

West Virginia.—Clarksburg, 19th.
Wisconsin.—Milwaukee and Madison, 23d.
Wyoming.—Fort Bridger, 6th.

WINDS.

The most frequent directions of the wind during September, 1886, are shown on chart ii by the arrows flying with the wind; they are also given in the table of miscellaneous meteorological data. In the south Atlantic states, east Gulf states, Tennessee, and Florida, the prevailing direction of the wind during September has been from the northeast or east; in the west Gulf states, middle slope, Rio Grande, Mississippi, and lower portion of the Missouri valleys the wind was mostly from the south; in the extreme northwest and upper portion of the Missouri Valley the prevailing direction was northwest; the wind was variable in all other districts.

HIGH WINDS.

[In miles per hour.]

Wind-velocities of fifty or more miles per hour were recorded during the month, as follows:

Mount Washington, New Hampshire, 58, nw., 1st; 64, w., 8th; 61, w., 9th; 68, w., 11th; 74, w., 12th; 60, w., 13th; 87, sw., 14th; 60, w., 15th; 67, se., 16th; 79, w., 17th; 93, w., 18th; 100, w., 19th; 90, w., 20th; 64, nw., 21st; 80, w., 24th; 76, w., 25th; 80, w., 26th; 80, w., 27th; 54, s., sw., 28th; 75, sw., 29th.

Pike's Peak, Colorado, 56, w., 2d; 52, nw., 15th; 64, w., 17th; 50, sw., 27th.

Moorhead, Minnesota, 50, s., 14th.

Brownsville, Texas, 68, e., 22d; 52, e., 23d.

LOCAL STORMS AND TORNADOES.

New York City: on the 12th, at 5.25 p. m., light rain and thunder-storm, with high wind, set in and continued until 6.55 p. m.; the storm began again at 9 p. m. and ended at 10.10 p. m. Considerable damage was done in the northern part of the city; smoke-stacks were blown down and a number of houses unroofed. This storm was quite severe over Long Island, in northern New Jersey, and in southeastern New York. In Manhattanville considerable damage was done by wind; houses were unroofed and telegraph poles thrown down. At Coney Island fifty-eight bath houses, a railway station, and pavillion were destroyed.

Hartford, Connecticut: a destructive tornado occurred at the town of Burnside, three miles from Hartford, shortly after sunset of the 12th. It travelled from the southwest towards the northeast, making a path about one-eighth of a mile in width through groves of oak, elm, and pine. The tornado was accompanied by a large, black, whirling cloud, and a loud roaring noise.

White Plains, Westchester county, New York: the following is an extract from the report of the observer at this place:

On the 12th the most remarkable rainfall ever recorded at this station occurred. At the time of the shower the wind was perfectly calm; the rain began at 6.15 p. m. and continued about ten minutes, after which the wind began to blow and the rain instantly ceased, during the ten minutes 1.35 inches of rain fell, and in less than ten minutes the sky was clear. During the storm thunder was heard once, lightning distant.

Onancock, Accomack county, Virginia: during the night of the 12-13th, shortly after midnight, a tornado passed over this town, levelling everything in its track to the ground. About midnight the sky was overcast by dark clouds which were illuminated by an almost incessant display of vivid lightning. The storm was preceded by a black funnel-shaped cloud, coming from the southwest, and accompanied by a loud roaring noise. The steeple of a church was blown off, and with it the bell weighing six hundred pounds. Several houses were blown down and many unroofed. The track of the tornado varied in width from fifty to seventy-five yards, its length was about five miles; along this track the largest oak trees were uprooted or broken off near the ground. The town lies between two arms of an estuary of the Chesapeake Bay. In approaching the town the tornado passed over one of these inlets and

raised up a large column of water, forming a water-spout which broke over the lower end of the town with destructive violence. During the day preceding the storm the weather had been unusually warm and oppressive.

Saint Vincent, Minnesota: during the 14th the barometer fell rapidly, reaching a minimum pressure of 29.38 at 11 p. m. In the afternoon the sky became overcast and at 7.35 p. m. heavy rain and thunder-storm set in, the thunder and lightning being almost continuous; several buildings were struck but the damage was slight. At 8.05 p. m. high east wind set in, attaining a maximum velocity of thirty miles at 9.15 p. m.

Lansing, Michigan: a very severe storm prevailed over northern Michigan on the afternoon of the 16th, causing considerable damage to property at all points. At Brighton barns were demolished and orchards injured; in Clinton county houses and barns were wrecked and stacks of hay and wheat blown down and otherwise injured by wind and rain. The effects of the storm were severely felt at Howell, where several houses were blown down and many unroofed. Reports from Lenawee, Clinton, Livingston, and Wayne counties state that the storm was severe, destroying much property in the form of barns, hay-stacks, and fruit trees.

Tolono, Champaign county, Illinois: the storm of the 16th was very destructive and is reported as a tornado which rose and fell alternately as it passed across the county. Fences, trees, and houses were wrecked at some points, while objects at other points (and directly in the path of the tornado) were left undisturbed, owing to the fact that the tornado cloud had ascended from the surface. The cloud touched the ground at the town of Saveri, where a church in process of erection, a large barn, and a warehouse were destroyed.

Terre Haute, Vigo county, Indiana: at 11.30 a. m. of the 16th a tornado occurred at this place, coming from the southwest; the storm continued about fifteen minutes, during which time the air was filled with debris. Numerous large buildings were unroofed, and the rain which followed did great damage. Among the buildings unroofed were the Masonic Hall and a hotel. In the town of Newport, Vermilion county, six buildings were destroyed. The damage done to farm property along the Wabash Valley was estimated at \$90,000. Reports of the severity of this storm have been received from Montezuma, Michigan City, Shelbyville, and various other towns in Indiana.

Tuscola, Douglas county, Illinois: the storm of the 16th was very severe in this county, many barns were blown down, houses unroofed, and large trees uprooted; it was accompanied by heavy rain, overflowing all streams in an unusually short time. The storm was heavy at Woodside, numerous buildings were unroofed and several blown down. The rainfall throughout this section was unusually heavy and was of great value to farmers.

Joliet, Will county, Illinois: at 8.30 p. m. of the 18th a heavy wind storm set in, blowing down numerous houses and uprooting trees. A large grain elevator and several office buildings were levelled to the ground.

Davenport, Iowa: at 5.30 p. m. of the 18th the sky became threatening, with heavy clouds moving rapidly from the southwest, wind-direction southeast. Light rain commenced at 6 p. m.; at 6.45 p. m. the wind veered to the northwest and increased in velocity, heavy rain setting in at the same time. Hail began falling at 6.47 p. m. and continued two minutes, the stones were small and did very little damage. For the five minutes ending at 6.40 p. m. the wind blew at the rate of forty-eight miles per hour from the northwest. The high wind did considerable damage, blowing down chimneys, trees, fences, and signs; telegraphic communication was interrupted, the wires being down in all directions. The storm was quite severe in the surrounding country, blowing down trees, fences, and out-buildings.

Wheaton, Du Page county, Illinois: a heavy storm of wind and rain passed over this county on the night of the 18-19th, commencing at 8 p. m. In the country north of this town much damage was done; several barns and out-houses were demol-

ished and dwellings unroofed or otherwise damaged, numerous windmills and hay-stacks were blown down. Some cattle were killed by falling buildings. The storm was quite severe at De Kalb, the telegraph wires were down and communication was cut off for several hours. A large building was struck by lightning and consumed, loss \$20,000.

Detroit, Michigan: a thunder-storm began at 12.05 a. m. of the 19th. Heavy rain fell between 12.20 and 11 a. m. No damage was done by this storm although the wind for a few minutes blew at the rate of sixty miles per hour from the north. Direction of wind before the storm, southeast; during the storm, north; after, southwest. A westerly gale set in at midday attaining a velocity of twenty-nine miles per hour.

Buffalo, New York: the morning of the 19th opened with heavy rain, the weather continued rainy until the afternoon. Cautionary signals were hoisted at 10.55 a. m. A severe gale from the southwest began at 2 p. m., reaching at 3.55 p. m. a velocity of forty-four miles per hour. The water in the lake was very rough, completely submerging the outer breakwater. No vessel left port during the display of cautionary signals; a number, that left before the warning was given were compelled to return, several of them in a disabled condition. In the country about Buffalo many barns were unroofed, while fences, hay-ricks, and fruit trees were thrown down by the gale. Country roads were rendered almost impassable by the heavy rain, which fell continuously during the day.

Oswego, New York: a heavy thunder-storm and high wind occurred on the afternoon of the 19th. The rainfall was heavy between 5 and 5.20 p. m. From 6.50 to 7.15 p. m. the wind blew from the west at the rate of thirty-two miles per hour. A few shade trees were blown down in the city, and considerable fruit destroyed in the country by being blown from the trees.

Sandusky, Ohio: on the 19th a gale began at 1.43 a. m. and ended at 2.45 a. m., began again at 9 a. m. and ended at 6.15 p. m.; maximum velocity, thirty-four miles per hour from the northwest, at 2.05 p. m. Heavy rain, accompanied by thunder and lightning, set in at 1.40 a. m.

Alden Station, Luzerne county, Pennsylvania: this town was visited by a heavy wind and rain storm on the night of the 19-20th. Nearly every building in the town was damaged; several small buildings were completely destroyed. A hotel and a public school building were partially destroyed, and several persons injured.

Wellsborough, Tioga county, Pennsylvania: on the 19th a tornado occurred in Tioga county near Knoxville. The storm destroyed several barns and houses and blew down forest trees. Its track extended over a distance of ten miles. Heavy thunder-storms and high winds were general throughout eastern Pennsylvania on the afternoon of the 19th. At Alden several miners' houses were blown down, and many other buildings unroofed. Farmers suffered considerable loss, the wind unroofing barns and destroying unripe fruit.

Decatur, Indiana: on the afternoon of the 22d a violent wind and rain storm did considerable damage in this town and vicinity. Many buildings were unroofed and small structures demolished. West of the town the storm assumed the form of a tornado and uprooted many acres of forest trees. A heavy storm also occurred on the 24th, destroying fencing and blowing down orchards. In this town much damage was done to the manufacturing interests by the unroofing of buildings. The total damage is estimated at \$50,000.

Cincinnati, Ohio: heavy rain and thunder-storm set in at 5.30 p. m. of the 23d and continued until 6.40 p. m. The storm came from the west and moved toward the southeast and was accompanied by high wind, maximum velocity thirty-two miles per hour. Reports from numerous places show that severe thunder-storms, in some places accompanied by hail and high wind, prevailed throughout the state. At Urbana, in Champaign county, several buildings were unroofed and considerable damage done to fruit and shade trees. The railroad station at Bluffton, and numerous barns in Wyandot, Seneca,

Champaign, and Allen counties were struck by lightning and burned.

Lima, Allen county, Ohio: at 7 a. m. of the 23d a heavy rain and thunder-storm set in. During the storm a large oil tank was struck by lightning and burned, together with a large building and the machinery used in refining the oil; the loss is estimated at \$25,000.

Fort Assinaboine, Montana: fair, cool weather, with brisk and high winds from the southwest and west, prevailed during the 23d. Between 3 and 4 p. m. the wind attained a velocity of forty-one miles per hour. High west winds also prevailed during the 24th and 25th; on the 25th, between 4 and 5 p. m., it blew at the rate of forty miles per hour from the southwest.

Grand Haven, Michigan: heavy rain and vivid lightning set in at 1.02 and continued until 5.05 a. m. of the 24th; amount of rainfall 2.02 inches. Telegraph and telephonelines suffered considerable damage, communication being cut off until 11 a. m. During the storm several houses in the city were struck by lightning. Reports show that the storm was severe throughout the surrounding country, several barns being struck by lightning and burned.

Fort Sill, Indian Territory: a thunder-storm began at 2 p. m. and continued until 4.30 p. m. of the 26th. The storm came from the southwest and was accompanied by heavy rain and high wind, which unroofed one of the post buildings.

TORNADO STUDIES FOR SEPTEMBER, 1886.

[Prepared by Lieut. JNO. P. FINLEY, Signal Corps, U. S. Army, Assistant.]

Tornadoes occurred in September on three days, the 12th, 16th, and 18th, as will be seen by reference to the accompanying table, which presents a brief history of each storm and the authority upon which the report is based.

The tornadoes occurring on the 16th were found to be the most destructive as well as the most numerous of the month. In order to invite special attention to the marked disturbances on this day, and graphically present the surrounding atmospheric conditions which were prevailing at the time, chart number vii has been prepared and will be found on the last page of this REVIEW.

Chart number vii is the 3 p. m. (Eastern time) tri-daily weather map of September 16th. The isobars are drawn for every tenth of an inch difference in pressure, and the isotherms for every difference of 10° in temperature. The words "High" and "Low," as used on the chart, indicate the centres of the regions of highest and lowest pressure, respectively. The location and direction of the progressive movement of the tornadoes are shown by the following sign, $\times \times \times \times \longrightarrow$, placed upon the chart, and to the southeast of the centre of lowest pressure.

The low-pressure area with which the tornadoes of the 16th were associated was one of the most remarkable depressions of the month. It first appeared in the Saskatchewan Valley, north of Montana, on the afternoon of the 13th. From this locality it moved slowly eastward along the northern boundary of the United States, with little increase in intensity, until the afternoon of the 15th when it was then central in extreme northern Minnesota. On this day a decided change took place in the character of the depression, which inaugurated the conditions of temperature, wind-force, and direction that precipitated the violent local storms of the 16th.

On the morning of the 14th, while the main area was central in Montana, a secondary depression appeared in southern Colorado, which at the expiration of twenty-four hours united with the former in developing a huge and irregular trough of low pressure extending from Lake Superior southwestward to New Mexico. This elongated area increased its major axis to the southwest and northeast, at the same time contracting the shorter axis until the trough reached from the Rio Grande to the fiftieth parallel, north of Lake Superior. The maximum condition was realized on the afternoon of the 16th, and disappeared on the following morning, when the combined depressions were central as a single area in the lower Saint Law-