METEOROLOGICAL RECORD AT ORONO, ME.

By Prof. JAMES S. STEVENS, dated November 23, 1903.

From January 1, 1869, to January 1, 1893, a series of meteorological records was kept at Orono, Me., by Dr. M. C. Fernald, ex-president and sometime professor of physics at the University of Maine. The observations included three records daily of temperature, relative humidity, maximum and minimum temperature, air pressure, cloudiness, and wind direction and force. These were taken at 7 a. m. and 2 and 9 p. m. local time.

The latitude of the place of observation is 44° 54′ 2″ north; longitude 68° 40′ 11″ west, and height above sea level 115 feet.

These results have not been published heretofore and it was thought that their presentation here might be of general interest, and that some of the results might prove of more than passing value.

Considering first the observations relating to temperature, we note the following:

	°F.
Mean of warmest day, August 7, 1876	85.3
Mean of coldest day, January 8, 187 .8	—17.2
Absolute highest temperature, August 31, 1876	96.7
Absolute lowest temperature, December 31, 1890	—36.3
Mean of maximum temperatures	51.26
Mean of minimum temperatures	33.68
Mean of the mean maximum and minimum temperatures	42.47
Mean of three daily readings for the same period	42.48

The agreement between the last two numbers in the above list is remarkable. So far as these observations go, the average of the maxima and minima is essentially the same as the average of three daily readings when carried through a sufficiently prolonged period. Taking the records for each separate month of the twenty-four years it is found that about once a year the mean from the maximum and minimum differ from that of three daily readings by as much as one degree.

A striking result is obtained if we take the mean of the mean daily temperature for each month of the period under consideration, and then in turn take the mean of the months which differ by six. This is shown, as follows:

Mean temperature for twenty-four years.

Month.	Mean.	Month.	Mean.	Mean of both.
	°		°	°
January	16.09	July	67.40	41.75
February	19.21	August	65.54	42.38
March	27.31	September	57.51	42.41
April	40.19	October	45.81	43.00
May	52.51	November	34.12	43.32
June	62.41	December	25.57	41.99
Average	36.29	Average	48.66	42.48

Comparing these results with the mean temperature for the whole period (42.48°), we observe that in no case does the mean of the pairs of months considered differ by as much as one degree therefrom. It is hoped that other observers who have recorded the data for long periods will apply this test.

The mean temperature for each month shows that the maximum occurred in July, 67.40°, and the minimum in January, 16.09°. This latter is contrary to the prevailing opinion regarding Maine temperature, as February is generally regarded as the coldest month. When the monthly means are plotted the curve has the general characteristics of curves of this class plotted by other observers. See, for example, Loomis's Treatise on Meteorology, p. 31, where is plotted a like curve for New Haven, covering a period of eighty-six years. The similarity of the two curves is striking.

During the period in question the total annual rainfall averaged 36.00 inches and the snowfall 94.43 inches, making the average annual precipitation 45.44 inches, or 3.79 inches per month.[1]

[1] It can not be too strongly urged that observers measure both depth of snowfall and equivalent melted snow water; the use of the ratio 10 is only allowable in extreme necessity.—ED.

The mean percentage of cloudiness for the twenty-four years was 52. The direction and force of the wind, recorded in accordance with the instructions of the United States Weather Bureau, resulted as follows: Northwest and west, 40 per cent; southwest and south, 28 per cent; northeast and north, 20 per cent; southeast and south, 12 per cent.

The maximum barometric pressure reduced to 32° F. was 30.833 inches; the minimum, 28.423 inches; and the mean, 29.842 inches. The correction for gravity is inappreciable.

The mean pressure of vapor for fifteen years (1869–1884) was 0.257 inches of mercury.

The relative humidity ranged from a maximum of 100 per cent to a minimum of 10 per cent, with a mean for the 24-year period of 77 per cent.

The number of thunderstorms observed[2] during the period was as follows:

Year.	No.	Year.	No.
1870	7	1882	12
1871	5	1883	12
1872	10	1884	10
1873	4	1885	13
1874	4	1886	13
1875	6	1887	11
1876	4	1888	12
1877	7	1889	11
1878	9	1890	10
1879	12	1891	13
1880	9	1892	8
1881	13		

When these numbers are plotted there seem to exist periods of maxima and minima of thunderstorms.

MOUNTAIN AND VALLEY BREEZES.

By Mr. W. S. TOWER, Assistant in Meteorology in Harvard University, dated Cambridge, November 17, 1903.

It is a well-known fact that mountains and valleys have certain phenomena that are peculiarly their own. Probably the best known of these are mountain and valley breezes.

Because of active radiation at night the layers of air near the earth become cooled, hence heavy, and tend to move down hill. This tendency soon results in a general down-valley movement of the lower strata, producing a perceptible breeze. This is the so-called mountain breeze. During the day, the presence of warmer, therefore lighter air near the earth, causes a general movement up the valley slope, and also gives a sensible breeze. This is the valley breeze.

While in the Needle Mountains of southwestern Colorado during the past summer, with the Harvard University class in Rocky Mountain geology, I had an opportunity to see these phenomena under favorable conditions. In all the valleys of these mountains, and particularly in the side valleys of the Rio de las Animas canyon, this system of winds was very marked. Each valley had its own separate wind. That is, during the day, in a west draining valley there was a west wind, but in a nearby east draining valley an east wind, so that in passing from one such valley to the other a reversal of wind direction was experienced.

The duration of each wind seemed to depend almost entirely on the time that the sun entered the valley in the morning and left it at night; or in other words, it was dependent on the time when nocturnal cooling ceased and diurnal warming began and vice versa. But though the hours of duration for either wind varied because of local topography, and from day to day, according to general atmospheric conditions, the average hours remained fairly constant. Thus, in this particular region the valley wind ordinarily prevailed from 8 or 9 a. m. until 6 or 7 p. m., and the mountain wind from 8 or 9 p. m. until 6 or 7 a. m., leaving between the two winds a transitional period of relative calm.

In the case of two valleys heading together, there is, as we

[2] Actually experienced at this station.

have seen during the daytime, a condition of two opposing winds blowing toward each other. What is the result? No observations were obtained at the time which would explain this point. However, Hann[1] says that the daytime wind from the deeper valley, resulting from the warming of a greater body of air, will cross the dividing line and blow down the shallower valley. To support this he cites the case of the Inn and the Maira rivers, where the day wind from the deep valley of the latter extends over the pass separating the two and gives a down-valley wind along the headwaters of the Inn. Under similar conditions, it is probable that the same phenomena can be found in this country.

Although both these mountain and valley winds, as observed in Colorado, were very constant in their daily recurrence, they were entirely interrupted by a cyclonic disturbance, and somewhat modified during spells of general cloudiness.

The passage of thunderstorms across a valley showed still more marked control over the breezes. While in the neighborhood of Durango, in the Animas Valley, which runs north and south at this point, the movement of a thunderstorm across the valley to the south of the observer entirely reversed the wind direction, so that during the passage of the storm the wind blew down the valley from the north, instead of up the valley from the south. In this particular case the reversal of wind direction resulted in a change from a warm south wind to a cool north wind, and back to south again, all in the space of less than twenty minutes. But the passage of a storm across the valley to the north of the observer was seen later to have no effect upon the wind beyond a slight increase in velocity.

No such interruptions were observed in the case of mountain breezes, but it is reasonable to suppose that they do occur, the more so because mountain breezes are as a rule weaker than valley breezes. The cause of the interruption lies plainly enough in the radial circulation of air around the storm center.

In a single instance one other modification of the valley wind was observed. Near the head of Ten Mile Creek, a tributary of the Animas some five miles above Needleton, the valley bottom is occupied by Balsam Lake, about one-half mile long by one-quarter of a mile wide. This lake is at an elevation of about 11,450 feet; is fed by streams running from melting snow fields, and had, during the week of our stay there, a maximum temperature of about 45° F. During the day, therefore, the water was much cooler, often more than 25° cooler, than the air in the surrounding valley. In a small gorge at the outlet of this lake in the afternoon I observed a feeble wind blowing out from the water surface, that is, down valley, in direct opposition to the general valley wind. Though this contrary wind was perceptible for only a short distance from the lake, its occurrence is easily explained, and it seems probable that more observations would indicate a general interruption of both valley and mountain breezes.

[1] Hann, J. "Lehrbuch der Meteorologie," p. 439 and Z. O. G. M., 1885, Vol. XX, p. 139.

WATERSPOUTS AT CAPE MAY, N. J., AUGUST 24, 1902.

By Dr. C. Fontaine Maury Leidy, dated Philadelphia, September 5, 1902.

Because of the great interest and comparative rarity of waterspouts, I report as an eyewitness a most interesting storm which occurred off Cape May, August 24, 1902, at 10:30 a. m. Looking out to sea, about 1 mile, slightly west of a line, from the center of the town to Cape Henlopen light, there was a dense black, overhanging cloud; from its south edge there hung a black column, perpendicularly to the ocean, the base was enveloped in a dense cloudy steam-like mist. The extreme end entered directly into the densest part of the cloud. The sides of the column were parallel, and it seemed to be of the same density from top to bottom and from side to side. The accompanying cut[1] gives a most accurate view as it was in reality. One curious feature of this dense cloud was that it seemed to be absolutely alone. Surrounding clouds were few, and none other so dense. From the rapidity with which it enlarged there was not the slightest doubt but that it was fed from this enormous waterspout. Shortly after the first column faded away, the base seemingly enveloped in steam, about 200 yards distant another column formed, apparently suddenly, the first column remaining only in the form of a pedicle, appearing to hang from the clouds, about one-fourth the original length. About 400 yards to the left another column appeared, at no time was there more than one complete column, the others fading away and then returning. The first column almost entirely disappeared, but returned more dense than ever before, with the total disappearance of the other two waterspouts; they continued for fully forty minutes in almost the same location.

There was a heavy depressing feeling in the atmosphere. The tide was high at about 11 a. m.; it was unusually high at this hour. The wind was increasing but the sea was unusually calm but choppy in the course of the storm.

Living directly on the beach, I saw almost over the back buildings of the house, so low that one could have easily thrown a ball into the mass, an enormous bottle-shaped cloud, white and dense, hanging from the cloud, with the neck pointing toward the earth. It appeared to be 8 to 9 feet long and about 4 feet in diameter. Shortly the neck became greatly elongated and 8 or 10 feet of tubing seemed to protrude. During this change there was considerable wind, with enormous drops of rain, the largest I have ever seen. This mass crossed the edge of the house, there being great disturbance in the wind but not until it reached the beach was there noticed any circular or spiral movements. The first object met was a small dog which endeavored to return home but was lifted off his fore feet and turned around and around in the direction of the hands of a clock. Not once was this poor frightened animal able to regain his feet until he managed to get so far into the outskirts of the whirlwind as to regain all four feet and run away. The next object was a large "A" tent which, though very securely pinned down, was lifted up and and torn completely off the staples excepting one fastening; the tent twirled round and round and remained suspended perpendicularly in the air for several minutes, the whirlwind passing over it finally. As the sand was reached we saw the dense mass drawn up into a cylindrical shape which quickly passed to the breakers, and when there almost as though a curtain was raised, the waterspout appeared from the base upward. The column was dense and black, the base enveloped in mist; there was no distinct rotary direction but the choppy sea was twirled and seemed to flow in all directions. During the formation of this last column there was considerable rain but no hail, although the size and force with which the enormous drops struck caused one to stop and look for hail. There was very little thunder and lightning. The disturbance remained in the water possibly fifteen minutes after the disappearance of the waterspouts. At one time there were four individual waterspouts to be seen, but only one entirely perfect at any one time; the other three merely formed the pedicles which hung from the cloud. The first column remained on and off for more than half an hour. The last one remained not more than eight to ten minutes.

[1] The cut here referred to was a half tone reproduction of an admirable photograph taken by an unknown local artist, representing the third of the series of waterspouts. After some delay a copy of this photograph was obtained, but in the mean time the original negative seems to have been altered by the addition of lines that destroy its value for meteorological study, and we have, therefore, with much regret, decided not to reproduce it.—ED.