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-