were too dry for germination of wheat in the drier parts of the eastern counties.—*G. N. Salisbury.*

West Virginia.—Fall plowing was rapidly pushed during the first week and seeding was mostly done. Wheat, rye, and oats germinated quickly under the warm sunshine, and were looking green and thrifty at the close of the month. Later sown grain did not germinate so well for lack of moisture. Corn hardened nicely and some was husked. Cabbages and turnips turned out better than expected. Pastures were short, but stock was in good condition; apples were mostly picked, but the yield was light and of inferior quality.—*E. C. Vose.*

Wisconsin.—The month was slightly warmer than usual and favorable for the completion of fall work. Corn was secured early in the month in the southeastern counties and along the lake shore, where there was little damage from the early September frosts. Winter wheat and rye attained a good stand and is generally reported in excellent condition. Fall pasturage was very good throughout the month.—*W. M. Wilson.*

Wyoming.—The month was pleasant throughout the State, and favorable to the stock. No extremely cold weather or heavy snowfall was reported from any section of the State. In a few sections water for stock became scarce, owing to the absence of rain or snow; owing to lack of snow some stock could not be moved to the winter ranges.—*W. S. Palmer.*

SPECIAL CONTRIBUTIONS.

CLOUDBURSTS.

By A. D. ELMER, Voluntary Observer, Northfield, Mass.

I have seen the tracks of several so-called cloudbursts in New England and have also seen some of the storms themselves at a distance. Observers who happen to be in close proximity can determine whether these storms differ from thunderstorms except as to direction and velocity of motion. The cyclonic thunderstorm passes over the observer slantingly. If it moves broadside it passes over the observer quickly, with a tornado of wind; this is rare. Conversely, if it moves lengthwise, then it may last at one point until the whole length of the disturbance has passed over; in this case the observer experiences a calm with heavy rain. When the thundercloud moves transversely to the line of action it moves rapidly and, therefore, its short rainfall covers a wide area. In proportion as it moves more obliquely it is less squally, the area of precipitation is narrower, and the total amount heavier. If it moves along on the line of its greatest axis, the path of precipitation must be very narrow and the total amount very heavy; the most excessive amounts, of course, make the line of heaviest condensation. Therefore, such a local storm is capable of depositing as much water along a narrow track as a storm moving sidewise would do over a much wider area. The prevailing tendency of storms is to move in a median direction; those moving lengthwise are as rare as those moving broadside on. The latter, as described by Hinrichs, in Iowa, have a local name (*derecho*). The fact that they move along their short axis accounts for their covering a wide area, and for their being observed by many. The local storm that moves lengthwise being both infrequent and felt over a narrow area, is, of course, very rarely recorded. Its amount of precipitation may be still further increased at any given point by another characteristic. As above stated, the side-moving squall has the greatest velocity, the oblique-moving thunderstorm has less, and the disturbance which moves lengthwise sometimes seems to drag along. Let us consider the effect of this slow progress on an Indian file of pouring rain clouds when lifted in its march over a hill or mountain range. I have seen two such; one was climbing over the Northfield Mountains rising about 1,400 feet from the Connecticut River Valley; the other was passing up over the Hoosac Mountains, in Adams County, and rising about 2,500 feet from the valley of the Hoosac River. In such cases we have a continuous rain for hours along one line and which may amount to ½ inch in five minutes, or 6 inches in one hour. If the storm line is 60 miles long and moves 20 miles per hour, 18 inches may fall in the three hours it occupies in marching over. Such being possible on the windward side of a mountain, at valley stations in New England thunderstorms, where the rate of fall occasionally equals 6 inches per hour, how long would it take a valley brook starting in the mountains to increase into a destructive body of water? It is probable that many of these storms are discontinuous, coming in series of showers. The one observed by me on the Northfield Mountains was at times so narrow that I could look under it and through the rain wall to distant Mount Toby; it lasted much of the afternoon and the brooks washed out every culvert on the railroad for several miles. The storm in Adams County and that of June, 1902, at Middlesex, Vt., and northeast of that place were more destructive. Davis's Report on the New England Thunderstorms, 1885, furnishes good illustrations of storms which move broadside on (see July 21) and of the ordinary but severe thunderstorms (see July 9). I have not mentioned the occasional advance of an isolated thundershower, which being practically a point, has no breadth; but hope I have made it clear that the long thunderstorm cloud, advancing along its long axis may be directly responsible for all so-called cloudbursts.

DOES THE LIGHTNING EVER STRIKE THE OCEAN.

By Prof. JOHN TROWBRIDGE.

Prof. John Trowbridge, Cambridge, Mass., calls attention to the fact that—

Low lying clouds heavily charged may possibly sometimes discharge electrically to the surface of a large body of water like the sea; but he believes that his experiments show that at the average altitude of thunder clouds the tendency is to discharge from one region of cloud to another in preference to discharging to the sea. The testimony of persons who claim to have seen lightning strike the sea is not very reliable, since most persons are ignorant of the phenomena of irradiation, they are confused by the blinding flash and mistake reflection in the water for the flash itself.

He adds:

By means of a battery of 20,000 small cells a voltage of about 6,000,000 is obtained, which is at least comparable to that of lightning. With this large battery, I was able to obtain an electric spark about 7 feet long and found that instead of striking the water a spark of 6 or 7 feet in length invariably jumped to some adjacent object in preference to striking the liquid surface. A spark of only a few inches in length, however, will strike the water, but such a spark is not comparable to lightning.

Beyond a million volts the initial resistance of atmospheric air to electrical discharges becomes less, and the discharges, therefore, are shunted through the air instead of upon the water, and strike some object adjacent to the water.

THE CLIMATE OF BAGUIO, PHILIPPINE ISLANDS.

By FRANK O. STETSON, United States Weather Bureau.

Rev. Jose Algué, the Director of the Philippine Weather Bureau, has published an interesting study of the weather at Baguio, the first of a series of reports "On the climatological conditions of certain regions of the archipelago which might be advantageously chosen as health resorts." Baguio, on the island of Luzon, about 140 miles north of Manila and some 18 miles from the western coast, occupies a plateau 4,777 feet above sea level. The observations, which are taken ten times daily, are given in extenso for pressure, humidity, cloudiness, precipitation, fog, and wind direction. The record covers only a period of twelve months, but this will perhaps suffice for a general idea of the climate of a locality within 17° of the equator. The claims of Baguio as a health resort rest chiefly, if not entirely, upon its temperature. This, as the latitude and elevation would indicate, is delightfully mild and equable. During the period under examination it varied from a minimum of 47° in February, the coldest month of the year, to a maximum of 84° in April, which is the hottest month. The extremes at Key West, Fla., during the same period were 89° and 51°.

With the exception of a limited area on our Pacific coast, there is probably no section of the United States where yearly extremes would, as a rule, fall within the limits. A fairer idea of the variability of temperature is obtained from a comparison of records for corresponding hours. This shows a difference of 23° between the highest and the lowest temperatures recorded at noon and a variation of 16° in the 4 a. m. temperatures. The mean of the warmest month at Baguio is 6.5° lower than the mean of the coldest month at Manila.

The invalid would find the chief drawback to Baguio in the fog, cloud, and rain, which are excessive during the rainy season (May to December), and are of course accompanied by a high relative humidity. A record of 203 foggy days in the year is at first thought somewhat appalling, but is modified by the fact that the fog occurred, for the most part, during the night hours. The report does not explain just what constitutes a "fog," nor does it state whether all of the fogs recorded actually enveloped the observing station. The volume is commendable as to its tabular and graphical presentation and is a welcome addition to Philippine climatology.

SOME PECULIARITIES IN FROST FORMATION OVER THE COAST REGION OF SOUTH CAROLINA.

By L. N. JESUNOFSKY, Local Forecast Official, Charleston, S. C., dated Nov. 19, 1902.

Among the chief industries developed at Charleston, S. C., and on the sea islands contiguous thereto, in recent years, are the cultivation of asparagus, beans, cabbages, beets, onions, cucumbers, peas, potatoes, squashes, and other vegetables late in autumn, late in winter, and early in spring for shipment to market in the larger cities, where brisk demands are met by eager produce dealers and where the large yields of these products bring good prices. Truck farming has reached large proportions in this section; the acreage is now double the area of that cultivated but a few years ago. Large tracts of wooded lands are at present being cleared to meet the requirements of this widely expanding industry.

The writer has been intimately acquainted with the truck growing interests in and around Charleston during the past decade, since his connection with the Weather Bureau has brought him into close business relations with the farmers. In the discussions of crop growth and the effect of abnormal temperature and weather changes thereupon, reference has almost invariably been made to the pecularities in frost formation upon the farms and truck gardens. One resident states that were it not for the fact that numerous patches of vegetables are unharmed while others are injured in the same field during the occurrence of frost, the matter would not receive the attention it deserves, since many suppose frost to form uniformly upon vegetation irrespective of physical conditions and surroundings. The main features of this somewhat complex phenomenon, as related by the said resident are: 1, frost spots, of both large and small dimensions; 2, alternate scorching of plants equally exposed, and, 3, the destruction of certain fields containing beans, peas, cabbages, etc., upon one plantation and the apparent safety of the same kind of plants in another portion or an adjoining plantation. The farms in the vicinity of Charleston are quite level; a few are slightly undulating but not to such a great extent as would by cold air drainage serve as a protection against frost on the more elevated portions thereof; consequently this slight unevenness of the land need not be taken into consideration in this discussion.

It is not my purpose in this paper to discourse upon frost warnings, the means and methods of protection against frost, nor the causes which tend to produce frost, but merely to state the peculiar effects of frost formation along the coastal region of South Carolina as I have found them.

The phenomena were first noted early in the fifties and have engaged the earnest and thoughtful attention of many residents of this section ever since. Although discussed from various phases and standpoints, no one has up to the present offered any reasonable explanation of the cause of the three features above enumerated. Some of my colleagues, located at stations along the South Atlantic and Gulf coasts, may possibly have noted the same conditions or had their attention attracted thereto. It seems, however, that several gentlemen of marked scientific attainments, residing in the vicinity of Charleston, have pursued an unbroken series of investigations along this line for a number of years without having arrived at any satisfactory conclusions. Among the most distinguished of these was the late Rev. William Mueller, D. D., pastor of the St. Matthews Church, of Charleston, a botanist and biologist of considerable merit. From him it was learned that the staple crops of this section were subject to peculiar effects of frost formation. Cases were cited where during the occurrence of frost, both light and heavy in character, certain sections of the fields were burnt outright while in others vegetation was scarcely touched. Many cases were related where the frost appeared in circular patches, ranging in diameter from 3 to 10 feet or more. Somewhat more anomalous than the facts given above, may be noted the unaccountable occurrence of single and alternate plants, arranged in rows, being scorched by frost; yet, withal, those which intervened survived and showed but slight damage. It was also found that truck planted on the eastern side of groves of trees was less injured by frost than that grown on the western side of groves.

Having learned the views of Reverend Dr. Mueller and others, it was determined to pursue a series of investigations at length and to test more fully the accuracy of their observations. Upon the occurrence of frosts of different character within the past few years, the conditions under which they formed were carefully recorded; their effects upon young and tender vegetation were noted; those frosts were studied that were preceded by winds from each point of the compass, except the south point, a wind direction seldom preceding frosts in this locality. The conclusions were not so harmonious as at first hoped. Several of the cases were found to appear just as represented by the residents; others were not sufficiently defined to distinguish between abnormal frost formation and that which occurred ordinarily. With east winds the atmosphere was ladened with decidedly more moisture consequently there could not have been such a copious formation of frost, while with westerly winds the atmosphere contained decidedly less moisture, requiring a lower depression of the dew-point for the precipitation of frost. This relation between light frosts attended by easterly winds and heavy frosts with westerly winds does not, in any manner whatsoever, offer any reasonable theory as to the causation of the peculiar formation of frost in question.

The spring of 1897 was remarkably free from frosts. The only frost formation recorded was on March 28. Mr. L. H. Sahlmann, on Charleston Neck, at Myers post office, had peas, cabbages, and beans growing upon his farm on that date. The place is well exposed and free from trees. The frost injured the plants slightly on the western edge of the farm but on the eastern side there was less damage. The injured plants survived but were much dwarfed; the yield was light. On the western side of the bean patch quite large areas showed drooping leaves of a deep green color; on the southeastern side of the same patch the color of the plants appeared of a much healthier hue. It may be observed here that the stems of the plants were not damaged at all and that the injury to each alternate plant as before mentioned was entirely lacking. No injury was done to the cabbages.

The accompanying tabulated statement of frosts is transcribed from the records of the United States Weather Bureau office, Charleston, S. C., and pertains to all frosts of each