

MONTHLY WEATHER REVIEW.

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INTRODUCTION.

This REVIEW contains a general summary of the meteorological conditions which prevailed over the United States and Canada during September, 1884, based upon the reports from the regular and volunteer 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.

September was unusually warm over a greater part of the country east of the Rocky mountains, while to the westward the month was remarkably cool.

There was a marked deficiency in the monthly precipitation in the states bordering on the Atlantic and eastern Gulf coasts and over the middle and southern slopes. In the lower portions of the Ohio and Missouri valleys, throughout the Mississippi valley, in southern Texas, and west of the Rocky mountains, the precipitation was excessive.

Severe drought prevailed in the states on the Atlantic and Gulf coasts during the month.

The approximate paths of the centres of sixteen atmospheric depressions occurring within the limits of the Signal Service stations and of thirteen occurring over the north Atlantic ocean are shown on chart i. One of the latter was a tropical hurricane; that described as number 8 apparently developed near the south Atlantic coast and pursued an abnormal course. The average number of depressions occurring within the limits of the Signal Service stations in September, during the last eleven years, is nine, or seven less than the number for September, 1884.

Extensive auroral displays occurred on the evenings of the 13th and 17th; that on the latter date was observed at numerous intervening stations from Nova Scotia to the north Pacific coast and southward to southern Indiana and central Kansas.

An earthquake occurred on the afternoon of the 19th. The area affected by the shock extended from northeastern Michigan to the Ohio river and from western Pennsylvania to Indiana, and probably to eastern Iowa, a few reports having been received from that state, although none were received from Illinois.

Destructive tornadoes occurred in Iowa, Dakota, Minnesota, and Wisconsin on the 9th; and in Pennsylvania on the 28th.

In the preparation of this REVIEW the following data, received up to October 20th, 1884, have been used, viz.: the regular tri-daily weather-charts, containing data of simultaneous observations taken at one hundred and twenty-nine Signal Service stations and seventeen Canadian stations, as telegraphed to this office; one hundred and sixty-seven monthly journals; one hundred and sixty-one monthly means

from the former, and seventeen monthly means from the latter; two hundred and fifty-nine monthly registers from voluntary observers; forty-seven 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, Georgia, Illinois, Indiana, Iowa, Kansas, Louisiana, Missouri, Nebraska, Ohio, and Tennessee, and of the Central Pacific railway company; trustworthy newspaper extracts; and special reports.

ATMOSPHERIC PRESSURE.

[Expressed in inches and hundredths.]

The mean atmospheric pressure for September, 1884, determined from the tri-daily telegraphic reports of the Signal Service, is exhibited by the isobarometric lines on chart ii. This chart shows an area of barometric maxima, inclosed by the isobar of 30.1, over the middle and south Atlantic states, the greatest mean pressure, 30.14, being reported from Charlotte, and Kitty Hawk, North Carolina. The mean pressure is least over an area extending from Arizona and New Mexico north-eastward to British America; in this region, two areas, inclosed by the isobar of 29.85, are shown, one including portions of Arizona and New Mexico, and the other covering Manitoba and the northern portions of Dakota and Minnesota. Between these areas of barometric minima the pressure increases to 29.89 over southeastern Wyoming, southern Dakota, and western Nebraska. To the westward of this region the mean pressure increases gradually, being greatest on the north Pacific coast where the barometric means reach 30.0.

Compared with the mean pressure for the preceding month (August), an increase varying from .01 to .06 is shown at stations west of the Rocky mountains; an increase also occurs in all districts east of the Mississippi river, with the exception of the upper Mississippi valley, the western portion of the upper lake region, and the Canadian maritime provinces. The increase in the districts east of the Mississippi is greatest from New Jersey and eastern Pennsylvania southwestward to northern Georgia, where the departures range from .05 to .09. From the Rocky mountains eastward to the Mississippi the barometric means are lower than for August, the departures being greatest from Manitoba southward to the central part of the Missouri valley, where they range from .05 to .08.

The mean pressure for September, 1884, compared with the normal (see chart iv.), shows a slight excess on the California coast, in the Ohio valley and Tennessee, east Gulf states, and on the Atlantic coast south of New England. In all other districts the mean pressure is below the normal, the departures being greatest in the upper Missouri valley and extreme northwest, where they range from .10 to .16.

BAROMETRIC RANGES.

The monthly barometric ranges were greatest in the lake region and least in the southern districts; the extreme monthly

ranges are: .28 at Key West, Florida, and 1.26 at Mackinaw City, Michigan.

In the several geographical districts the ranges varied as follows:

New England.—From .69 on the summit of Mount Washington, New Hampshire, to .84 at Portland, Maine.

Middle Atlantic states.—From .56 at Norfolk, Virginia, to .84 at Albany, New York.

South Atlantic states.—From .37 at Atlanta, Georgia, to .52 at Kitty Hawk, North Carolina.

Florida peninsula.—From .28 at Key West to .33 at Cedar Keys.

East Gulf states.—From .32 at New Orleans, Louisiana, to .38 at Montgomery, Alabama.

West Gulf states.—From .36 at Galveston, Texas, to .50 at Fort Smith, Arkansas.

Rio Grande valley.—From .34 at Brownsville, Texas, to .36 at Rio Grande City, Texas.

Tennessee.—From .37 at Knoxville, to .43 at Nashville.

Ohio valley.—From .48 at Louisville, Kentucky, to .66 at Pittsburg, Pennsylvania.

Lower lake region.—From .69 at Cleveland, Ohio, to .87 at Buffalo, New York.

Upper lake region.—From .89 at Duluth, Minnesota, and Port Huron, Michigan, to 1.26 at Mackinaw City, Michigan.

Extreme northwest.—From .77 at Fort Buford, Dakota, to .93 at Saint Vincent, Minnesota.

Upper Mississippi valley.—From .45 at Cairo, Illinois, to .93 at Des Moines, Iowa.

Missouri valley.—From .82 at Leavenworth, Kansas, to .89 at Huron, Dakota.

Northern slope.—From .52 at Fort Maginnis, Montana, to .76 at North Platte, Nebraska.

Middle slope.—From .49 on the summit of Pike's Peak, Colorado, to .70 at Denver, Colorado.

Southern slope.—From .38 at Fort Stockton, Texas, to .53 at Fort Concho, Texas.

Southern plateau.—From .34 at Fort Grant, Arizona, to .44 at Prescott, Arizona.

Middle plateau.—From .75 at Salt Lake City, Utah.

Northern plateau.—From .54 at Spokane Falls, Washington Territory, to .74 at Boise City, Idaho.

North Pacific coast region.—From .56 at Fort Canby, Washington Territory, to .62 at Olympia, Washington Territory.

Middle Pacific coast region.—From .42 at Cape Mendocino, California, to .55 at Sacramento, California.

South Pacific coast region.—From .38 at Los Angeles, California, to .41 at San Diego, California.

AREAS OF HIGH BAROMETER.

Eight areas of high barometer were formed during the month; of which four, numbers iii., iv., v., and vii., appeared in the Pacific coast region and marched steadily across the continent. Four, numbers i., ii., vi., and viii., moved to the Atlantic coast, and clung there with great tenacity, causing the hot and dry weather to continue in the Atlantic coast states. All of these high areas brought decided changes of weather and temperature in their progress, except when they settled on the Atlantic coast; and all increased the influence and strength of the low areas that passed over the lake region and down the Saint Lawrence valley.

I.—The 7 a. m. map of the 1st showed an area of high barometer resting over the middle Atlantic and northern part of the south Atlantic states, and over the Ohio valley and Tennessee; the pressure, however, of this area was slightly below the normal, as it was also in all other sections of the country. By midnight this area had moved eastward and had extended along the Atlantic coast, so that it embraced the southern part of the New England states. In the middle Atlantic states alone was the pressure slightly above the normal. The afternoon map of the 2d showed a considerable rise, and a pressure .10 above the normal at coast stations of the middle

Atlantic states; by the morning of the 3d the line of .10 above the normal had extended to include the northern part of the south Atlantic states. By midnight of the 4th the line of .10 above the normal ran from near Duluth to Savannah; all the region east of the Mississippi river, except the northern part of the New England states, being above the normal. During all this time the pressure was greatest in the southern part of the middle Atlantic states and in the Carolinas; and this general condition continued until midnight of the 5th, when the normal line commenced to contract, and the pressure remained but slightly above the normal in Virginia and North Carolina until midnight of the 11th, when this high area entirely disappeared. From the 1st until the 9th the influence of this high pressure was felt in the states on the Atlantic and Gulf coast, where the winds were generally east to south; they were light and variable in the Ohio valley and Tennessee; southerly in the upper Mississippi and Missouri valleys, and south to west in the lake region. And from the afternoon of the 2d until the morning of the 10th the temperature was above the normal in all districts east of the Rocky mountains; and in the states on the Atlantic coast there was an almost entire absence of rain. The exceptions to this period of dryness being very light local showers in New England and on the Georgia coast.

II.—This area appeared in the British Northwest Territory on the afternoon of the 5th, and extended southeastward until the afternoon of the 6th, when it rested in the Yellowstone valley, where the pressure was .10 above the normal, having risen .30 to .40 in the twenty-four hours; from here it moved northeastward to Manitoba on the 7th, thence it moved eastward and entirely disappeared on the afternoon of the 8th. The influence of this high area was felt in the sudden falling of the temperature in Dakota, Montana, Wyoming, Nebraska, and Colorado, where, on the afternoon of the 6th, a fall of from 10° to 30° was shown to have occurred in the twenty-four hours. Frost occurred in Montana on the morning of the 6th. On the afternoon of the 7th the temperature was shown to have fallen from 10° to 30° in the northern part of the upper lake region; and frosts were reported by the press on the morning of this day in northern Minnesota and Dakota. As this area passed eastward the temperature rose quickly west of it.

III.—This area appeared in the south Pacific coast region on the afternoon of the 7th, and extended northward and eastward until the afternoon after the 9th, when the pressure was .20 above the normal, and was highest over the middle Pacific coast region. The midnight map of the 9th, showed this area as a long loop extending from California northeasterly to Manitoba. The 7 a. m. map of the 10th, shows this area as having become contracted, with the highest pressure in the Yellowstone valley. By midnight of the 10th, it had expanded, and moved southeastward, and embraced the upper Mississippi and Missouri valleys, Kansas and Colorado, and the pressure was from .10 to .20 above the normal in all this region, having risen from .10 to .40 in the twenty-four hours, the latter rise occurring in the Missouri valley. This area then moved a little north of east until the morning of the 13th, having gradually expanded so as to cover the lake regions, the middle Atlantic and New England states, the Ohio valley and Tennessee. The highest pressure on this date was north of Lake Huron, the readings at the stations in the northern part of the lake region being as follows: Mackinaw City, 30.50; Alpena, 30.49; Saugeen, 30.49; Parry Sound, 30.50. During the next twenty-four hours this area moved eastward with increasing pressure, particularly in the middle Atlantic and New England states, the rise being from .10 to .20. On the morning of the 14th the pressure was from .20 to .40 above the normal north and east of a line drawn from Duluth to Saint Louis, thence to Augusta, Georgia, and from there to Kitty Hawk, North Carolina. At this time the temperature in New England, the lower lake region, and in the northern part of the middle Atlantic states was from 10° to 15° below the normal, and killing frost was reported from Alpena. The weather was generally cool and clear, with high northeasterly winds on

the Atlantic coast. On the morning of the 15th this area had moved southward, with diminished pressure, to eastern Virginia, where it was from 30.32 to 30.40. Still diminishing, it moved southward, was highest in the Carolinas until midnight of the 16th, and finally disappeared on the afternoon of the 17th. While it hovered on the middle Atlantic and Carolina coasts its influence was similar to that of high area i.

IV.—This area appeared in the north Pacific coast region on the morning of the 13th, and, by the morning of the 15th, had embraced the entire Pacific coast, with an increase of pressure of about .10; at midnight of the 15th this area had expanded and the barometer was .20 above the normal in the north Pacific region, and in the northern part of California and Nevada. The afternoon map of the 16th showed this high area hovering over the north Pacific region, as did also the midnight map of this date. But the morning map of the 17th indicated a decided tendency for the formation of a high area in the Missouri valley; this was accomplished, and the afternoon map of this date showed its formation, although, at the same time, the pressure continued high in the north Pacific region. This area took an easterly motion with increasing pressure, and on the afternoon of the 18th the pressure was highest at Cairo, (30.22) and was from .10 to .18 above the normal in the upper lake region, the upper Mississippi valley, and in the Ohio valley and Tennessee. During the next twenty-four hours this area extended eastward and settled upon the Atlantic coast, from Nova Scotia to South Carolina, with a pressure of from .10 to .20 above the normal. The last vestige of this area was on the morning of the 20th, when it was passing off the Nova Scotia coast. The formation of this high area was attended in the north Pacific coast region by light rains and, afterward, by fair weather. On the morning of the 17th abundant showers fell in the Ohio valley and Tennessee, with northerly winds and lower temperature. While resting on the Atlantic coast its influence was similar to that of high area ii.

V.—This area also made its appearance in the north Pacific coast region, but was not very definite until the afternoon of the 18th. By midnight it had moved eastward with increasing pressure, and was distinctly outlined in Montana. In the next twenty-four hours it had extended still further eastward, the highest pressure (30.32) being in the Missouri valley, which pressure was .20 to .30 above the normal. The next twenty-four hours, that is, the midnight of the 20th, found it over the lower lake region and the Ohio valley, with a pressure .10 to .20 above the normal. The next twenty-four hours found it, like its predecessors, resting on the Atlantic coast, and then over the Carolinas, where it remained until the morning of the 23d, with the highest pressure in the middle and south Atlantic states, bringing again the hot, dry winds from the south, that seemed by this time to have burned everything from Georgia to Maine. On the morning of the 19th light frosts were reported from the Canadian stations on the lower lakes.

VI.—This area appeared in Manitoba on the afternoon of the 21st. It had a general eastward movement, with a slight inclination towards the lake region, until the morning of the 24th, when it rested over Nova Scotia, where the highest pressure was 30.29 to 30.33, being .20 to .30 above the normal. The progress of this area was preceded and accompanied by grateful showers in the lake regions, in New England, and the northern part of the middle Atlantic states. The morning after the 25th showed that it had disappeared. Killing frost occurred at Mackinaw City on the morning of the 22d; otherwise there were no decided changes of temperature, which, during the eastward progress of this area, remained near the normal, the greatest departure being 10° below.

VII.—This appeared on the morning of the 22d in the north Pacific region, where it remained nearly stationary until the morning of the 25th. The morning of the 26th showed a filling up with a tendency to move eastward, but this was checked, and a retrogression seemed to occur, and it hovered on the Pacific coast until midnight of the 29th, with diminishing pressure, when it appeared over Montana with a

pressure of 29.92 in the Yellowstone valley. The afternoon of the 30th showed that it had moved eastward over Minnesota where the pressure was 30.10, which was .10 to .15 above the normal. The midnight map of the 30th showed an extension to the south and eastward, with the highest pressure over Lake Superior from .20 to .27 above the normal. Killing frosts occurred in Montana on the morning of the 29th and 30th, and in Dakota on the latter date; and on this day the temperature was generally 10° to 20° below the normal in Montana, Dakota and Wyoming.

VIII.—This area appeared to form suddenly about midnight of the 23d in Colorado and Kansas; there was a rise of .10 to .20 in eight hours; it seems to have been a part of vii. when this area retreated. By the afternoon of the 24th area viii. had moved eastward, the highest pressure being observed in Kansas, where in the twenty-four hours there was a rise of .40. The morning of the 25th showed a general extension and movement eastward, the highest pressure, 30.21, being in Illinois. At midnight of this date the pressure was highest over the lower lakes (from 30.30 to 30.34), with a general increase in the Mississippi valley and all the region eastward, where it was from .10 to .20 above the normal. The weather was generally clear, and the temperature very nearly normal. In the next twenty-four hours it moved eastward, with increasing pressure (30.40 to 30.43) over Nova Scotia, being .20 to .35 above the normal in New England, the middle Atlantic states, and in Nova Scotia. From this time until midnight of the 30th the pressure gradually decreased, but remained nearly stationary on the Carolina coast, where this area clung tenaciously, producing effects similar to all the rest that remained here for any length of time, and causing the temperature to continue somewhat above the normal in the middle, south Atlantic and Gulf states, and in the Ohio valley and Tennessee.

AREAS OF LOW BAROMETER.

There were sixteen well-defined areas within the limits of the stations of the Signal Service during the month, eight of which developed between the 98th and 114th degrees of west longitude and the 37th and 42d degrees of north latitude. These moved northeastward to the upper lake region and, all but one, thence down the Saint Lawrence valley. Only one storm, low area vii., presented tropical characteristics, but the data do not warrant any tracing of its track before the morning of the 10th; it remained nearly stationary on the Georgia and South Carolina coast. The remaining seven originated in the extreme northwest and in the British Northwest Territory. With two exceptions, areas vii. and xii., they moved eastward into the lake region and thence down the Saint Lawrence valley. Nearly all these storms exhibited considerable energy.

The following table shows the latitude and longitude in which the centres of the several areas were first and last located, and the average hourly velocity of movement:

Areas of low barometer.	First observed.		Last observed.		Average velocity in miles per hour.
	Lat. N.	Long. W.	Lat. N.	Long. W.	
No. I.....	50 15	66 00	48 30	57 00	29.7
II.....	49 30	102 00	50 00	58 00	29.2
III.....	41 00	114 00	50 00	95 00	35.0
IV.....	38 30	104 30	51 30	61 15	40.6
V.....	39 30	113 00	46 30	61 30	46.0
VI.....	38 15	104 00	50 30	58 00	32.5
VII.....	30 45	81 00	31 45	79 00	8.2
VIII.....	40 00	113 00	38 30	103 30	15.0
IX.....	47 30	100 00	51 00	61 00	29.7
X.....	45 30	96 30	49 00	57 00	31.6
XI.....	47 30	103 30	51 00	65 00	38.5
XII.....	52 00	102 00	51 00	60 00	37.5
XIII.....	41 30	98 30	51 00	60 00	35.3
XIV.....	38 30	105 30	51 00	65 30	35.0
XV.....	51 00	106 30	49 30	61 30	39.3
XVI.....	39 30	107 30	49 00	74 00	38.5
Mean hourly velocity.....					32.6

*Centres united in N. 43° 00', W. 90° 00'.

I.—This depression was fully described as number xi. for August, and by midnight of September 1st had passed over the Gulf of Saint Lawrence to Newfoundland; from this point it probably merged with that charted as number 1, of the north Atlantic storms.

II.—This area was first noticed on the morning of the 1st in Manitoba, where in the previous twenty-four hours there was a fall of .50, with the same depression below the normal. This area remained nearly stationary in Manitoba until the afternoon of the 2d, when it seemed to take a course a little to the west of north, and rains were reported in northern Dakota and Montana and in Manitoba, and the territory to the west, with brisk northwest to southwest winds. The centre seemed to linger in the vicinity of Lake Winnipeg until midnight of the 3d, when it took up a decided movement eastward. Light local rains occurred in the northern part of the upper lakes, and the winds were quite fresh. By midnight of the 4th the centre was north of Father Point, with high wind and threatening weather at that place. On the afternoon of the 5th it had reached the coast of Newfoundland; the winds were fresh, but the rainfall was local and light. In the movement eastward the pressure steadily increased, but was .20 to .26 below the normal when last noted. From this point it will be described as number 4, of the north Atlantic storms.

III.—This area was first apparent on the afternoon of the 4th, and the centre was just west of Salt Lake City, the pressure being .30 below the normal, a fall of .30 in the twenty-four hours. By the morning of the 5th it had moved in a northeasterly direction to the western part of Dakota; on the north and east sides of the centre there were abundant rains. By midnight of the 5th the centre was in the eastern part of Manitoba, with rains to the west and southwest of the centre. The 7 a. m. map of the 6th showed that this depression had filled up and lost its strength, or had combined with area iv.

IV.—This area formed in Colorado on the afternoon of the 5th, and by the morning of the 6th extended in a long trough from Colorado to the western end of Lake Superior; the barometer was from .12 to .24 below the normal. The centre of the depression was in the southwest corner of Minnesota. In the afternoon the centre was north of Lake Superior. Light rains were reported in the upper Mississippi and Missouri valleys. By the morning of the 7th the centre was north of Lake Huron and nearly west of Ottawa; rains fell in the upper lake regions and in the upper Mississippi and Missouri valleys. On the afternoon of the 7th the centre was north of Ottawa, with the pressure at that place .16 below the normal. By the morning of the 8th the centre had reached the Labrador coast, and in its progress had been accompanied by light rains in the lower lake region and in the province of Ontario; light rains also fell in New England. From this point it will be described as number 5, of the north Atlantic storms.

V.—This area formed in Utah on the morning of the 7th. At Salt Lake City the pressure was .30 below the normal. In the next twenty-four hours the centre had moved northeastward and was between Huron and Bismarck, Dakota. Light rains fell in western Minnesota, in Dakota, Montana, and Manitoba. From this point the centre moved nearly northward, and at midnight of the 8th was near the northern end of Lake Winnipeg. Abundant rains fell in Minnesota and in the northern part of the upper lake region; in the two last mentioned sections the winds were fresh, whilst in Manitoba the storm was severe. By midnight of the 9th the centre had gone northward and then turned suddenly eastward, and on the morning of the 10th was in the southern part of the Gulf of Saint Lawrence, from which point it passed eastward, with increasing pressure, off the coast.

VI.—This area developed in southeastern Colorado on the 8th; at midnight the pressure at West Las Animas was .28 below the normal. By midnight of the 9th, the centre had moved to the vicinity of Omaha, with considerable rain in Minnesota, Dakota, and eastern Montana. By the afternoon of the 10th, the storm was central over Lake Superior, with

rain and fresh winds. On the morning of the 11th, the centre had moved eastward, and was near Ottawa. The rain area had extended, and had included the southern part of the upper lake region, and the lower lake region. Rains also fell in Illinois. By the morning of the 12th, the centre had moved in a northeasterly direction, and was on the western coast of Newfoundland, with the pressure .30 to .40 below the normal in the Gulf of Saint Lawrence. Fresh and occasional high winds and rain accompanied the movement of the centre, and the storm was severe in the Gulf of Saint Lawrence. From this point this area will be described as number 9, of the north Atlantic storms.

VII.—This was the only storm that reached the coast during the month which presented features of a tropical character, but the data do not warrant any tracing of its track before the 10th, on the morning of which date it appeared off the Georgia coast, the barometer at Savannah showing a fall of .11 in eight hours, with a fresh easterly wind, and rains at Charleston, Savannah, and Jacksonville. On the morning of the 20th the centre was between the two last named cities. In the next twenty-four hours it had moved inland and was between Savannah and Augusta, with rain at both places, and a fresh southerly wind at the former and a northerly wind at the latter. In the next eight hours it moved northward and was between Charleston and Augusta, with fresh winds at both places. At midnight of the 11th and on the morning of the 12th, the centre remained nearly north of Charleston, and the pressure was about .20 to .23 below the normal, being at Charleston, 29.84. Heavy rains fell at Charlotte and at Fort Macon, North Carolina, and at the latter the wind reached a maximum velocity of 32 miles. On the afternoon map of the 12th it appeared that the centre was near the coast between Charleston and Savannah. Heavy rains fell at these two places, and a very heavy rain at Fort Macon—3.20 inches in eight hours. The barometer at Charleston was 29.78, being .25 below the normal. High winds occurred at Fort Macon and Wilmington, the maximum velocity at each being 32 miles. The midnight map of the 12th showed the centre to be southeast of Savannah; northward from here the rain was general on the coast to Hatteras, the rainfall at Charleston being 3.43 in eight hours. The morning of the 13th the centre was east of Savannah, and rain fell on the coast from Hatteras to Jacksonville. From here the storm-centre seemed to move in an easterly, then it took a northerly direction, as high winds occurred on the coast as far north as Block Island until the morning of the 14th. The following maximum velocities were reported at this time: Sandy Hook, 33; Delaware Breakwater, 58; Chincoteague, 31; Cape Henry, 41; Kitty Hawk, 47; Fort Macon, 40. At midnight of the 13th the following velocities were reported: Block Island, 32; Sandy Hook, 39; Chincoteague, 44; Delaware Breakwater, 44; Cape Henry, 39; Kitty Hawk, 50; Hatteras, 32; Fort Macon, 42. At Kitty Hawk the storm signal was ordered and displayed sixty-one hours before the storm came, and was fully justified with the above velocity: the storm continued for sixty hours. From the morning of the 13th this storm will be referred to as number 8 of the north Atlantic storms.

VIII.—This area appeared in Utah on the morning map of the 13th, with a pressure, at Salt Lake City, of 29.76, which was .15 below the normal, and in the afternoon it was .21 below the normal. In the next twenty-four hours the centre had moved eastward and was between Denver and West Las Animas, with a pressure .19 below the normal at the latter place. On the 14th rain fell at Salt Lake City, and heavy rain in front of the storm at Omaha, at the latter place 1.26 inches. At midnight the centre was east of Denver, but the morning map of the 15th showed this area to have disappeared as a distinct storm, apparently having combined with the next storm which was more severe and was further north.

IX.—This depression developed on the afternoon of the 14th east of Bismarck, where the barometer was 29.79, being .16 below the normal. The wind was northwest and fresh, and rain was

falling. The wind at Moorhead at this report was 29 miles. By midnight the centre had moved northward into Manitoba, where rain fell, as also in Dakota, Minnesota, and Montana. The morning map of the 15th showed a trough extending to Colorado, but the centre of the storm was in northern Minnesota, and this area seems to have drawn into it low area viii. The rains continued in Montana, Dakota, Minnesota, and extended into Wisconsin. By midnight of the 15th the centre was north of Lake Superior, with the pressure over the upper lakes from .10 to .52 below the normal, the latter figure being reached at Marquette. Rains were general in the northern part of the upper Mississippi valley and the northwest part of the upper lakes. With the eastward movement of the centre clearing and fair weather prevailed in Dakota and Montana. On the morning of the 16th the centre was northwest of Ottawa, and the winds were fresh, and at several places high in the lake regions. Local rains fell in the upper Mississippi valley, upper lake region, and in the Saint Lawrence valley. On the morning of the 17th the centre was on the coast of Labrador, and in the twenty-four hours preceding rain fell in New Brunswick, Nova Scotia, and northern part of New England. From this point this area will be number 10 of the north Atlantic storms.

X.—This area developed on the afternoon of the 18th, the map showing a fall of .10 in eight hours at Moorhead; the midnight map showed the centre to be nearly south of that place, with the pressure .10 below the normal. On the morning of the 19th the centre had moved to the northern shore of Lake Superior; by the afternoon it had moved to the northeastern shore of the lake, with increasing fresh winds and local rains in the upper lake region. By the morning of the 20th the centre was a little northwest of Montreal and east of Ottawa; the pressure was about .10 to .14 below the normal. The rain was light but almost general in the lower lake region and in the province of Ontario. In the afternoon of this day the centre was between Quebec and Montreal, with rain at the latter place and in northern New York. High winds occurred on Lake Ontario. At midnight the centre had moved to the mouth of the Saint Lawrence; the rainfall was general in New England and in the province of Quebec, although light. Sleet occurred on Mount Washington. By the afternoon of the 21st the centre was in Newfoundland. Light rains fell in Nova Scotia and New Brunswick.

XI.—This area appeared in the northwest part of Manitoba on the afternoon of the 20th. In eastern Dakota the barometer showed a fall of .20 in eight hours. On the afternoon of the 21st the centre was north of Lake Superior; the winds were high at Marquette, Escanaba, and Mackinaw, and the pressure at these places about .20 below the normal; at Mackinaw City the barometer had fallen .28 in eight hours. No rain had thus far accompanied the movement. At midnight, however, with the combination of high area number vi., local rains fell in the upper Mississippi valley, and northern part of the upper lake region. On the morning of the 22d the centre was near the mouth of the Saint Lawrence river, and its movement was accompanied by light local rains in the provinces of Ontario and Quebec. By midnight the centre had moved north-eastward into Labrador, with clear weather and higher barometer in the Saint Lawrence valley.

XII.—This area appeared on the afternoon of the 22d in the northwestern part of Manitoba, and moved in a southeasterly direction until midnight of the 23d when it united with area xiii. in the southern part of Wisconsin. It was accompanied by light rains in Minnesota and Wisconsin on the 23d.

XIII.—This area formed on the morning of the 23d in eastern Nebraska near Omaha and Yankton; the pressure was .37 and .39 below the normal at these places, respectively. Its formation was attended by general rains in the upper Mississippi and Missouri valleys and in the southern part of the upper lake region. On the afternoon of the 23d the centre was between Yankton and Omaha; at the latter place the pressure was .48 below the normal. By midnight it had moved east-

ward to the southern part of Wisconsin, where it united with area xii. At this time the rain area extended as far east as eastern New York and was a long narrow oval, taking in the lake region and extending to the Indian Territory. The minor axis of this oval was from Huron, Dakota, to Saint Louis, Missouri, and the major axis from near Quebec to Fort Sill. By the morning of the 24th the centre had moved northeastward and was near Escanaba, with a high wind and heavy rain at this place—2.27 inches. The rain area had moved eastward and had preserved nearly the same form; the major axis extended from Quebec to Fort Sill and the minor axis from Saint Paul to Louisville. The winds were fresh and high on the lakes. Near the storm-centre the pressure was .60 to .75 below the normal. The fall in the barometer was .60 in the twenty-four hours, and .30 in the eight hours preceding. The storm continued in the lake region on the afternoon of the 24th with the centre near Ottawa. High winds and local rains occurred in these regions, and rain fell also in the Ohio valley. Colder clear weather followed in the western part of the upper lake region and in the upper Mississippi and Missouri valleys. On the morning of the 25th the centre was near the mouth of the Saint Lawrence river, and in the preceding sixteen hours rain had fallen in northern New England, and in the Saint Lawrence valley, and eastern part of the lower lake region. From there the storm passed off the Labrador coast, and will be described as number 12 of the north Atlantic storms.

XIV.—This area appeared in Colorado on the afternoon of the 25th, with the centre south of Denver, and west of West Las Animas, where the barometer was 29.69, or .21 below the normal. On the morning of the 26th, the centre was east of Denver and north of West Las Animas. In the afternoon, the centre was southeast of North Platte. The weather was cloudy in the upper Mississippi and Missouri valleys. Rain fell in the west Gulf states, and in the Ohio valley and Tennessee, and in Illinois. By midnight, the storm centre had moved to the central part of northern Iowa, with the pressure from .20 to .25 below the normal. Thunder storms occurred at Saint Paul, and at La Crosse, and the rainfall was nearly general in the Mississippi and Ohio valleys. The following heavy rains occurred: Omaha, 1.22; Saint Louis, 1.44; Springfield, 1.84, in eight hours. On the morning of the 27th, the storm was central over the eastern end of Lake Superior. The winds were generally fresh, and the rain area covered the lake regions, the Ohio and upper Mississippi valleys and the west Gulf states. The following heavy rains occurred: Chicago, 1.09; Alpena, 1.06, La Crosse, 1.48; Des Moines, 1.42, in eight hours. On the afternoon of the 27th, the centre was over Georgian bay, and the rain area had extended down the Saint Lawrence river beyond Quebec. High winds were recorded at all stations on the lower lakes. Rain continued in the Ohio valley, and in the west Gulf states; at Galveston, 1.78 inches fell in the eight hours preceding; and 1.33 at Brownsville; 1.42 at Louisville, and a thunder storm at Cairo. On the morning of the 28th, the centre was a little northwest of Anticosti. The rain area extended from Leavenworth to Sidney, and abundant rains fell on the Texas coast; at Galveston, 1.21, and at Indianola, 2.07. The pressure was below the normal in all districts except the north Pacific coast region, and the south Atlantic states, and eastern part of the east Gulf states; north of the fortieth degree of latitude, and east of the one hundred and twelfth degree of longitude, it was from .10 to .40 below the normal. From this point the storm passed beyond the limits of the stations of observation.

XV.—This depression appeared in the British Northwest Territory, north of Montana, on the morning of the 27th. In Montana the barometer fell .20 in eight hours, and was from .30 to .45 below the normal. By midnight of the 27th the centre had moved eastward to the northern part of Manitoba, where the pressure was .60 below the normal. This depression seemed to reinforce the rainfall following area xiv. in the upper lakes and upper Mississippi valley. By the afternoon of the 28th the centre had extended suddenly east-southeastward

and was north of Lake Huron, with a fall in the barometer of .22 in eight hours at Alpena, .26 at Saugeen, .25 at Rockliffe, which was .40 to .50 below the normal. A very heavy rain of 2.32 inches occurred at Alpena and 2.31 at Escanaba. The winds were fresh and high on the lakes, and continued until the morning in the eastern part of the lower lakes. On the morning of the 29th the centre was northwest of Father Point, with rains in New England and the northern part of the middle Atlantic states and in Nova Scotia. In the afternoon the centre was east of Anticosti, and from here passed over Newfoundland, whence it will be described as number 13 of the north Atlantic storms.

XVI.—This area developed in western Colorado about midnight of the 28th, with a pressure .20 to .30 below the normal. By the afternoon of the 29th the centre had moved northeastward and was near Yankton, with the pressure .41 below the normal. At midnight it was a severe storm in Minnesota, with the centre near Saint Paul, where the weather was threatening and the wind had a velocity of 27 miles. On the morning of the 30th the centre was over Lake Superior. Rain fell in Minnesota and the northwest part of the upper lakes, in the Ohio valley and in the lower lake region. A thunder storm occurred at Davenport, Iowa. In the afternoon of the 30th the centre was north of Lake Huron, and the rain continued in the lower lake region and in the southern part of the upper Mississippi valley. The winds on the lakes were not very strong. At midnight the centre was northwest of Quebec, with partly cloudy weather and local rains in the Saint Lawrence valley and in the lower lake region. The only high wind attending this storm was at Duluth, 41 miles, the morning of the 30th. At the midnight report cooler, clearing weather followed in the upper lake region, and clear weather in the northwest.

NORTH ATLANTIC STORMS DURING SEPTEMBER, 1884.

[Pressure expressed in inches and in millimetres; wind-force by scale of 0—10]

The paths of the atmospheric depressions that have appeared in the north Atlantic ocean during the month have been approximately determined from reports of observations furnished by agents and captains of ocean steamships and sailing vessels; from data obtained through the co-operation of the Hydrographic Office, U. S. Navy, and the "New York Herald Weather Service;" also from abstracts of the logs of Spanish steamers, furnished through the courtesy of the Reverend Benito Viñes, S. J., Director of Belen College Observatory, Havana; and from other miscellaneous data received at this office up to October 25, 1884.

To the Hydrographic Office, U. S. Navy, the Chief Signal Officer desires particularly to express his indebtedness for valuable information and data furnished through the kindness and courtesy of the officers there on duty.

The Chief Signal Officer calls the attention of co-operating observers to the importance of carefully noting each successive change of wind, especially when in the vicinity of tropical hurricanes, and, when practicable, the hour at which such change occurs; also the vessel's course and rate of sailing per hour, or her estimated drift when hove to.

The most noteworthy feature of the month of September was the occurrence of two tropical hurricanes during the first half of the month. The first of these originated to the eastward of the forty-fifth meridian and near N. 15°, moving thence west-northwestward to about W. 57°, where it recurved to the northeastward. The second hurricane appears to have developed near the coasts of Florida and Georgia, no observations having been received which point to its existence at a lower latitude, or prior to the 10th; the centre of this hurricane remained near the coast of the United States for three or four days, during which the disturbance exhibited great energy and finally moved northeastward along the course of the Gulf stream. The month was unusually stormy over the region south of N. 40° and between W. 20° and 40°. Several depressions passed northeastward at latitudes north of 50°, such

being, in general, continuations of disturbances which originated in the United States. The weather, during September, over that part of Atlantic between the United States and Europe, most frequented by steamers, may be summarized as follows: 1st to 20th, strong breezes to gales from sw. to nw; weather generally cloudy or rainy, frequent fogs west of the fiftieth meridian. From the 20th to 30th, moderate to strong gales, especially heavy over the region east of W. 40°, weather cloudy or rainy.

The following are descriptions of the storms charted:

1.—This disturbance appeared near N. 41°, W. 58°, on the 1st, and caused strong se. gales over the ocean south of Newfoundland. Captain Braes, commanding the s. s. "State of Nebraska," in N. 42° 30', W. 61° 45' reported as follows: "4 a. m., barometer 28.81 (756.9), wind se., force 5, hauling to eastward; ran into what was evidently the northern edge of a cyclone moving to the eastward, barometer (aneroid) falling .4 inch in two hours; very high sea from sw. At 6 a. m., barometer 29.4 (746.7), oscillating .2 inch, wind nue., force 9, very heavy rain; 9 a. m., barometer 29.6 (751.8) rising, wind nw., weather clearing; noon, barometer 29.9 (759.4), light wind, fine weather." The s. s. "Oder," in N. 43° 55', W. 58° 01', had a fresh sse. gale from 10 a. m. to 3 p. m., then from se. to sw., blowing with hurricane force, with heavy rain. The bark "Addie E. Sleeper," lost spars and sails during a heavy gale in N. 41° W 61°, and the bark "Engelbert," sixty miles east of Sable island, lost sails in a hurricane on the 1st; several vessels on the Banks had severe gales, and sustained loss of spars and sails. On the 2d, the centre of disturbance was to the northward of the fiftieth parallel, the minimum barometric reading being 29.36 (745.7); moderate to strong sw. breezes prevailed over the Banks, with s. and e. winds, north of 53° N., and east of 45° W. During the 3d, 4th, and 5th, the disturbance moved eastward north of the fifty-fifth parallel, the pressure ranging from 29.2 (741.7) to 29.6 (751.8). On the 6th, the area of low pressure was to the northward of the British Isles.

2.—This was a tropical hurricane which prevailed over the Atlantic south of the thirtieth parallel during the first decade of the month, having developed within the region south of 15° north latitude, and east of 47° west longitude. The earliest reports relating thereto, as yet received, date from the 3d of the month and are as follows: On the 3d Captain N. C. Walker, commanding the bark "Campanero," in about N. 13° 27', W. 47° 33', reported: "wild, threatening weather throughout the day; at 9 p. m. the wind was nnw.; at 10 p. m. nw. by w.; 11 p. m., nnw.; at 1 a. m. of the 4th it was w.; 2 a. m.; sw.; 3 a. m., s.; barometer 29.84 (757.9). The wind blew in heavy heavy and sudden squalls of about two minutes duration, with heavy rain and high seas; at 8 a. m. the barometer began to rise, but the squalls of wind and rain continued and a very rough and confused sea came up from s. and sw.; at noon the wind was blowing a strong breeze from ssw., with rain, and the sea became more regular."

On the 4th the bark "Ella," from Buenos Ayres to Boston, in N. 16° (no longitude given), had a heavy gale from w., in which she lost and split sails; and the brig "Emeline," on the same date, in N. 16° 23', W. 52° 24', had a heavy gale from ene. to ssw., lasting twelve hours. On the 5th Captain H. F. Schive, commanding the brig "Lilian," in about N. 17° 39', W. 57° 50', reported very heavy ene. and ese. sea swell, with cloudy, squally, and threatening weather and strong nw. wind until 2 p. m., when it began to blow in heavy squalls, with rain, from w. and w. by s.; barometer 29.79 (756.7). This weather continued for about six hours, when the wind shifted to sw. and blew with the force of a moderate gale.

The above vessels appear to have been to the southward of the storm-vortex, which was evidently moving in a westerly or west-northwesterly direction, as shown by the directions and shifts of the wind; it appears probable that they were, however, at a considerable distance from the vortex, since the wind with them did not exceed the force of a moderate to