rarely be sufficient to cause rain independently, but would increase the amount in most cases when cyclonic action comes into play. Professor Harrington in "The Rainfall of the United States," attributes the excessive rainfall of the southern Blue Ridge entirely to the contact of storms, especially Gulf storms. * * * I believe, however, that these mountain and valley winds increase the rainfall greatly. They may have something to do with the severe cloud bursts which are common here, and of which an unusually large number occurred in June, 1876.

THE CALCULATION OF NORMAL VALUES.

It is important to decide whether a normal value of any meteorological datum is always best obtained by simply taking the mean of all observed values. Our idea of a normal implies, first, that it is the average of a great number, and, secondly, that it contains within itself nothing abnormal—that is to say, that abnormal events have so counteracted each other as not to injuriously affect the average of many values. If, for instance, we have a number of total monthly rainfalls for August ranging between zero and two inches, and if we know that, as far as experience goes, there is no reason to think any of these to be very abnormal, then the average of all will properly be used as the approximate normal for that month and place; but if among these there occurs one month with a cloud-burst (as when 24 inches of rain fell at Palmetto, Nev., in August, 1890), then this abnormal value will so affect the average of all that the latter will not be a proper normal. Such an abnormal value should be included with the others in the general average only when the series is so long—say 100 or 500 values—that the error introduced by counting it in shall become insignificant because divided by the large number. That is to say, if a cloud-burst may be expected but once in a hundred years at the station, then the average of a century of records including one cloud-burst would be a proper normal, but the average of ten years, including the cloud-burst, would not be a proper normal. In the latter case we must reject the cloud-burst and take the average of nine years as an approximate normal and wait for the century of records to accumulate.

There is a general proposition in the mathematical laws of chance, according to which the most probable mean value is determined only after rejecting observations whose abnormality is such that the probable error of the resulting mean is increased by using them. The rule according to which we may judge whether an observation should be rejected for such abnormality is fully explained in Chauvenet's treatise on "The Method of Least Squares," published as an appendix in the second volume of his "Spherical Astronomy." The application of the laws of chance or probability to meteorologi-