

# MONTHLY WEATHER REVIEW.

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No. 11.

## INTRODUCTION.

This REVIEW contains a general summary of the meteorological conditions which prevailed over the United States and Canada during November, 1886, based upon the reports from the regular and voluntary observers of the Signal Service and from co-operating state weather services.

Descriptions of the storms which occurred over the north Atlantic Ocean during the month are also given, and their approximate paths shown on chart i. In tracing the centres of the paths of these storms, data from the reports of one hundred and eighty-five vessels have been used.

With the exception of one iceberg, observed on the 2d, no ocean ice has been reported in the vicinity of the trans-Atlantic ship routes.

On chart i for this month are traced the paths of fourteen areas of low pressure; the average number for November during the last fourteen years being 11.7. That described as number vii was the severest storm of the month, and caused, in connection with the succeeding area of high pressure, meteorological disturbances over the greater part of the country east of the Rocky Mountains; the gales on the Lakes, and high winds with snow in the Missouri and upper Mississippi valleys, were especially severe.

The mean pressure for the month is normal, or nearly so, over the eastern slope of the Rocky Mountains; from this region eastward it is generally below the normal; along the Pacific coast it is considerably above the normal.

The month has been colder than the average November in all districts of the United States, except New England, the middle Atlantic states, and North Carolina.

The precipitation is very small on the Pacific slope and in the south Atlantic and Gulf states; in the other districts it presents no great departures from the normal.

In this REVIEW, under "Notes and extracts," will be found an instructive paper by Prof. Cleveland Abbe, Assistant, on "The effects of wind and exposure upon barometric readings;" also a paper by Private I. M. Cline, Signal Service observer at Abilene, Texas, on "Rainfall and its source in the southern slope;" and an article by Dr. H. B. Baker, secretary of the Michigan State Board of Health, containing a short discussion of the relations existing between dry and cold air and the causes of pneumonia.

In the preparation of this REVIEW the following data, received up to December 20, 1886, have been used, viz., the regular tri-daily weather-charts, containing data of simultaneous observations taken at one hundred and thirty-three Signal Service stations and twenty Canadian stations, as telegraphed to this office; one hundred and sixty-two monthly journals; one hundred and fifty-six monthly means from the former, and twenty monthly means from the latter; two hundred and sixty-nine monthly registers from voluntary

observers; fifty-four monthly registers from United States Army post surgeons; marine records; international simultaneous observations; marine reports through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs furnished by the publishers of "The New York Maritime Register;" monthly weather reports from the local weather services of Alabama, Indiana, Illinois, Iowa, Minnesota, Mississippi, Missouri, Nebraska, New England, New Jersey, Ohio, and Tennessee; trustworthy newspaper extracts, and special reports.

## ATMOSPHERIC PRESSURE.

[Expressed in inches and hundredths.]

The distribution of mean pressure for November, 1886, determined from the tri-daily telegraphic observations of the Signal Service, is shown by isobarometric lines on chart ii.

An examination of the chart will show that the mean atmospheric pressure over the United States during the month is greatest in Washington Territory, Oregon, Nevada, Utah, and northern California, where it ranges from 30.16 at Tatoosh Island, Washington Territory, to 30.31, the highest mean pressure of the month, at Fort Bidwell, California, and averages about 30.24. The area of minimum pressure covers Maine, New Hampshire, Vermont, northern New York, and the upper lake region; within this area the pressure ranges from 29.89 at Mount Washington, New Hampshire, to 29.93 at several stations on the upper lakes, and averages about 29.92. Southward of the isobar of 29.95, which extends almost directly east and west through the centre of New England, New York, and the Lakes, the pressure increases steadily at the rate of about .05 to each three degrees of latitude until the pressure of 30.13 is attained along the Gulf coast.

The departures from the normal pressure are given in the table of miscellaneous meteorological data, and are also shown on chart iv by lines connecting stations of equal departure. The mean pressure when compared with the normal will be found deficient, except in Florida and a narrow strip along the Gulf coast, over the eastern half of the country, and excessive in the western half, with the exception of Dakota and eastern Montana where it is normal or slightly below. The largest departures below the normal occur in New England, New York, Pennsylvania, and Maryland, where they range from .14 at New London, Connecticut, to .10 at several stations; in the south Atlantic and Gulf states the pressure exhibits only slight departures from the normal. In the Rocky Mountain regions and along the Pacific coast the pressure of the month is considerably above the normal, the largest departures occurring in Washington Territory and Oregon, where they average about .16. At two stations, Tatoosh Island and Fort Canby, Washington Territory, the unusually large departure of .23 occurs; this is partially owing to the short record from which the normal at these stations is deduced; all stations in California show an increase of .07.

When compared with the mean pressure of the preceding month, October, 1886, a very large decrease is noted in the portion of country lying north of the thirty-fifth parallel and east of the Mississippi River, the deficiency in New England and the Lake region is especially large, the departures ranging from .17 to .27. In the Rocky Mountain regions and along the Pacific coast the increase is equally as large, the

pressure at Salt Lake City, Utah, and Winnemucca, Nevada, being, respectively, .27 and .24 above that of last month; along the Pacific coast the increase averages about .15.

The mean pressure for November, 1886, as compared with that of November, 1885, exhibits some noteworthy features, especially over the north Pacific coast region; in November, 1885, this was the region of minimum pressure, the barometric means ranging from 29.95 in the interior to 29.75 on the coast, this month it is the region of maximum pressure, the barometric means averaging about 30.24.

BAROMETRIC RANGES.

The monthly barometric ranges at the various Signal Service stations are given in the table of miscellaneous data. The following are some of the extreme monthly ranges:

| Greatest.                       |       | Least.                     |       |
|---------------------------------|-------|----------------------------|-------|
|                                 | Inch. |                            | Inch. |
| Salt Lake City, Utah            | 1.57  | Key West, Florida          | 0.26  |
| Mount Washington, New Hampshire | 1.55  | Sacramento, California     | 0.36  |
| Huron, Dakota                   | 1.49  | Sunford, Florida           | 0.39  |
| Moorhead, Minnesota             | 1.47  | Cedar Keys, Florida        | 0.44  |
| Fort Bridger, Wyoming           | 1.46  | Jacksonville, Florida      | 0.47  |
| Marquette, Michigan             | 1.43  | San Diego, California      | 0.49  |
| Pike's Peak, Colorado           | 1.40  | Charleston, South Carolina | 0.54  |
| Montrose, Colorado              | 1.38  | Savannah, Georgia          | 0.56  |

AREAS OF HIGH PRESSURE.

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

In discussing areas of high pressure for November, 1886, it has appeared advisable to change somewhat the usual method of describing them, having in view the twofold purpose of condensing the information and directing attention only to the salient points exhibited by each area during its progress eastward within the limits of observation.

In order to accomplish this scheme the information at hand has been systematically arranged, as shown in the accompanying table. That the designations employed may be clearly understood, the following explanations are deemed necessary:

The times 7 a. m., 3 p. m., and 10 p. m. are the hours (75th meridian time) at which the tri-daily telegraphic meteorological observations are made at Signal Service stations. These observations are used in the preparation of the daily weather maps from which indications are made, and from a study of which the tracks of high pressure areas are charted and described.

Barometric departure refers to the maximum deviation of pressure from the normal within the central area, which deviation in all cases will have the plus sign.

Temperature departure refers to the maximum deviation of temperature from the normal within the central area, which deviation in all cases will have the minus sign.

The location of the maximum deviation of temperature was almost invariably found several hundred miles in advance, to the south and east, of the region of highest barometer. Similar to the extension eastward of the area of precipitation in advance of the central area of lowest pressure, so appeared the influence of the high pressure area upon the fall of temperature, carrying the cold wave frequently far in advance of the region of barometric maxima.

It is important to note the varying intensity of each high pressure area as shown by the barometric departures during its progressive movement to the eastward, and also the relation of these changes to the fluctuations in temperature departures.

Eleven areas of high pressure appeared within the limits of the Signal Service charts for the month of November, 1886. The majority of these areas made their first appearance in the Pacific coast states, north of parallel 37° N.

Areas numbers i, iii, v, and xi were particularly sluggish in their progressive movement.

Area number viii possessed the highest velocity of translation.

Table of high pressure areas.

| Number of area | Date.   | Hour of observation. | Location of central storm area. | Barometer departure. | Temperature departure. | Remarks.  |         |   |
|----------------|---------|----------------------|---------------------------------|----------------------|------------------------|---|---------|---|
|                |         |                      |                                 |                      |                        |   | Inches. | °   |
| I              | 1       | 7 a. m.              | Northern California             | +0.16                | -8                     | This area merged during the day with No. III which entered Washington Territory on the 4th. |         |   |
|                |         | 3 p. m.              | Northern Nevada                 | +0.18                | -15                    |   |         |   |
|                | 2       | 7 a. m.              | do                              | +0.17                | -14                    |   |         |   |
|                |         | 3 p. m.              | do                              | +0.22                | -9                     |   |         |   |
|                | II      | 3                    | 7 a. m.                         | Northern Utah        | +0.26                  |   | -1      | This area remained stationary for two days off the south Atlantic coast and then disappeared eastward over the ocean. |
|                |         |                      | 3 p. m.                         | do                   | +0.29                  |   | -4      |   |
|                |         | 4                    | 7 a. m.                         | Central Utah         | +0.34                  |   | -3      |   |
|                |         |                      | 3 p. m.                         | Northern Nevada      | +0.29                  |   | -4      |   |
|                |         | 5                    | 7 a. m.                         | do                   | +0.23                  |   | -2      |   |
|                |         |                      | 3 p. m.                         | do                   | +0.26                  |   | -8      |   |
| III            | 4       | 7 a. m.              | West Washington Ter.            | +0.51                | -2                     | This area disappeared over northern Canada.   |         |   |
|                |         | 3 p. m.              | Central Washington Ter.         | +0.35                | -5                     |   |         |   |
|                | 5       | 7 a. m.              | West Montana                    | +0.50                | -7                     |   |         |   |
|                |         | 3 p. m.              | Southwest Montana               | +0.48                | -8                     |   |         |   |
|                | 6       | 7 a. m.              | West Nebraska                   | +0.42                | -7                     |   |         |   |
|                |         | 3 p. m.              | West Kansas                     | +0.42                | -14                    |   |         |   |
|                | 7       | 7 a. m.              | Indian Territory                | +0.33                | -18                    |   |         |   |
|                |         | 3 p. m.              | do                              | +0.24                | -11                    |   |         |   |
|                | 8       | 7 a. m.              | Northeast Texas                 | +0.24                | -17                    |   |         |   |
|                |         | 3 p. m.              | Central Texas                   | +0.21                | -20                    |   |         |   |
|                | 9       | 7 a. m.              | Southern Texas                  | +0.18                | -11                    |   |         |   |
|                |         | 3 p. m.              | West Tennessee                  | +0.14                | -18                    |   |         |   |
| IV             | 9       | 7 a. m.              | Northern Georgia                | +0.13                | -14                    | This area merged with No. VI, central in Iowa, on the morning of the 15th.                  |         |   |
|                |         | 3 p. m.              | Coast of South Carolina         | +0.10                | -17                    |   |         |   |
|                | 10      | 7 a. m.              | West Washington Ter.            | +0.35                | -12                    |   |         |   |
|                |         | 3 p. m.              | Northwest Montana               | +0.20                | -12                    |   |         |   |
|                | 11      | 7 a. m.              | Northwest Dakota                | +0.30                | -15                    |   |         |   |
|                |         | 3 p. m.              | Central Dakota                  | +0.40                | -25                    |   |         |   |
|                | 12      | 7 a. m.              | Southeast Dakota                | +0.41                | -19                    |   |         |   |
|                |         | 3 p. m.              | East Minnesota                  | +0.41                | -14                    |   |         |   |
|                | 13      | 7 a. m.              | Northwest Wisconsin             | +0.40                | -7                     |   |         |   |
|                |         | 3 p. m.              | Northern Wisconsin              | +0.39                | -6                     |   |         |   |
| V              | 11      | 7 a. m.              | do                              | +0.41                | -9                     | This area disappeared northward in British America.   |         |   |
|                |         | 3 p. m.              | Lake Superior                   | +0.33                | -14                    |   |         |   |
|                | 12      | 7 a. m.              | Northern Utah                   | +0.38                | -16                    |   |         |   |
|                |         | 3 p. m.              | do                              | +0.37                | -24                    |   |         |   |
|                | 13      | 7 a. m.              | do                              | +0.35                | -19                    |   |         |   |
|                |         | 3 p. m.              | Western Colorado                | +0.34                | -24                    |   |         |   |
|                | 14      | 7 a. m.              | do                              | +0.31                | -27                    |   |         |   |
|                |         | 3 p. m.              | Indian Territory                | +0.30                | -15                    |   |         |   |
|                | 15      | 7 a. m.              | Arkansas                        | +0.27                | -19                    |   |         |   |
|                |         | 3 p. m.              | Southern Missouri               | +0.32                | -18                    |   |         |   |
| 16             | 7 a. m. | Southern Arkansas    | +0.27                           | -13                  |                        |   |         |   |
|                | 3 p. m. | Northern Alabama     | +0.30                           | -18                  |                        |   |         |   |
| VI             | 14      | 7 a. m.              | do                              | +0.28                | -15                    | This area disappeared eastward over the Atlantic during the day.                            |         |   |
|                |         | 3 p. m.              | Mississippi                     | +0.25                | -11                    |   |         |   |
|                | 15      | 7 a. m.              | West Washington Ter.            | +0.41                | -12                    |   |         |   |
|                |         | 3 p. m.              | Northern Oregon                 | +0.44                | -10                    |   |         |   |
|                | 16      | 7 a. m.              | do                              | +0.48                | -9                     |   |         |   |
|                |         | 3 p. m.              | Washington Territory            | +0.68                | -8                     |   |         |   |
|                | 17      | 7 a. m.              | do                              | +0.72                | -11                    |   |         |   |
|                |         | 3 p. m.              | do                              | +0.75                | -15                    |   |         |   |
|                | 18      | 7 a. m.              | do                              | +0.76                | -16                    |   |         |   |
|                |         | 3 p. m.              | do                              | +0.64                | -25                    |   |         |   |
| 19             | 7 a. m. | Northwest Montana    | +0.68                           | -19                  |                        |   |         |   |
|                | 3 p. m. | Central Montana      | +0.57                           | -25                  |                        |   |         |   |
| VII            | 15      | 7 a. m.              | do                              | +0.41                | -33                    | This area disappeared eastward over the Atlantic during the day.                            |         |   |
|                |         | 3 p. m.              | West Dakota                     | +0.35                | -31                    |   |         |   |
|                | 16      | 7 a. m.              | Northeast Dakota                | +0.27                | -26                    |   |         |   |
|                |         | 3 p. m.              | Iowa                            | +0.44                | -8                     |   |         |   |
|                | 17      | 7 a. m.              | Northern Illinois               | +0.42                | -3                     |   |         |   |
|                |         | 3 p. m.              | Southern Michigan               | +0.39                | -11                    |   |         |   |
|                | 18      | 7 a. m.              | Lower Canada                    | +0.45                | -18                    |   |         |   |
|                |         | 3 p. m.              | Southern New York               | +0.40                | -10                    |   |         |   |
|                | 19      | 7 a. m.              | Massachusetts                   | +0.37                | -11                    |   |         |   |
|                |         | 3 p. m.              | Nova Scotia                     | +0.33                | -9                     |   |         |   |
| VIII           | 17      | 7 a. m.              | New Brunswick                   | +0.29                | -11                    | This area merged with No. X, central the afternoon of the 25th in Nevada.                   |         |   |
|                |         | 3 p. m.              | Gulf of Saint Lawrence          | +0.24                | -6                     |   |         |   |
|                | 18      | 7 a. m.              | Southern Texas                  | +0.29                | -24                    |   |         |   |
|                |         | 3 p. m.              | do                              | +0.35                | -26                    |   |         |   |
|                | 19      | 7 a. m.              | Texas coast                     | +0.31                | -16                    |   |         |   |
|                |         | 3 p. m.              | Coast of Louisiana              | +0.28                | -23                    |   |         |   |
|                | 20      | 7 a. m.              | Southern Mississippi            | +0.30                | -21                    |   |         |   |
|                |         | 3 p. m.              | Southern Alabama                | +0.29                | -11                    |   |         |   |
|                | 21      | 7 a. m.              | do                              | +0.21                | -12                    |   |         |   |
|                |         | 3 p. m.              | Southern Georgia                | +0.16                | -17                    |   |         |   |
| IX             | 21      | 7 a. m.              | East coast of Florida           | +0.16                | -6                     | This area disappeared eastward over the Atlantic.   |         |   |
|                |         | 3 p. m.              | Manitoba                        | +0.23                | -14                    |   |         |   |
|                | 22      | 7 a. m.              | Lake Superior                   | +0.29                | -15                    |   |         |   |
|                |         | 3 p. m.              | East of Lake Huron              | +0.26                | -7                     |   |         |   |
|                | 23      | 7 a. m.              | Vermont                         | +0.21                | -8                     |   |         |   |
|                |         | 3 p. m.              | Nova Scotia                     | +0.20                | -12                    |   |         |   |
|                | 24      | 7 a. m.              | Northern California             | +0.24                | -6                     |   |         |   |
|                |         | 3 p. m.              | do                              | +0.22                | -17                    |   |         |   |
|                | 25      | 7 a. m.              | Southern Oregon                 | +0.36                | -10                    |   |         |   |
|                |         | 3 p. m.              | Northern Utah                   | +0.22                | -23                    |   |         |   |
| X              | 24      | 7 a. m.              | do                              | +0.32                | -26                    | This area disappeared eastward over the Atlantic during the day.                            |         |   |
|                |         | 3 p. m.              | Western Colorado                | +0.39                | -20                    |   |         |   |
|                | 26      | 7 a. m.              | Nevada                          | +0.26                | -19                    |   |         |   |
|                |         | 3 p. m.              | Central Utah                    | +0.32                | -20                    |   |         |   |
|                | 27      | 7 a. m.              | Central Colorado                | +0.49                | -17                    |   |         |   |
|                |         | 3 p. m.              | Central Kansas                  | +0.50                | -20                    |   |         |   |
|                | 28      | 7 a. m.              | Southern Missouri               | +0.45                | -18                    |   |         |   |
|                |         | 3 p. m.              | Kentucky                        | +0.39                | -19                    |   |         |   |
|                | 29      | 7 a. m.              | Southwestern Virginia           | +0.31                | -14                    |   |         |   |
|                |         | 3 p. m.              | Southeast Virginia              | +0.19                | -13                    |   |         |   |
| 30             | 7 a. m. | Southern Utah        | +0.52                           | -17                  |                        |   |         |   |
|                | 3 p. m. | Central Utah         | +0.50                           | -18                  |                        |   |         |   |
| 31             | 7 a. m. | do                   | +0.56                           | -13                  |                        |   |         |   |
|                | 3 p. m. | do                   | +0.54                           | -16                  |                        |   |         |   |
| 32             | 7 a. m. | do                   | +0.49                           | -15                  |                        |   |         |   |
|                | 3 p. m. | do                   | +0.47                           | -11                  |                        |   |         |   |

Table of high pressure areas—Continued.

| Number of area. | Date. | Hour of observation. | Location of central storm area. | Barometer departure. | Temperature departure. | Remarks.   |
|-----------------|-------|----------------------|---------------------------------|----------------------|------------------------|--|
| XI.             | 28    | 3 p. m.              | Central Utah.....               | 0.46                 | -12                    | A further consideration of this area will appear in the REVIEW for December, 1886. |
|                 |       | 10 p. m.             | do.....                         | 0.37                 | -13                    |  |
|                 | 29    | 7 a. m.              | do.....                         | 0.32                 | -17                    |  |
|                 |       | 3 p. m.              | do.....                         | 0.33                 | -8                     |  |
|                 | 30    | 10 p. m.             | Northern Nevada.....            | 0.20                 | -9                     |  |
|                 |       | 7 a. m.              | do.....                         | 0.09                 | -9                     |  |
|                 |       | 3 p. m.              | Southern Montana.....           | 0.21                 | -37                    |  |
|                 |       | 10 p. m.             | Western Dakota.....             | 0.37                 | -39                    |  |

AREAS OF LOW PRESSURE.

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

The following table shows the latitude and longitude in which each area of low pressure was first and last observed, with the average rate of translation in miles per hour:

| Areas of low pressure. | First observed. |          | Last observed. |          | Average velocity of translation in miles per hour. |
|------------------------|-----------------|----------|----------------|----------|--|
|                        | Lat. N.         | Long. W. | Lat. N.        | Long. W. |  |
| No. I.....             | 37 00           | 107 00   | 48 00          | 62 00    | 23.0   |
| II.....                | 51 00           | 112 00   | 50 00          | 70 00    | 33.0   |
| III.....               | 39 00           | 81 00    | 50 00          | 62 00    | 15.0   |
| IV.....                | 51 00           | 107 00   | 49 00          | 70 00    | 21.0   |
| V.....                 | 41 00           | 110 00   | 50 00          | 59 00    | 19.0   |
| VI.....                | 52 00           | 112 00   | 50 00          | 87 00    | 22.0   |
| VII.....               | 40 00           | 116 00   | 49 00          | 62 00    | 24.0   |
| VIII.....              | 40 00           | 78 00    | 50 00          | 58 00    | 26.0   |
| IX.....                | 49 00           | 122 00   | 50 00          | 62 00    | 27.0   |
| X.....                 | 31 00           | 102 00   | 48 00          | 65 00    | 20.0   |
| XI.....                | 51 00           | 117 00   | 41 00          | 99 00    | 28.0   |
| XII.....               | 51 00           | 109 00   | 50 00          | 67 00    | 33.0   |
| XIII.....              | 50 00           | 113 00   | 41 00          | 71 00    | 33.0   |
| XIV.....               | 51 00           | 108 00   | 49 00          | 85 00    | 29.0   |

Average rate of movement, 25.2 miles per hour.

In discussing areas of low pressure for November, 1886, it has been deemed advisable to depart somewhat from the usual method heretofore pursued in the presentation of this subject, and invite attention to certain important and interesting changes which characterize the storm at each hour of observation during its progress eastward within the limits of the Signal Service charts.

Among the many phenomena which attend, and are peculiar to barometric depressions, none are more valuable for examination and study than precipitation and the variability of storm-energy.

In order that the text may be clearly understood, the following explanations are deemed necessary:

The times 7 a. m., 3 p. m., and 10 p. m. are the hours (75th meridian time) at which the tri-daily telegraphic meteorological observations are made at Signal Service stations. These observations are used in the preparation of the daily weather maps from which indications are made, and from a study of which the tracks of low-pressure areas are charted and described.

The word "departure" refers to the maximum departure of the barometer from the normal within the central area of low pressure.

The word "position" refers to the region covered by the central storm-area.

The word "precipitation" refers to all rain or snow that has fallen during the past eight hours, or since the last observation. In order to show, approximately, the distribution of precipitation about the central area of low pressure, the four quadrants of the depression are separately considered by designating the number of stations in each at which precipitation has taken place.

It is important to note the variability of energy manifested by each depression, as shown by the barometric departures from the normal, during its progressive movement to the eastward, and also the relation of these changes to the position and extent of the region of precipitation.

The tracks of fourteen areas of low pressure have been charted from a study of the tri-daily weather charts of the Signal Service for the month of November, 1886. Considering their first appearance, there seems to have been two regions of development, one in the Saskatchewan Valley of British North America, and the other in the southern plateau, which embraces the state of Colorado and the territories of Arizona, New Mexico, and Utah. The majority of the disturbances first appeared in the former region, and passed thence eastward over the Lakes to the Canadian Maritime Provinces, beyond which their further course lies without the limits of the daily weather map.

I.—1st, 7 a. m. Position, *southeast Colorado*: Departure, —.52 inch. Precipitation, ne. quadrant, seven stations; se. quadrant, none; sw. quadrant, none; nw. quadrant, two stations.

3 p. m. Position, *southwest Nebraska*: Departure, —.59 inch. Precipitation, ne. quadrant, three stations; se. quadrant, none; sw. quadrant, two stations; nw. quadrant, five stations.

10 p. m. Position, *southeast Dakota*: Departure, —.59 inch. Precipitation, ne. quadrant, none; se. quadrant, one station; sw. quadrant, six stations; nw. quadrant, two stations.

2d, 7 a. m. Position, *southwest Minnesota*: Departure, —.66 inch. Precipitation, ne. quadrant, three stations; se. quadrant, none; sw. quadrant, two stations; nw. quadrant, two stations.

3 p. m. Position, *northern Minnesota*: Departure, —.68 inch. Precipitation, ne. quadrant, none; se. quadrant, two stations; sw. quadrant, three stations; nw. quadrant, one station.

10 p. m. Position, *north of Lake Superior*: Departure, —.64 inch. Precipitation, ne. quadrant, none; se. quadrant, five stations; sw. quadrant, three stations; nw. quadrant, none.

3d, 7 a. m. Position, *northeast of Lake Superior*: Departure, —.48 inch. Precipitation, ne. quadrant, none; se. quadrant, four stations; sw. quadrant, five stations; nw. quadrant, one station.

3 p. m. Position, *northern Canada*: Departure, —.42 inch. Precipitation, ne. quadrant, no reports; se. quadrant, none; sw. quadrant, nine stations; nw. quadrant, none.

10 p. m. Position, *northern Canada*: Departure, —.35 inch. Precipitation, ne. quadrant, none; se. quadrant, none; sw. quadrant, nine stations; nw. quadrant, two stations.

4th, 7 a. m. Position, *northeast Canada*: Departure, —.33 inch. Precipitation, ne. quadrant, no reports; se. quadrant, none; sw. quadrant, eight stations; nw. quadrant, none.

3 p. m. Position, *mouth of Saint Lawrence River*: Departure, —.31 inch. Precipitation, ne. quadrant, none; se. quadrant, none; sw. quadrant, five stations; nw. quadrant, none.

10 p. m. Position, *Gulf of Saint Lawrence*: Departure, —.23 inch. Precipitation, ne. quadrant, no reports; se. quadrant, three stations; sw. quadrant, 1 station; nw. quadrant, no reports. From this region the depression moved thence eastward to the Atlantic.

II.—3d, 3 p. m. Position, *Saskatchewan Valley*: Departure, —.30 inch. Precipitation, in all quadrants, none.

10 p. m. Position, *Saskatchewan Valley*: Departure, —.45 inch. Precipitation, in all quadrants, none.

4th, 7 a. m. Position, *Manitoba*: Departure, —.80 inch. Precipitation, in all quadrants, none.

3 p. m. Position, *north of Minnesota*: Departure, —.71 inch. Precipitation, ne. quadrant, one station; se. quadrant, none; sw. quadrant, none; nw. quadrant, one station.

10 p. m. Position, *north coast of Lake Superior*: Departure, —.53 inch. Precipitation, ne. quadrant, no reports; se. quadrant, none; sw. quadrant, none; nw. quadrant, six stations.

5th, 7 a. m. Position, *north of Lake Huron*: Departure, —.35 inch. Precipitation, ne. quadrant, no reports; se. quadrant, none; sw. quadrant, two stations; nw. quadrant, four stations.

3 p. m. Position, *northern Canada*: Departure, —.18 inch. Precipitation, ne. quadrant, none; se. quadrant, none; sw. quadrant, two stations; nw. quadrant, two stations.

10 p. m. Position, *mouth of Saint Lawrence River*: Depart-

ure, —.09 inch. Precipitation, in all quadrants, none. From this region the depression moved thence eastward to the Atlantic.

III.—6th, 7 a. m. Position, *northern Virginia*: Departure, —.25 inch. Precipitation, ne. quadrant, seven stations; se. quadrant, none; sw. quadrant, thirteen stations; nw. quadrant, seven stations.

3 p. m. Position, *eastern Pennsylvania*: Departure, —.31 inch. Precipitation, ne. quadrant, six stations; se. quadrant, no reports; sw. quadrant, eighteen stations; nw. quadrant, fourteen stations.

10 p. m. Position, *Connecticut*: Departure, —.46 inch. Precipitation, ne. quadrant, ten stations; se. quadrant, no reports; sw. quadrant, seventeen stations; nw. quadrant, fifteen stations.

7th, 7 a. m. Position, *coast of Maine*: Departure, —.93 inch. Precipitation, ne. quadrant, two stations; se. quadrant, no reports; sw. quadrant, twenty stations; nw. quadrant, five stations.

3 p. m. Position, *northern Maine*: Departure, —.93 inch. Precipitation, ne. quadrant, no reports; se. quadrant, one station; sw. quadrant, thirteen stations; nw. quadrant, two stations.

10 p. m. Position, *lower Saint Lawrence valley*: Departure, —.61 inch. Precipitation, ne. quadrant, two stations; se. quadrant, three stations; sw. quadrant, twelve stations; nw. quadrant, no reports.

8th, 7 a. m. Position, *mouth of Saint Lawrence River*: Departure, —.51 inch. Precipitation, ne. quadrant, two stations; se. quadrant, one station; sw. quadrant, nine stations; nw. quadrant, no reports.

3 p. m. Position, *Gulf of Saint Lawrence*: Departure, —.40 inch. Precipitation, ne. quadrant, no reports; se. quadrant, one station; sw. quadrant, nine stations. From this region the depression moved thence eastward to the Atlantic.

IV.—7th, 3 p. m. Position, *Saskatchewan Valley*: Departure, —.15 inch. Precipitation, in all quadrants, none.

10 p. m. Position, *Saskatchewan Valley*: Departure, —.25 inch. Precipitation, in all quadrants, none.

8th, 7 a. m. Position, *Manitoba*: Departure, —.42 inch. Precipitation, ne. and se. quadrants, none; sw. quadrant, two stations; nw. quadrant, none.

3 p. m. Position, *Manitoba*: Departure, —.48 inch. Precipitation, ne. quadrant, none; se. quadrant, four stations; sw. quadrant, three stations; nw. quadrant, none.

10 p. m. Position, *Manitoba*: Departure, —.57 inch. Precipitation, ne. quadrant, none; se. quadrant, seven stations; sw. quadrant, two stations; nw. quadrant, four stations.

9th, 7 a. m. Position, *northern Minnesota*: Departure, —.49 inch. Precipitation, ne. quadrant, none; se. quadrant, twenty stations; sw. quadrant, one station; nw. quadrant, five stations.

3 p. m. Position, *northern Wisconsin*: Departure, —.35 inch. Precipitation, ne. quadrant, three stations; se. quadrant, twenty-nine stations; sw. quadrant, three stations; nw. quadrant, six stations.

10 p. m. Position, *Lake Superior*: Departure, —.24 inch. Precipitation, ne. quadrant, no reports; se. quadrant, twenty-eight stations; sw. quadrant, seven stations; nw. quadrant, one station.

10th, 7 a. m. Position, *north of Lake Huron*: Departure, —.12 inch. Precipitation, ne. quadrant, two stations; se. quadrant, twenty-one stations; sw. quadrant, twelve stations; nw. quadrant, two stations.

3 p. m. Position, *Lower Canada*: Departure, —.12 inch. Precipitation, ne. quadrant, four stations; se. quadrant, ten stations; sw. quadrant, twenty-two stations; nw. quadrant, five stations.

10 p. m. Position, *Upper Canada*: Departure, —.05 inch. Precipitation, ne. quadrant, four stations; se. quadrant, seven stations; sw. quadrant, seventeen stations; nw. quadrant, no reports.

11th, 7 a. m. Position, *mouth of Saint Lawrence River*: Departure, —.01 inch. Precipitation, ne. quadrant, two stations; se. quadrant, three stations; sw. quadrant, eighteen stations; nw. quadrant, no reports. From this region the depression probably moved thence eastward to the Atlantic north of the Gulf of Saint Lawrence.

V.—9th, 3 p. m. Position, *northern Colorado*: Departure, —.24 inch. Precipitation, ne. quadrant, four stations; se. quadrant, none; sw. quadrant, none; nw. quadrant, four stations.

10 p. m. Position, *southern Colorado*: Departure, —.18 inch. Precipitation, ne. quadrant, one station; se. quadrant, none; sw. quadrant, none; nw. quadrant, four stations.

10th, 7 a. m. Position, *northwest Texas*: Departure, —.16 inch. Precipitation, ne. quadrant, none; se. quadrant, one station; sw. quadrant, none; nw. quadrant, four stations.

3 p. m. Position, *west Texas*: Departure, —.07 inch. Precipitation, ne. quadrant, none; se. quadrant, none; sw. quadrant, none; nw. quadrant, five stations.

10 p. m. Position, *southwest Texas*: Departure, —.12 inch. Precipitation, ne., se., and sw. quadrants, none; nw. quadrant, five stations.

11th, 7 a. m. Position, *central Texas*: Departure, —.14 inch. Precipitation, ne. quadrant, four stations; se. quadrant, one station; sw. quadrant, none; nw. quadrant, three stations.

3 p. m. Position, *Louisiana*: Departure, —.17 inch. Precipitation, ne. quadrant, five stations; se. quadrant, five stations; sw. quadrant, one station; nw. quadrant, three stations.

10 p. m. Position, *Mississippi*: Departure, —.21 inch. Precipitation, ne. quadrant, six stations; se. quadrant, five stations; sw. quadrant, six stations; nw. quadrant, six stations.

12th, 7 a. m. Position, *Tennessee*: Departure, —.42 inch. Precipitation, ne. quadrant, thirteen stations; southeast quadrant, nine stations; southwest quadrant, ten stations; nw. quadrant, four stations.

3 p. m. Position, *southwest Virginia*: Departure, —.48 inch. Precipitation, ne. quadrant, eleven stations; se. quadrant, five stations; sw. quadrant, eleven stations; nw. quadrant, six stations.

10 p. m. Position, *Maryland*: Departure, —.64 inch. Precipitation, ne. quadrant, ten stations; se. quadrant, one station; sw. quadrant, eight stations; nw. quadrant, seven stations.

13th, 7 a. m. Position, *off Long Island*: Departure, —.68 inch. Precipitation, ne. quadrant, ten stations; se. quadrant, no reports; sw. quadrant, twelve stations; nw. quadrant, nine stations.

3 p. m. Position, *off Massachusetts coast*: Departure, —.73 inch. Precipitation, ne. quadrant, six stations; se. quadrant, no reports; sw. quadrant, four stations; nw. quadrant, twelve stations.

10 p. m. Position, *off Maine coast*: Departure, —.82 inch. Precipitation, ne. quadrant, four stations; se. quadrant, no reports; sw. quadrant, nine stations; nw. quadrant, four stations.

14th, 7 a. m. Position, *New Brunswick*: Departure, —.82 inch. Precipitation, ne. quadrant, two stations; se. quadrant, two stations; sw. quadrant, four stations; nw. quadrant, two stations.

3 p. m. Position, *Gulf of Saint Lawrence*: Departure, —.89 inch. Precipitation, ne. quadrant, none; se. quadrant, two stations; sw. quadrant, five stations; nw. quadrant, no reports.

10 p. m. Position, *Gulf of Saint Lawrence*: Departure, —.74 inch. Precipitation, ne. quadrant, none; se. quadrant, one station; sw. quadrant, three stations; nw. quadrant, no reports. From this region the depression moved thence eastward to the Atlantic.

VI.—12th, 7 a. m. Position, *Saskatchewan Valley*: Departure, not given. Precipitation, ne., se., and nw. quadrants, none; sw. quadrant, three stations.

3 p. m. Position, *Saskatchewan Valley*: Departure, —.15 inch. Precipitation, in all quadrants, none.

10 p. m. Position, *Saskatchewan Valley*: Departure, —.19 inch. Precipitation, in all quadrants, none.

13th, 7 a. m. Position, *Manitoba*: Departure, —.18 inch. Precipitation, in all quadrants, none.

3 p. m. Position, *north of Minnesota*: Departure, —.19 inch. Precipitation, in all quadrants, none.

10 p. m. Position, *north of Lake Superior*: Departure, —.06 inch. Precipitation, in all quadrants, none. From this region the depression passed beyond the limits of the Signal Service charts.

VII.—14th, 10 p. m. Position, *Utah*: Departure, —.09 inch. Precipitation, ne. quadrant, two stations; se. quadrant, none; sw. quadrant, none; nw. quadrant, two stations.

15th, 7 a. m. Position, *northern Arizona*: Departure, —.22 inch. Precipitation, ne. quadrant, two stations; se. quadrant, three stations; sw. quadrant, none; nw. quadrant, two stations.

3 p. m. Position, *New Mexico*: Departure, —.31 inch. Precipitation, ne. quadrant, four stations; se. quadrant, three stations; sw. quadrant, none; nw. quadrant, four stations.

10 p. m. Position, *New Mexico*: Departure, —.50 inch. Precipitation, ne. quadrant, eight stations; se. quadrant, one station; sw. quadrant, none; nw. quadrant, twelve stations.

16th, 7 a. m. Position, *Indian Territory*: Departure, —.40 inch. Precipitation, ne. quadrant, five stations; se. quadrant, six stations; sw. quadrant, three stations; nw. quadrant, seven stations.

3 p. m. Position, *southwest Kansas*: Departure, —.43 inch. Precipitation, ne. quadrant, eight stations; se. quadrant, seven stations; sw. quadrant, four stations; nw. quadrant, eight stations.

10 p. m. Position, *northern Missouri*: Departure, —.63 inch. Precipitation, ne. quadrant, thirteen stations; se. quadrant, fifteen stations; sw. quadrant, six stations; nw. quadrant, five stations.

17th, 7 a. m. Position, *central Iowa*: Departure, —.77 inch. Precipitation, ne. quadrant, seventeen stations; se. quadrant, twenty-eight stations; sw. quadrant, eight stations; nw. quadrant, one station.

3 p. m. Position, *southern Wisconsin*: Departure, —.79 inch. Precipitation, ne. quadrant, twenty-eight stations; se. quadrant, twenty-five stations; sw. quadrant, six stations; nw. quadrant, eight stations.

10 p. m. Position, *northeast Wisconsin*: Departure, —.83 inch. Precipitation, ne. quadrant, twelve stations; se. quadrant, thirty-five stations; sw. quadrant, eleven stations; nw. quadrant, six stations.

18th, 7 a. m. Position, *north of Lake Huron*: Departure, —1.02 inches. Precipitation, ne. quadrant, no reports; se. quadrant, forty stations; sw. quadrant, thirteen stations; nw. quadrant, four stations.

3 p. m. Position, *north of Lake Huron*: Departure, —.88 inch. Precipitation, ne. quadrant, four stations; se. quadrant, thirty-one stations; sw. quadrant, thirteen stations; nw. quadrant, three stations.

10 p. m. Position, *northeast of Lake Huron*: Departure, —.68 inch. Precipitation, ne. quadrant, none; se. quadrant, eight stations; sw. quadrant, eleven stations; nw. quadrant, six stations.

19th, 7 a. m. Position, *Upper Canada*: Departure, —.66 inch. Precipitation, ne. quadrant, no reports; se. quadrant, five stations; sw. quadrant, thirteen stations; nw. quadrant, no reports.

3 p. m. Position, *Gulf of Saint Lawrence*: Departure, —.70 inch. Precipitation, ne., se., nw. quadrants, no reports; sw. quadrant, fourteen stations. From this region the depression moved thence eastward to the Atlantic.

The following notes from observers will serve to indicate the severity of this storm:

Marquette, Michigan: snow and sleet, accompanied by high easterly wind, prevailed throughout the 17th; maximum velocity of the wind, thirty-nine miles per hour, at 3.07 p. m.; telegraph and telephone poles and wires were blown down in several places, and travel was greatly impeded by snow. The breakwater harbor light was broken from its fastenings and carried into the lake by the waves, which were unusually high. The schooner "Florida"

arrived while the gale was at its height, and in a heavy snow-storm, she was laden with coal and was driven on the beach, becoming a total wreck. At 10.55 a. m. of the 18th the wind again began to blow hard; maximum velocity, twenty-eight miles per hour from the northwest, at noon. The steam-barges "Robert Wallace" and "David Wallace" were driven ashore about four miles from Marquette and suffered serious damage; the cargo, 105,000 bushels of wheat, was lost. The steam-barge "Manistec," towing the barges "Marinette" and "Menominee," laden with lumber, was struck by the gale with great force on the night of the 18-19th, when twenty miles off Manitou Island. The tow-line broke and the vessels drifted apart and became water-logged, most of their rigging was carried away, and the "Manistec" and "Marinette" were driven ashore near Burnham and became total wrecks. The crews of both vessels, fourteen persons, were lost.

Grand Haven, Michigan: light snow began falling at 12.05 a. m. of the 18th and continued throughout the day. High southwesterly winds prevailed until the afternoon of the 19th, reaching at 3.05 p. m. of the 18th a maximum velocity of sixty miles per hour. The waves of the lake were very high, rising above the fog-horn on the outer pier, and flowing over a trestle work thirty feet in height. The boat house of the Life Saving Service was washed into the lake and considerable damage was done to other property along the lake shore. During the storm the schooner "Helen" was lost with all on board; the schooner "South Haven" was blown on the beach north of Muskegon and broke up rapidly.

Escanaba, Michigan: during the 17th heavy snow fell nearly all day; at 5 a. m. a northeasterly gale set in and continued until after midnight. The barometer fell rapidly during the 17th and 18th, and at 7 a. m. of the 18th reached the unusually low point of 29.05 inches. At 1 a. m. the wind veered to the southwest and during the afternoon to the northwest. This storm was one of the severest and most destructive that has occurred here for several years; reports have been received from many points along the lakes of vessels wrecked and lives lost. No disasters occurred in the immediate vicinity of Escanaba as the cautionary signal was displayed in time to give ample warning to ship captains.

Alpena, Michigan: rain fell during the early morning of the 17th, turning to snow at 6 a. m., and again into rain at 7.30 a. m. A wind storm set in at 7.18 a. m., accompanied by heavy rain, which continued nearly all day; maximum velocity, thirty-three miles per hour from the east, at 7.58 p. m. During the 18th light snow fell and the wind blew a gale from the southwest. This storm was unusually severe and destructive on the lakes, and many vessels were lost; the schooner "Itasco," from Buffalo to Milwaukee, laden with coal, encountered, when about twenty-five miles north of Alpena, a heavy gale blowing from the south and southwest, which carried away her sails and otherwise damaged her; she was brought into this port for repairs. The observer at this station states that this storm was more disastrous to shipping than any that has visited the lakes for a number of years, and that the timely warning given of the approach of the storm was undoubtedly the means of preventing many losses to shipping that otherwise would have occurred.

Mackinaw City, Michigan: an easterly gale, with light rain and snow at intervals, prevailed during the 17th. The total movement of the wind for the twenty-four hours ending 11 p. m. was 951 miles; maximum velocity, fifty-three miles per hour from the east, at 10.30 p. m. At 7 a. m. the barometer stood at 29.95; at 11 p. m. it had fallen to 29.19, a fall of .76 inch in sixteen hours. At 1.45 a. m. of the 18th the wind shifted to south and the gale subsided until 8 a. m., when the wind again increased in force shifting to the west at 4.30 p. m. and attaining a velocity of thirty-nine miles per hour at 10.50 p. m. The water of the lake was very high on the 18th, overflowing the wharves and carrying away two piers and injuring others. The schooner "C. B. Jones," from Buffalo to Chicago, dragged her anchor and struck the beach, breaking her shoe and rudder; she floated off when the wind shifted. During the gale and snow storm of the night of the 18-19th the schooner "Marsh" ran ashore on Graham's shoals; the schooner "Harvey Bissell" went ashore at Green Island, but was gotten off with slight damage.

Sandusky, Ohio: light snow began falling at 7.20 a. m. of the 18th and continued at short intervals throughout the day. The wind blew hard from the southwest during the morning and veered to the west during the night. Owing to high west and northwesterly winds the water in the harbor was lower than it has been for several years. Maximum velocity of wind forty-six miles per hour from the southwest.

Rochester, New York: high westerly winds, with heavy rain, prevailed during the morning and afternoon of the 18th, with light snow at night; the maximum velocity of the wind, thirty-eight miles per hour, was recorded at 7.10 a. m. The gale continued until 9.45 p. m. of the 19th, and at 12.10 p. m. a velocity of forty-eight miles per hour from the west was recorded. The storm did considerable damage on the lake; several schooners and barges were driven ashore at Charlotte.

Buffalo, New York: rain began falling at 1.30 a. m. of the 17th and continued until 9.05 a. m. of the 18th; snow began falling at 6.05 p. m. and continued until after midnight, temperature falling rapidly. A severe gale set in from the southwest at 1.20 a. m. of the 18th, and continued throughout the entire day, reaching a maximum velocity of fifty-eight miles per hour at 9.55 a. m. The gale continued throughout the 19th the wind being from the west all day, reaching a velocity of fifty-two miles per hour several times during the 19th. Considerable damage was done to property in this city and over the surrounding country by high wind and the heavy waves from the lake. No severe casualties occurred to shipping during this storm, which is due to the timely warning given.

Erie, Pennsylvania: during the 18th heavy rain fell and the wind blew hard

from the west, maximum velocity forty-three miles per hour; heavy snow fell from 6.45 to 9.00 a. m., and from 11.25 a. m. to 4.40 p. m. of the 19th. The wind storm continued until 3 p. m. of the 19th, prevailing direction, west. Considerable damage was done to vessels and other property along the wharf by the high waves of the lake; numerous vessels were broken from the wharves, and many houses damaged by water.

Below is an estimate, from the "Evening Wisconsin," of Milwaukee, of the value of the vessels driven ashore or wrecked on the lakes by this storm, together with the number of lives lost. Many of the vessels were rescued, but the wrecking expense at this season of the year was necessarily large:

| Vessels.              | Pecuniary lost. | Lives lost. | Vessels.           | Pecuniary lost. | Lives lost. |
|-----------------------|-----------------|-------------|--------------------|-----------------|-------------|
| Dickinson             | \$5,000         | 3           | Buckhout           | \$2,500         |             |
| Emerald               | 6,000           | 5           | McDougal           | 2,500           |             |
| Marinette             | 15,000          | 7           | Lyman Casey        | 2,500           |             |
| Menekaunee            | 15,000          | 7           | B. M. Baker        | 2,500           |             |
| Lucerne               | 25,000          | 9           | Star of the North  | 2,500           |             |
| Helen                 | 2,500           | 6           | Golden Harvest     | 2,500           |             |
| Florida               | 8,000           | 1           | J. G. Kollage      | 3,500           |             |
| Pathfinder            | 20,000          |             | Mary               | 5,500           |             |
| William Jones         | 2,000           |             | Thomas P. Sheldon  | 10,000          |             |
| South Haven           | 2,000           |             | Queen of the Lakes | 5,000           |             |
| Wallace and consort * | 300,000         |             | Dauntless          | 3,500           |             |
| P. S. Marsh           | 16,000          |             | Unadilla           | 18,000          |             |
| Harvey Bissell        | 15,000          |             | Ida Walker         | 8,000           |             |
| City of New York      | 25,000          |             | Wm. Jones          | 4,000           |             |
| Libbie Nau            | 4,000           |             | Evening Star       | 4,500           |             |
| Cuyahoga              | 2,500           |             | Chris Grover       | 4,500           |             |
| Tallahassie           | 1,800           |             |                    |                 |             |
| Nellie Church         | 1,800           |             | Total              | 531,100         | 38          |

\* Including grain cargoes.

Philadelphia, Pennsylvania: on the 18th light rain fell from 2 a. m. until 9.50 a. m., when unusually heavy rain began falling and continued about twenty minutes; during this time the wind blew a gale of forty miles per hour.

Atlantic City, New Jersey: a southerly gale set in at 12.30 a. m. of the 18th and continued until noon, attaining a maximum velocity of forty-two miles per hour at 11.30 a. m.

Albany, New York: a severe wind storm occurred on the afternoon of the 18th; a brick house in course of construction was blown down, crushing a smaller house as it fell.

Lynchburg, Virginia: during the early morning of the 18th the wind blew hard from the southwest, doing considerable damage in and about the city; numerous windows were broken and trees and roofs blown down. At Dearington, a small place on the outskirts of the city, two frame houses were blown down. The storm was especially severe in the vicinity of the agricultural fair grounds.

Notes in reference to other meteorological phenomena, occurring during the prevalence of this area of low pressure, will be found in this REVIEW under "Local storms and tornadoes" and "Snow."

VIII.—18th, 7 a. m. Position, *central Pennsylvania*: Departure, —.68 inch.

This low-pressure area having formed as a secondary depression to number vii it was found necessary to consider the distribution of precipitation in the description of the latter.

3 p. m. Position, *eastern Maine*: Departure, —.64 inch.

10 p. m. Position, *New Brunswick*: Departure, —.71 inch.

19th, 7 a. m. The depression united in the Gulf of Saint Lawrence with area number vii and thence moved eastward to the Atlantic.

IX.—20th, 7 a. m. Position, *Washington Territory*: Departure, —.60 inch. Precipitation, ne. quadrant, three stations; se. quadrant, three stations; sw. quadrant, no reports; nw. quadrant, one station.

3 p. m. Position, *northeast Oregon*: Departure, —.68 inch. Precipitation, ne. quadrant, two stations; se. quadrant, one station; sw. quadrant, five stations; nw. quadrant, three stations.

10 p. m. Position, *southern Idaho*: Departure, —.78 inch. Precipitation, ne. quadrant, one station; se. quadrant, two stations; sw. quadrant, five stations; nw. quadrant, two stations.

21st, 7 a. m. Position, *northern Utah*: Departure, —.85 inch. Precipitation, ne. quadrant, three stations; se. quadrant, fifteen stations; sw. quadrant, four stations; nw. quadrant, four stations.

3 p. m. Position, *central Utah*: Departure, —.99 inch. Pre-

cipitation, ne. quadrant, six stations; se. quadrant, fifteen stations; sw. quadrant, one station; nw. quadrant, three stations.

10 p. m. Position, *central Colorado*: Departure, —.74 inch. Precipitation, ne. quadrant, seven stations; se. quadrant, fifteen stations; sw. quadrant, one station; nw. quadrant, nine stations.

22d, 7 a. m. Position, *central Nebraska*: Departure, —.78 inch. Precipitation, ne. quadrant, thirteen stations; se. quadrant, twenty-two stations; sw. quadrant, six stations; nw. quadrant, six stations.

3 p. m. Position, *southern Dakota*: Departure, —1.02 inches. Precipitation, ne. quadrant, seven stations; se. quadrant, twenty-eight stations; sw. quadrant, three stations; nw. quadrant, eight stations.

10 p. m. Position, *northern Minnesota*: Departure, —1.04 inches. Precipitation, ne. quadrant, no reports; se. quadrant, thirty-nine stations; sw. quadrant, twelve stations; nw. quadrant, three stations.

23d, 7 a. m. Position, *Lake Superior*: Departure, —.87 inch. Precipitation, ne. quadrant, no reports; se. quadrant, forty-four stations; sw. quadrant, five stations; nw. quadrant, eight stations.

3 p. m. Position, *north of Lake Superior*: Departure, —.95 inch. Precipitation, ne. quadrant, four stations; se. quadrant, twenty-eight stations; sw. quadrant, nine stations; nw. quadrant, nine stations.

10 p. m. Position, *northern Canada*: Departure, —1.02 inches. Precipitation, ne. quadrant, four stations; se. quadrant, fourteen stations; sw. quadrant, twenty-six stations; nw. quadrant, no reports.

24th, 7 a. m. Position, *Upper Canada*: Departure, —.76 inch. Precipitation, ne. quadrant, three stations; se. quadrant, seven stations; sw. quadrant, seventeen stations; nw. quadrant, no reports.

3 p. m. Position, *Gulf of Saint Lawrence*: Departure, —.68 inch. Precipitation, ne. quadrant, no reports; se. quadrant, two stations; sw. quadrant, ten stations; nw. quadrant, no reports. From this region the depression moved thence eastward to the Atlantic.

The following notes from Signal Service observers are of interest:

Mackinaw City, Michigan: brisk southeasterly winds, average velocity twenty miles per hour, began at 6 a. m. of the 22d, and gradually increased in force until 3 p. m., when a gale, with snow, set in and continued throughout the day; maximum velocity, fifty-three miles per hour from the east, at 8.15 p. m. The gale ended at 7.30 a. m. of the 23d; at 2.45 p. m. the wind shifted to the southwest and suddenly increased to the force of a gale; maximum velocity thirty-eight miles per hour; at 8.15 it changed to west and blew at the rate of thirty-two miles per hour. The docks were badly damaged by the high waves caused by this storm.

Port Huron, Michigan: on the 22d a heavy wind storm set in from the south-east at 12.55 p. m., and at 10.35 p. m. was blowing at the rate of thirty miles per hour; the wind continued high until 12.15 a. m. of the 23d. A gale from the southwest began at 1 p. m. and reached a height of forty-four miles per hour at 7 p. m.

Rochester, New York: on the morning of the 23d the wind blew hard from the south, attaining the force of a gale at 4.15 a. m.; maximum velocity, forty-four miles per hour, at 5.15 a. m.; the gale ended at 5.40 a. m. At 7.30 p. m. the wind again increased in force, blowing from the southwest, and soon attained the velocity of a gale, forty miles per hour being recorded at 8.15 p. m. During the storm several chimneys and roofs were blown off in this city, and in the surrounding country numerous barns were damaged and fences blown down.

X.—22d, 10 p. m. Position, *southern Texas*: Departure, —.44 inch. Precipitation, ne. quadrant, four stations; se. quadrant, two stations; sw. quadrant, none; nw. quadrant, three stations.

23d, 7 a. m. Position, *Texas coast*: Departure, —.36 inch. Precipitation, ne. quadrant, five stations; se. quadrant, no reports; sw. quadrant, none; nw. quadrant, none.

3 p. m. Position, *Texas coast*: Departure, —.25 inch. Precipitation, ne. quadrant, eight stations; se. quadrant, no reports; sw. quadrant, one station; nw. quadrant, no reports.

10 p. m. Position, *coast of Louisiana*: Departure, —.32

inch. Precipitation, ne. quadrant, five stations; se. quadrant, no reports; sw. quadrant, none; nw. quadrant, none.

24th, 7 a. m. Position, *east of New Orleans*: Departure, —.31 inch. Precipitation, ne. quadrant, six stations; se. quadrant, one station; sw. quadrant, none; nw. quadrant, one station.

3 p. m. Position, *west Florida*: Departure, —.26 inch. Precipitation, ne. quadrant, four stations; se. quadrant, none; sw. quadrant, three stations; nw. quadrant, none.

10 p. m. Position, *southern Georgia*: Departure, —.30 inch. Precipitation, ne. quadrant, four stations; se. quadrant, none; sw. quadrant, three stations; nw. quadrant, one station.

25th, 7 a. m. Position, *central North Carolina*: Departure, —.50 inch. Precipitation, ne. quadrant, nine stations; se. quadrant, one station; sw. quadrant, seven stations; nw. quadrant, nine stations.

3 p. m. Position, *off Delaware coast*: Departure, —.64 inch. Precipitation, ne. quadrant, seven stations; se. quadrant, no reports; sw. quadrant, eleven stations; nw. quadrant, twenty-seven stations.

10 p. m. Position, *off Massachusetts coast*: Departure, —.64 inch. Precipitation, ne. quadrant, five stations; se. quadrant, no reports; sw. quadrant, twenty-four stations; nw. quadrant, sixteen stations.

26th, 7 a. m. Position, *Gulf of Saint Lawrence*: Departure, —.94 inch. Precipitation, ne. quadrant, no reports; se. quadrant, three stations; sw. quadrant, nineteen stations; nw. quadrant, no reports. From this region the depression moved thence eastward to the Atlantic.

XI.—24th, 3 p. m. Position, *British Columbia*: Departure, —.09 inches. Precipitation, ne., se., and nw. quadrants, none; sw. quadrant, four stations.

10 p. m. Position, *Province of Assiniboia, British America*: Departure, —.30 inch. Precipitation, ne. quadrant, two stations; se. quadrant, none; sw. quadrant, two stations; nw. quadrant, none.

25th, 7 a. m. Position, *northwest Dakota*: Departure, —.52 inch. Precipitation, ne. quadrant, none; se. quadrant, three stations; sw. quadrant, none; nw. quadrant, one station.

3 p. m. Position, *central Nebraska*: Departure, —.12 inch. Precipitation, ne. quadrant, seven stations; se. quadrant, none; sw. quadrant, none; nw. quadrant, two stations. During the day the depression filled up and disappeared in the lower Missouri valley.

XII.—27th, 3 p. m. Position, *Province of Assiniboia, British America*: Departure, —.04 inch. Precipitation, in all quadrants, no reports.

10 p. m. Position, *northwest Dakota*: Departure, —.28 inch. Precipitation, ne. quadrant, three stations; se. quadrant, one station; sw. quadrant, none; nw. quadrant, none.

28th, 7 a. m. Position, *southeast Dakota*: Departure, —.35 inch. Precipitation, ne. quadrant, five stations; se. quadrant, four stations; sw. quadrant, none; nw. quadrant, five stations.

3 p. m. Position, *east Iowa*: Departure, —.51 inch. Precipitation, ne. quadrant, nineteen stations; se. quadrant, three stations; sw. quadrant, one station; nw. quadrant, four stations.

10 p. m. Position, *Lake Michigan*: Departure, —.49 inch. Precipitation, ne. quadrant, ten stations; se. quadrant, four stations; sw. quadrant, five stations; nw. quadrant, nine stations.

29th, 7 a. m. Position, *north of Lake Ontario*: Departure, —.57 inch. Precipitation, ne. quadrant, three stations; se. quadrant, four stations; sw. quadrant, ten stations; nw. quadrant, three stations.

3 p. m. Position, *Upper Canada*: Departure, —.41 inch. Precipitation, ne. quadrant, one station; se. quadrant, one station; sw. quadrant, sixteen stations; nw. quadrant, no reports.

10 p. m. Position, *mouth of Saint Lawrence River*: Departure, —.29 inch. Precipitation, ne. quadrant, no reports; se. quadrant, five stations; sw. quadrant, seven stations; nw.

quadrant, no reports. From this region the depression moved thence eastward to the Atlantic.

XIII.—28th, 3 p. m. Position, *Province of Alberta, British America*: Departure, —.09 inch. Precipitation, ne. quadrant, no reports; se. quadrant, two stations; sw. quadrant, none; nw. quadrant, one station.

10 p. m. Position, *eastern Montana*: Departure, —.28 inch. Precipitation, ne. quadrant, two stations; se. quadrant, three stations; sw. quadrant, one station; nw. quadrant, no reports.

29th, 7 a. m. Position, *southern Dakota*: Departure, —.30 inch. Precipitation, ne. quadrant, five stations; se. quadrant, three stations; sw. quadrant, none; nw. quadrant, three stations.

3 p. m. Position, *southern Iowa*: Departure, —.35 inch. Precipitation, ne. quadrant, four stations; se. quadrant, three stations; sw. quadrant, one station; nw. quadrant, three stations.

10 p. m. Position, *southeast Missouri*: Departure, —.38 inch. Precipitation, ne. quadrant, seven stations; se. quadrant, one station; sw. quadrant, none; nw. quadrant, one station.

30th, 7 a. m. Position, *eastern Kentucky*: Departure —.44 inch. Precipitation, ne. quadrant, seven stations; se. quadrant, three stations; sw. quadrant, two stations; nw. quadrant, ten stations.

3 p. m. Position, *off Virginia coast*: Departure, —.53 inch. Precipitation, ne. quadrant, four stations; se. quadrant, no reports; sw. quadrant, two stations; nw. quadrant, thirteen stations.

10 p. m. Position, *off Long Island*: Departure, —.56 inch. Precipitation, ne. quadrant, five stations; se. quadrant, no reports; sw. quadrant, nine stations; nw. quadrant, five stations.

A description of this depression throughout the remainder of its course will appear in the REVIEW for December.

XIV.—29th, 3 p. m. Position, *Province of Saskatchewan, British America*: Departure, —.35 inch. Precipitation, ne. quadrant, two stations; se. quadrant, four stations; sw. quadrant, three stations; nw. quadrant, no reports.

10 p. m. Position, *Province of Assiniboia, British America*: Departure, —.41 inch. Precipitation, ne. quadrant, four stations; se. quadrant, two stations; sw. quadrant, none; nw. quadrant, four stations.

30th, 7 a. m. Position, *southern Dakota*: Departure, —.42 inch. Precipitation, ne. quadrant, eight stations; se. quadrant, two stations; sw. quadrant, none; nw. quadrant, four stations.

3 p. m. Position, *east Minnesota*: Departure, —.29 inch. Precipitation, ne. quadrant, five stations; se. quadrant, nine stations; sw. quadrant, five stations; nw. quadrant, six stations.

10 p. m. Position, *Lake Superior*: Departure, —.32 inch. Precipitation, ne. quadrant, no reports; se. quadrant, two stations; sw. quadrant, twelve stations; nw. quadrant, three stations.

A description of this depression throughout the remainder of its course will appear in the REVIEW for December.

#### NORTH ATLANTIC STORMS DURING NOVEMBER, 1886.

[Pressure in inches and millimetres; wind-force by Beaufort scale.]

The paths of the depressions that have appeared over the north Atlantic Ocean during the month are determined, approximately, from international simultaneous observations furnished by captains of ocean steamships and sailing vessels; abstracts of ships' logs and other data collected by the Signal Service agencies at the ports of New York, Boston, and Philadelphia; reports received through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs furnished by the proprietors of the "New York Maritime Register," and from other miscellaneous data received at this office up to December 21, 1886.

Twelve depressions are traced, of which three, numbers 7, 9, and 12, passed eastward over Newfoundland; number 1 first appeared south of Nova Scotia, in about N. 37°, and