SPECIAL CONTRIBUTIONS.

REMARKABLE AURORA AT BRAIDENTOWN, FLA., NOVEMBER 18, 1899.

By H. TEN BROECK.

There was a display of the aurora borealis, November 18, of extraordinary brilliancy, considering the low latitude of this place, N. 27° 30′, W. 82° 30′. It was 11:30, local time, when I first saw it. There was a bright arch due north very irregular and undefined in outline, about 20° high. It was white with a yellowish tinge, from it issued lambent streamers, reaching beyond the zenith and extending from the eastern to the western horizon, merging into a haze on the horizon—the effect of perspective probably. The streamers were pale white with an occasional light red tint. In about fifteen minutes they extended to the southern horizon merging into a haze. They were very straight and regular in form, varying in brightness constantly, though slowly. The arch in the north also varied some in brightness and changed to a slight rosy tint now and then. A halo formed around the moon, about 35° in diameter and 4° or 5° broad, but with no dark circle within; there was also a small halo around the moon touching it, and having bands of faint blue and yellow colors. The sky was clear, except a small cirrus cloud in the south, air calm, thermometer 66°. By midnight the meteor had faded greatly, and by 12:30 had almost entirely disappeared and made no further appearance. Even in the light of the full moon it was extraordinarily bright, and in the absence of the moon it would have been, of course, far more so and of a brightness above the common in such displays. I never saw such a bright one even when living for thirty-nine years in latitude 40° to 45°. One small meteor appeared in the northeast going northwest with a track of about 20°, while the aurora was at its brightest.

SMALL SEISMIC CHANGES CAUSED BY BUILDING OPERATIONS.

By C. F. MARVIN, Professor of Meteorology, dated December 15, 1899.

Mr. H. H. Kimball, of the Instrument Division, reports a marked effect upon the Weather Bureau seismograph resulting from building operations in progress for some months past on the Weather Bureau property. The following is a brief statement of the circumstances and results.

About the first of July last, building operations were begun on additions to the so-called annex to the main Weather Bureau building, and on a row of two-story brick storerooms near to, but not adjoining the main building. The work is now practically completed.

The seismograph is installed as formerly in a small basement room of the main building, within about 18 inches of the south wall, and about one-fifth the length of the building from the southwest corner. The registration of effects is produced electrically; the register being located in a room in the annex. The row of brick storerooms extends parallel to the south and west walls of the main building, with a roadway about 10 feet wide separating the two.

The main building is erected upon a terrace of ground, ranging from 12 to 18 feet above the level of the adjacent streets and pavements. Originally, the floor of the basement room containing the instrument was about 6 feet below grade, but the 10-foot roadway and the space occupied by the storerooms were cut down and graded to about the same level as the basement floor of the main building. These operations exposed the south and west foundation walls of the old building in several places.

The soil consists of a fine, hard, clay, resting upon a granite formation 10 to 20 feet lower down. A portion of this granite had to be removed in the deeper excavations for the new engine room, about 200 feet to the northeast. Notwithstanding that a number of blasts were fired to break out the rock, these do not appear, in any case, to have disturbed the instrument sufficiently to produce a record. The charges, however, were necessarily very small, owing to the immediate proximity of the printing and boiler rooms adjoining, which circumstance, together with the distance of the focus from the seismoscope and the probable rapid rate of oscillation of the earth particles seem to sufficiently explain the results.

The excavation of the roadway exposed and extended below the foundation wall of the *southeast corner* of the main building, and it was necessary to underpin this wall and carry the foundation down to the proper depth. The grading and excavation were practically completed, and the brickwork on the storerooms was far advanced before the corner wall was underpinned.

As the work of excavation advanced the seismic apparatus recorded a large number of disturbances from September 20 to September 24. The latter date falling on Sunday. From 4:45 a. m. to 10 a. m. the circuit remained permanently closed, showing that apparently the floor of the room had tilted slightly.

About this date the underground cable connection between the Instrument Room and the seismoscope was interrupted by the excavations and not finally restored until October 20. In readjusting the instrument it was found the level of the floor had permanently changed, the south edge being depressed.

After the instrument was again readjusted on October 20 no further disturbance was recorded until November 16, at which time the work of underpinning the southeast corner wall was in progress. The instrument was more or less continuously disturbed for about an hour, whereupon the circuit became permanently closed at about 10:30 a. m., showing again a pronounced subsidence of the south edge of the floor. The instrument being again adjusted, recorded no further disturbance until December 8. This record on this date accompanied the removal of a flight of outside stone steps leading down to the basement from the old grade level. A bench of earth in a small recess of the wall of the main building, immediately outside the seismoscope room, was also removed at this time, the instrument in this case showing a subsidence of the east edge of the floor.

The small alterations of level thus recorded by the seismograph have not produced the slightest visible effect on the walls of the main building, and it is not considered that these have in any way suffered injury.

From the known dimensions of the seismograph it is roughly estimated that an angular tilting of its foundation of about five minutes of arc will suffice to permanently close the electric circuits and produce the results noted. During the seven years the instrument has been in use no permanent change of level such as noted above was ever observed.

NOTES ON THE CLIMATE OF MISSOURI.

By ARTHUR E. HACKETT, Section Director, Columbia, Mo., dated January 30, 1900.

The annual mean temperature of Missouri, as computed from all available records to the end of 1898, is 54.5°. The annual mean of each of the five physiographical divisions of the State is as follows: Northwestern plateau, 51.9°; northeastern plain, 53.6°; southwestern lowlands, 54.5°; Ozark plateau, 55.2°; and southeastern lowlands, 57.6°. The lowest annual mean temperature is found in the extreme northwestern counties, where it is slightly below 50°, and the highest in the extreme southeastern counties, where it is about

60°. The variations in the annual mean temperature from year to year rarely exceed 3°, and are often less than 1°. The following table shows the mean temperature of each division by seasons:

Divisions.	Spring.	Summer.	Autumn.	Winter.
	°	°	°	°
Northwestern plateau	27.7	51.8	74.5	53.6
Northeastern plain	30.6	53.5	75.3	55.1
Southwestern lowlands	31.9	54.3	75.7	56.1
Ozark plateau	34.7	55.1	74.8	56.2
Southeastern lowlands	37.3	58.0	76.7	58.3
State	32.4	54.5	75.3	55.9

The warmest month of the year is July, with a mean temperature for the State of 77°, and the coldest is January, with a mean temperature of 29.8°. During the months of June, July, August, and September the temperature occasionally rises to 95°, but does not often exceed 100°. During the winter months the temperature sometimes falls to 5° or 10° below zero, but temperatures of 20° below zero are of rare occurrence. The average number of days during the year with maximum temperature above 90° is 20, and the average number with minimum temperature below 32° ranges from about 75 in the southern to 110 in the northern portion of the State. During the winter cold waves occasionally sweep over the State which cause falls in the temperature of from 40° to 60° in twenty-four hours, but periods of extreme cold are usually of short duration, as are also periods of extreme heat in summer.

The average date of the last killing frost in spring and the first in autumn, as computed from the records of the several Weather Bureau stations, is as follows:

Station.	Last in spring.	First in autumn.	Length of season.
			Days.
Keokuk, Iowa	April 11	October 13	184
Hannibal, Mo	April 13	October 16	185
St. Louis, Mo	April 10	October 31	203
Columbia, Mo	April 13	October 14	183
Kansas City, Mo	April 8	October 16	190
Springfield, Mo	April 16	October 13	180
Cairo, Ill	March 29	October 25	209

The average annual precipitation for each division and for the State, compared from all records to the end of 1898, is as follows: Northwestern plateau, 36.33 inches; northeastern plain, 38.41 inches; southwestern lowlands, 39.24 inches; Ozark plateau, 43.73 inches; southeastern lowlands, 46.36 inches; and for the State, 40.81 inches. The wettest months are May and June, the average precipitation for the State for those months being 5.23 and 4.95 inches, respectively, and the driest are February and October, with an average for the State of 2.33 and 2.36 inches, respectively. The following table shows the average precipitation for each division by seasons:

Division.	Spring.	Summer.	Autumn.	Winter.
	Inches.	*Inches.*	*Inches.*	*Inches.*
Northwestern plateau	10.74	13.62	7.32	4.65
Northeastern plain	11.58	11.87	8.45	6.51
Southwestern lowlands	13.44	12.59	7.79	6.42
Ozark plateau	14.00	13.75	8.89	8.09
Southeastern lowlands	14.53	11.86	9.90	10.57
State	12.65	13.44	8.47	7.25

Of the years from 1888 to 1899, inclusive, the wettest was 1898, with an average for the State of 53.67 inches, and the driest was 1894, with an average of 33.18 inches. Rainfalls of from 2 to 3 inches in twenty-four consecutive hours occur in some portion of the State during nearly every month of the year, but falls of more than 4 inches in twenty-four hours are comparatively rare.

From November to March, inclusive, the precipitation is usually general in character, but during the summer months the greater part occurs in the form of local showers.

The average seasonal snowfall ranges from about 10 inches in the southeastern to about 25 inches in the northwestern portion of the State.

The prevailing winds are southerly, although during the winter season northwesterly winds prevail a considerable part of the time. The average hourly wind velocity ranges from 5 to 10 miles during the summer, and from 8 to 12 miles during the winter months.

The average cloudiness ranges from 35 to 50 per cent during the summer and autumn, and from 50 to 55 per cent during the winter and spring. The average number of rainy days (days on which .01 of an inch or more of precipitation falls) is 9 in January and February, 10 in March, 11 in April, 13 in May, 11 in June, 9 in July, 8 in August and September, 7 in October, and 8 in November and December.

The mean annual relative humidity is 72 per cent.

CLIMATOLOGY OF ST. KITTS.

By WILLIAM H. ALEXANDER, Observer, Weather Bureau, dated November, 29, 1899.

Discovered by and named for the peerless prince of mariners, the little island of St. Christopher, or as more generally known St. Kitts, first appears on the pages of written history in 1493, possessed of a charm which becomes more and more intense as we follow its varied history through subsequent years. Believing that this history could be made to pay rich tribute to the subject of meteorology, the writer began and is diligently pursuing an investigation of all available records of whatever character which might throw some light upon any phase of this subject. The present memoir gives some of the results of these labors.

Because of the intimate relation between the topography of any place and many phases of its meteorological history, a clear understanding of its topography is highly important, consequently I begin this discussion with a few words on this point.

The island lies in north latitude 17° 20′ and west longitude 65° 45′. The area of the main body resembles a long oval from the southeastern end of which runs a narrow neck, gradually expanding into a small knob. The total length of the island is 23 miles, and the breadth of the main body is about 5 miles; that of the knob or peninsula, about 2 miles. The breadth of the neck varies from half a mile to a mile. The total area of the island is 68 square miles.

The central part of the main body is occupied by a range of lofty, rugged mountains which traverses it from southeast to northwest, attaining its greatest height at Mount Misery, with a secondary culminating point near the southeastern end of the island, and between these two there is a decided depression. Mount Misery is about 4,100 feet high, and the secondary elevation about 3,200 feet. The mountains appear to be crowded together and are intersected by rocky precipices. From the secondary culmination a range of hills branches off describing almost a semi-circle, and forming the spacious and fertile valley or plane in which Basséterre is situated. Immediately beyond the hills on the southeast is the narrowest part of the neck, which at this point is perfectly flat, but as it expands it rises into conical hills which traverse the knob or peninsula in almost every direction. In one spot, however, the hills recede from the sea, forming a basin within which is a salt pond about 2 miles in circumference.

The circle of land formed by the skirts and lower slopes of the mountains of the main body of the island and the valley of Basseterre, constitute nearly the whole of the arable