

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 October, 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.

The principal feature of the month was the number of areas of low pressures that occurred, with the average track high to the north, over the lakes and down the Saint Lawrence valley. The average number of barometric depressions and their average velocity per hour were in excess.

The temperature was decidedly above the mean, which is shown by the chart of departures from the normal.

The long and severe drought has continued in some of the southern states, with the absence, or only traces, of rain in some localities.

The atmospheric pressure was above the normal in the eastern and central portions of the country. The line of normal pressure runs nearly parallel to the forty-fifth degree of north latitude.

The severest storms of the month occurred during the 5th; 7th, and 8th; on the 13th; 20th and 21st; 23d, 24th, and 25th.

The principal cold waves were: from the 6th to 10th, crossing the country from Montana to Florida; that from the 13th to 16th, in the eastern sections; also that from the 19th to 24th, which moved first south and then east over the country east of the Rocky mountains.

The excessive rainfall in the lower Rio Grande valley was also a distinguishing feature of the month.

No tropical storm reached the United States during the month. Under "north Atlantic storms" are described, as numbers 5 and 5a, two tropical cyclones, which prevailed in the vicinity of Cuba.

In the preparation of this REVIEW the following data, received up to November 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 fourteen Canadian stations, as telegraphed to this office; one hundred and fifth-nine monthly journals; one hundred and fifty-seven monthly means from the former, and fourteen monthly means from the latter; two hundred and fifty-eight monthly registers from voluntary observers; forty-three 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, 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 October, 1884, determined from the tri-daily telegraphic observations of the Signal Service, is exhibited by the isobarometric lines on chart ii. The mean pressure for the month is greatest between the parallels of 33° and 40° north latitude, east of the Mississippi river, this region being inclosed by an isobar of 30.15. The highest barometric mean for the month, 30.19, is reported from Knoxville, Tennessee, and Charlotte, North Carolina. To the northward of the area of greatest pressure, the barometric means decrease to slightly below 30.05, in the lake region and lower Saint Lawrence valley; and to slightly below 30.0 in the extreme northwest and Canadian Maritime Provinces. Along the Gulf coast the barometric means vary from 30.07 to 30.12; at Key West, Florida, the monthly mean is 29.98. The isobar of 30.1 includes nearly the whole of the country lying between the parallels of 30° and 38° north latitude, east of the one-hundredth meridian. From the western portions of Kansas and Nebraska northwestward to the north Pacific coast the monthly barometric means are slightly above 30.05. The area of least mean pressure, inclosed by the isobar of 29.95, includes the southern portions of Arizona and California, the mean pressures varying from 29.94 at Forts Apache, Grant, and Thomas, Arizona, to 29.96 at San Diego, California. Along the Pacific coast, north of Los Angeles, the mean pressure varies but slightly from 30.0.

Compared with the preceding month the mean pressure is higher in all districts, except southern Florida and Nova Scotia, where there is a slight decrease. The increase is greatest over the eastern Rocky mountain slope, where it varies from .18 to .22; in the western plateau districts, the lake region and central valleys, the increase is from .08 to .17; and along the Atlantic and Pacific coast from .02 to .08.

Compared with the normal pressure for October (see chart iv.), deficiencies varying from .01 to .05 are shown along the northern border of the country from northeastern Montana to New England. There is also a slight deficiency in California and in southern Florida. In all other portions of the country the mean pressure is above the normal, the departures being greatest over northern Texas, and portions of Arkansas, Indian Territory, and Louisiana, where they vary from .10 to .13. On chart iv. the line inclosing the region over which the departures exceed .05, is drawn from southern New Mexico northward to eastern Wyoming, thence southeastward in an irregular course to the south Atlantic coast, and thence southward to the lower Rio Grande valley.

BAROMETRIC RANGES.

The monthly barometric ranges are greatest in the upper lake region, extreme northwest, northern and middle plateau districts, and on the north Pacific coast, where they are from 1.00 to 1.12; they are least in southern Florida, and on the

coast of Texas, where they are from .32 to .40. In the table of "Miscellaneous meteorological data" published elsewhere in the REVIEW, will be found the monthly ranges as reported from the several stations of the Signal Service.

AREAS OF HIGH BAROMETER.

In this chapter, devoted to the discussion of high barometric anti-cyclonic areas, only those are considered that have had a distinct movement in contra-distinction to the permanent or relative high areas, and in locating the centre, consideration is taken of the departure from the normal as determined for October. A feature that appears to show itself is that the area of greatest departure is generally found to be nearly concentric with the high areas as drawn from the readings reduced to sea level, being but a little in advance of them. The imperfection of the monthly constants now used, when extreme high or low readings are considered with temperatures differing considerably from the normal, often becomes apparent when locating the exact centres of barometric areas. The chart accompanying this REVIEW is approximate, and is interesting in studying the cold waves, "northers," and many northeasterly gales on the Atlantic coast. During the month eight such areas have occurred, whose departures have equalled or exceeded .20 inch.

I.—On the morning of the 1st this area rested over the upper lake region with a departure from the normal of .3 inch. Its movement was easterly, and in advancing, it increased in intensity. It followed low area number i. and was succeeded by low area number ii. A cool wave accompanied the area, causing precipitation in the lake regions on the 1st. During the 2d the low temperatures were felt from the Saint Lawrence valley to Virginia, and rain fell from the middle Atlantic states to the upper lakes. Northeasterly gales occurred on the 2d along the Atlantic coast south to the Delaware capes. On the 3d it passed off Nova Scotia, the southern edge having parted from the main area and resting over the middle Atlantic coast during the 3d, 4th, and 5th, it slowly moved into the south Atlantic and Gulf states as an area only slightly above the normal. On the morning of the 3d the winds on the Atlantic coast had shifted to southerly, and fine weather and normal temperatures prevailed over the Atlantic and Gulf states.

II.—This area appeared on the 6th in Washington Territory, and by the morning of the 7th appeared central in Dakota. It lent its influence in developing low area number v. on the 7th. It was preceded by a cold wave which, on the night of the 7-8th, was accompanied by frosts from Kansas to Minnesota. The cold wave with this area was the most severe of the season. It first appeared in the northwest on the afternoon of the 6th and spread rapidly to the southeast. Within twenty-four hours the fall in temperature from Minnesota to Colorado was from 20 to 30 degrees, and during the next twenty-four hours the cold wave extended from Lake Erie to Texas. By the morning of the 9th the wave covered a belt of territory from the Saint Lawrence valley to the Mexican boundary, and frosts were reported in the lake regions, Ohio valley, and northwest. A severe "norther" was felt in Texas. By the morning of the 10th the cold wave had covered the states southeast of a line extending from the mouth of the Saint Lawrence southwest to Texas. Frosts occurred in the states north of Tennessee and North Carolina. The cold wave ceased during the 11th in the south Atlantic states. The area of high, after passing east of the Mississippi valley, diminished, and after remaining central over the middle Atlantic states, disappeared on the 12th off Cape Hatteras. With the advance of the cold wave rains occurred in the northern states, but no rain fell in the southern states and the long continued drought in those districts, which promised to break up, continued. Cold wave signals were announced in advance of the wave in Iowa, Kansas, Missouri, Illinois, and Wisconsin on the 7th, and frost warnings were distributed in northern Missouri and Wisconsin on the same date. On the 8th the cold wave was announced in Arkansas, Indiana, Michigan, Ohio, Kentucky, and

Tennessee. On the 9th warnings for cold wave and frosts were sent to the New England states, the middle states, and continued in the states north of Tennessee. The chart which accompanies this REVIEW shows the southern limit of frost.

III.—This area originated in Colorado early on the 12th, moving to the northeast, and by midnight was central in Dakota. During the 13th it prevailed in the upper lake region, lowering the temperature slightly in the northern districts, where it increased in intensity. During the 14th, 15th, and 16th it moved into Alabama where it diminished and merged into high area number iv. then approaching from Wyoming. The temperatures were lowered in all the states to the east of its central path. During the 14th and 15th northeasterly gales were experienced along the Atlantic coast severe enough to run the schooner "Sarah Shubert" ashore on Hog Island, near Norfolk. Heavy frosts occurred in the lower lake region, Ohio valley, and middle Atlantic states on the morning of the 15th, and on the morning of the 15th were reported in the states of Tennessee, Virginia, and North Carolina and on the 17th in Alabama. Fine weather prevailed during the dates of its southerly movement, and, except in the New England and middle Atlantic states, remarkably fine weather prevailed during the presence of this high area and that into which it merged, number v., lasting until after the 21st, when the storm, number x., interrupted the drought slightly. With the approach of the cold wave wild geese and ducks were seen migrating southward at several stations in North Carolina and Virginia. Warning by cold-wave signals, the Farmers' Bulletin, and special messages to railroad companies who co-operate in distributing frost announcements, were sent on the 13th and 14th into the states of Wisconsin, northern Illinois, Michigan, Indiana, Ohio, Pennsylvania, New York, and into New England, and later on the 14th into the states of Delaware, Maryland, and Virginia.

IV.—The first appearance of high area number iv. was on the morning of the 14th in Washington Territory. It moved slowly southeast and was present in Wyoming on the morning of the 15th. Upon crossing the Rocky mountains it increased in intensity, and from the 15th it appears as a large region of high barometer, extending from Wyoming to Florida, having merged with high area number iii. on the Gulf coast. On the 18th it was central in Texas, and during this date it overspread the central valleys, and at midnight of the 18th was central in Pennsylvania. It hovered on the middle Atlantic coast until the 22d, when it was broken up in North Carolina. It was characterized by no decided cold wave but by dry and fine weather. The temperature was gradually lowered in the eastern sections and light frosts occurred.

V.—The study of this area, in connection with the circumstances accompanying it, is quite interesting. It was preceded by a zone of low pressure on the 19th which extended from Lake Superior southwesterly to Colorado; it followed low area number ix., and late on the 19th it recurved and merged into high area number vi., and subsequently assisted in developing low area number x. On the morning of the 19th there was scarcely any indication that the phenomena that so soon after occurred were so near at hand. At the afternoon report the high pressure was in the Northwest Territory. Low area number ix. was near Lake Superior, and strong northerly winds were reported in the extreme northwest, and a fall in temperature from ten to forty degrees in Dakota, Montana and the Northwest Territory. By midnight the high was central near Fort Buford, and a blizzard had overspread the Rocky mountain slopes to Nebraska and Colorado. The departure from the normal barometer increased and the high area centre moved eastward behind the low area that was moving rapidly eastward. During the 20th it overlaid Dakota and Minnesota, and the cold wave, which was very severe, had reached Michigan, Missouri and northern Texas. During the 21st it took a southerly movement and soon recurved to the westward and merged into high area number vi., then central in Montana. The rapid advance of the cold wave was stopped, and during the afternoon and midnight of the 21st it extended from Michigan to the Texas Panhandle, and

was most severe in Iowa and Missouri. Its further description is continued in high area number vi. As early as the afternoon of the 19th announcements were made by hoisting cold wave signals in the cities of Leavenworth, Kansas City, Des Moines, Burlington and Chicago, and preliminary warnings were sent to the cities of St. Louis, Springfield, Illinois, Little Rock, Indianapolis, Detroit and Columbus. At the midnight report of the 19th announcements were made general in the states west of the Mississippi and north of the Ohio rivers. The advance of the cold wave was marked by rain, and the long drought in northern Georgia was slightly interrupted on the 22d by the first rain that had fallen, sufficient to lay the dust for seventy-three days. In advance of the cold wave wild geese were observed in South Carolina flying south. The fall in temperature at Birmingham, Alabama, was 52° in thirty-two hours. The different railroads in Texas and the southwest were informed by telegraph of the approach of the "norther." On the morning of the 20th the cold wave announcements were sent to New England and the middle states.

VI.—This area was, during the 20th, central over Washington Territory. During the 21st it moved from the Columbia valley eastward to northern Montana, and after the afternoon of this date was merged into high area number v., then central in western Nebraska. At midnight the barometer was highest in Montana, but it was high as far south as Texas. On the morning of the 22d nearly the same conditions continued as at midnight previous, and heavy frosts were reported in the upper Mississippi and Missouri valleys. During the remainder of the 22d this area moved rapidly southeastward into the Missouri valley. In the meantime the cold wave in Missouri and Iowa on the afternoon of the 21st, noticed in the description of high area number v., had become less severe, but with the advance of high area number vi. it was strengthened and moved rapidly south and southeasterly, its front at midnight of the 22d being along the Appalachian range of mountains and south to Louisiana. At the same time a "norther" in Texas had reached the Gulf coast. On the morning of the 23d frosts were reported in Alabama, Tennessee, Texas, and the upper Mississippi and Ohio valleys. On the 23d the centre of this high area moved down the Mississippi valley and advanced the cold wave to the Atlantic and Gulf states, northerly gales resulting along the Atlantic and Gulf coasts, being so severe in the Gulf of Mexico that they were reported as hurricanes, some miles from shore. On the morning of the 24th severe frosts were general north of latitude 33°. During the 24th the high area overspread the southern states and the temperatures reached their minimum, the cold wave moving into the Atlantic ocean. On the morning of the 25th severe frosts were reported from Georgia northward to Maryland. Ice was also observed in northern Georgia. No frosts occurred in Florida, though the temperature was lower than during any October within the least three years. During the first part of the 25th the high remained central in South Carolina, and at midnight merged into high area number vii., then central in the lower lake region. Before the advent of the conditions that began on the 20th in the northwest the weather throughout the United States had been remarkably dry and clear for over a week, but on the morning of that date was shown a wave of cold, stormy weather moving in a line to the southeast, its advance line extending from the Strait of Mackinac to Colorado. The next morning it was parallel to that of the morning previous and extended from Lake Ontario to central Texas. On the morning of the 22d it included the lower lake region and the Ohio valley, and was still parallel to its first position. During the 22d it reached the Atlantic and Gulf coasts, causing the first rains that had fallen in the southern states and Virginia for nearly two months; the rain, however, was not heavy enough to allay the long continued drought in those sections. The cold wave announcements of the 19th and 20th in connection with high area number v. were made long in advance and were verified. On the morning of the 23d frost warnings were sent to North and South Carolina, Kentucky, and Tennessee, and on the

24th to the northern portions of Georgia and Alabama. The warnings sent for Mississippi and Louisiana at this time were verified only in northern portions of those states, while the warnings for the fruit districts in northern Florida were not verified, though the temperature, as before stated, was remarkably low. The chart showing the frost limit of this date shows how near to the extreme south the approach was.

VII.—This area extended from Manitoba down to the Missouri valley on the afternoon of the 24th, but was central in Manitoba. By midnight of this date it had pushed forward to the upper Mississippi valley and was central in Minnesota. During the 25th it merged into number vi. in the Southern states, and a very large high barometric area overlaid the states from the Mississippi valley to New England and south to Cuba, with its centre in the lake regions. This area was characterized by the greatest departures occurring during the month, the readings being unusually high in the Northern states. At the close of the 26th this area had moved into the Atlantic states, being central off New England, but extending from Newfoundland to Florida. During the 27th the area of high continued to skirt the Atlantic coast states, and the centre had advanced northeasterly off Nova Scotia. High area number vi. preceded this area so closely and reduced the temperatures so that number vii. was not characterized by a cold wave, although the temperatures were further reduced. On the morning of the 26th frosts were reported from Virginia to New York. This area was followed by low area number xi., and general rains fell from the Gulf to Canada as it moved eastward. During the northwest gales which occurred, Lake Superior was made dangerous, and on the 24th the steamer "Scotia" went ashore on Keewenaw point. A severe snow storm occurred with the gales. The steam barge "Farwell" was compelled to return to Marquette on account of heavy sea on the 22d. Great numbers of wild geese were observed at the upper lake stations flying southward in advance of the cold weather attending this "high." The first ice of the season was observed at several of the northern stations.

VIII.—On the 25th, following low area number xii., this high area appeared in Washington Territory. It increased rapidly and continued central at midnight over that territory. During the 26th it remained constant in intensity and crossed the Rocky mountains. During the 26th the steep gradients between it and the low which was in front resulted in high northerly winds throughout this section. A cold wave was caused, which, by midnight, extended from Lake Superior to Colorado. During the 27th the high barometric centre moved from Wyoming to the Arkansas river valley. The temperatures were lowered with its advance and rain fell from Canada to the Gulf, but the decided lowering in the temperatures was not advanced south of the Arkansas and Ohio valleys. High northerly winds occurred on the Texas coast. On the morning of the 28th frosts occurred in Arkansas and northern and western Texas. After midnight of the 27th and during the 28th this area moved northeastward, and at the close of the day was central over Lake Ontario. The temperatures were reduced with its advance in the lake regions and Ohio valley and at midnight the middle and New England states felt the influence of the cold wave. During the 29th it moved slowly down the Saint Lawrence river and into the Saint Lawrence gulf where it continued. High northeasterly gales occurred on the Atlantic coast in advance and accompanying this "high." Gales were quite severe on the north Atlantic coast during its passage.

AREAS OF LOW BAROMETER.

On the chart showing tracks of centers of low barometer areas, fourteen are noted. The paths of those depressions are almost uniform, originating in the northwest or in the lake regions, passing eastward over the lakes and thence north of east over Canada and down the Saint Lawrence valley. The energy developed in the centers described under numbers iii., v., viii., x. and xi. was most severe. An absence of any paths

of tropical cyclones is shown, none reaching sufficiently far westward, a thing very rarely happening during months of October.

The following table gives the latitude and longitude in which each area was first and last observed, and the average hourly velocity, for October, 1884:

Areas of low barometer.	First observed.		Last observed.		Average velocity in miles per hour.
	Lat. N.	Long. W.	Lat. N.	Long. W.	
No. I.....	0	0	0	0	
II.....	49	68	48	59	25.0
III.....	44	109	46	59	29.5
IV.....	51	111	45	59	52.5
V.....	39	104	44	95	33.1
VI.....	50	100	49	61	46.9
VII.....	41	99	47	62	38.1
VIII.....	46	122	48	58	25.6
IX.....	48	128	46	61	31.9
X.....	44	70	47	56	35.9
XI.....	51	102	45	63	22.5
XII.....	43	91	46	70	35.0
XIII.....	49	98	48	60	27.1
XIV.....	49	111	45	81	29.8
XV.....	49	110	42	97	49.4
XVI.....	49	120			
Mean hourly velocity.....					34.4

The following table gives the number of low pressure areas during the month of October since 1873, with the average rate of movement since 1876:

Year.	Number.	Hourly velocity.	Year.	Number.	Hourly velocity.
1873.....	13		1879.....	9	30.8
1874.....	9		1880.....	12	22.3
1875.....	10		1881.....	6	43.5
1876.....	9	27.7	1882.....	13	27.7
1877.....	11	30.2	1883.....	9	37.3
1878.....	13	19.6	1884.....	14	34.4

The average number of storm-centres during the month of October is 10.7. The average hourly velocity of low centres for October is 29.3 miles.

I.—This is a continuation of cyclonic area number xvi., described in the REVIEW for September. Its course was eastward into the Gulf of Saint Lawrence and disappeared after midnight of the 1st; gales accompanied it in the Canadian Maritime Provinces and in the Bay of Fundy.

II.—On the morning chart of the 1st the pressure was considerably below the normal throughout the Rocky mountain region, and a distinct centre could be located in western Wyoming on the afternoon chart, with the barometer half an inch below the normal. In its advance was a rain area extending from Nebraska to Pennsylvania. By midnight a trough of low pressure existed from British America to Arizona, but the centre of storm action was in eastern Wyoming with a tendency to storm formation over Colorado. Steep gradients appeared between Deadwood and Lake Superior, with increasing southerly winds in advance and increased temperatures in the Missouri valley. By the morning of the 2d the centre was over Dakota, but with the low area extending to the southwest. These conditions continued till the morning of the 3d, at which time the centre had only advanced to central Minnesota. The advance of this depression now became rapid and soon passed beyond our boundary, the edge only being apparent at our northern lake and Canadian stations, and by the morning of the 4th was central over the Saguenay river. Brisk winds were felt over Lakes Superior and Huron in its progress. During the 4th the centre curved southeastward and by the morning of the 5th passed east of Sidney. Cautionary signals were ordered on Lakes Michigan and Superior on the 1st in the afternoon. The northeast gale commenced at Duluth soon after hoisting signal, with rain, the velocity of wind reaching forty-six miles. The storm continued at this point until the 3d when the signal was lowered, and the wind backed to westerly. During the gale the flag-staff was carried away and damage was done to several instruments. On the morning of the 2d

signals were extended to include Lake Huron, and in the afternoon were extended to include Lakes Erie and Ontario and the Atlantic coast from the Virginia capes to Block Island. At Marquette an east wind and rain storm occurred, commencing early in the morning. At Mackinaw City a brisk easterly gale with heavy rain commenced early in the morning of the 2d. On the 3d the wind shifted to southwest and continued as a gale. During the storm, instruments were damaged. At Escanaba, on the 1st, heavy rain began at night, with brisk northeast winds. On the 2d heavy and light rain fell occasionally, with winds generally easterly. Winds became southerly during the 3d. During this storm the wind reached a velocity of but twenty-three miles, which did not give an official verification of the signal. However, during the storm the propeller "Hurlbut" and schooners "Senator" and "Annie Vough" were damaged in the northern part of Lake Michigan, where ship captains report the hurricane during the 2d the worst of the year. At Alpena, Michigan, the easterly wind and rain storm began early in the morning of the 2d, and reached a velocity of thirty-five miles an hour. During this date the schooner "L. P. Ely" sprung a leak and the schooner "Quayle" was damaged; both schooners while being towed into harbor broke loose from tow. Dense fogs were reported over the lakes during the 2d. All signals on the west shore of Lake Michigan were justified except at Milwaukee. Rain began at night of the 1st. On the east side of Lake Michigan alternately light and heavy rains began late at night on the 1st, with brisk easterly winds. During the 2d a heavy sea was reported with occasionally heavy rain, clearing at close of day with wind veering to south. During the 2d brisk southerly winds and clear weather prevailed. Heavy thunder storms were reported on the 4th in southern Michigan and over Lake Erie, with high temperatures on the 3d, preceded by fog during the night of 2d. The wind was fresh to brisk from the southwest. On Lake Erie during the display of signals, except in the western portion where there were thunder-storms, the weather was clear and pleasant with fresh southwesterly winds. On Lake Ontario the signals could have been continued into the 4th, when thunder storms occurred.

III.—The chart shows that this storm-track originated in the uniting of two areas of low barometer. The greatest depression was observed in the Northwest Territory, and simultaneously a lesser depression in Colorado on the afternoon of the 4th, the departures from the normal in Colorado being but slight. By midnight, the Colorado depression had moved into southeastern Dakota, while that in the northwest remained nearly stationary. By the morning of the 5th, these two depressions had coalesced in a decided depression in northwestern Minnesota, with a departure from the normal of .70 inch. The movement of this area was now to the northeast, and its centre could no longer be distinctly traced, but it was evidently near the northern shore of Lake Superior. Its centre cannot be well defined until it reaches the Ottawa river, on the afternoon of the 6th. From its development in Minnesota to the 6th, gales prevailed on the lakes, and a cold wave followed in its rear. A very severe northeast storm occurred at Duluth in the early morning of the 5th, lasting till 9 o'clock, when it shifted to the southwest, and again increased to a gale. During this storm, the schooner "John Martin" was blown ashore on Park Point. On the afternoon of the 5th, a depression was observable in the Gulf of Saint Lawrence, and from this time until midnight, it passed rapidly to the east of Sidney, C. B., where a decided depression prevailed. Signals were ordered on Lake Superior, the west shore of Lake Michigan, and at the Strait of Mackinac on the morning of the 5th. At Marquette the storm commenced in the forenoon, from the southeast, with light rain. At Escanaba, on the forenoon of the 5th, the rain fell in torrents, being remarked by the observer the heaviest ever witnessed by himself and the oldest inhabitants; wind southeasterly. The sea was reported very high and dangerous in Little Bay de Noquet. Telegraph lines were prostrated. In the southern portion of Lake Michigan, brisk and high

southwest and south winds prevailed with light rain; severe thunder-storms also occurred. On Lake Huron the winds were southerly, but only fresh; thunder-storms were frequent.

IV.—The fourth depression was noticed on the morning of the 6th, in Montana. It moved southeasterly, and disappeared at midnight at the head waters of the Mississippi river. The departure from the normal pressure was but slight. It was accompanied by no decided meteorological features. It might be worthy of note that low area number v. developed twenty-four hours after number iv. had disappeared, and a little to the southeastward of the point of disappearance.

V.—This depression might properly be studied in connection with number iv., for from the disappearance of the one and development of the latter there was an area of low pressure overlying the states from Michigan to Missouri. The first cyclonic direction taken by the wind was over the state of Illinois on the afternoon of the 7th. During the remaining part of the 7th the development increased, and by midnight a distinct cyclonic area could be traced overlying the districts included between the states of Illinois and Michigan. The development and northeasterly movement during the 8th was rapid and by midnight it had reached northern Maine and the mouth of the Saint Lawrence river. This depression was preceded by decidedly heavy rains, causing wash-outs in Illinois and Iowa, near the place of development, which was apparently assisted by the movement of a high area and cold wave from the northwest, which is described in connection with the "high" of this date. Gales were prevalent on the lakes and were sudden and unannounced by signals, and many vessels were damaged. At Chicago heavy rain and a gale occurred. At Milwaukee the storm commenced at 10.30 p. m., suddenly backing from se. to n. and blew with the force of a heavy gale, accompanied by heavy rain; it continued for twelve hours. At Racine, Wisconsin, the damage was considerable. At Grand Haven, Michigan, the wind backed to ne. at 1.25 a. m., and blew from that quarter for ten hours. The wind and sea were very severe on the east shore. Several vessels were turned back to this harbor. In the northern portion of Lake Michigan northwesterly gales occurred during the day, causing rough and dangerous seas. On the morning of the 8th signals were ordered from the Strait of Mackinac to Cleveland, Ohio, and were changed to northwest signals in the afternoon and were also ordered for Lake Ontario. The signals on Lake Huron were lowered on the morning of the 9th and those at the other lower lake stations during the forenoon. On Lake Huron the northwest gale was very severe; many vessels sought shelter of the harbors. On the western end of Lake Erie a gale occurred on the morning of the 8th and is noted by the observer at Toledo as a brisk thunder-storm passing over the station from west to east with much lightning and heavy rain. The wind was southerly and veered, at about 9 a. m., to northwest and increased in force and continuing during the day till 2 p. m., then veering to northerly and diminishing. The severe squall or gust which swept over the western end of Lake Erie on the morning of the 8th is characteristic of the dangerous storms which are invariably felt on the approach of high areas from the west. The observer at Cleveland reports that during this heavy rain and thunder storm, which began at 6.30 a. m. the yacht "Sappho" went ashore and proved a total loss, and the "Constitution" lost her sails, while other damage was sustained. At Sandusky, Ohio, the gale commenced during the morning and ended just before 10 o'clock at night, with numerous disasters on Lake Erie, the observer reporting this gale as commencing with heavy rain and afterward turning into a northerly gale of considerable severity. The vessel "Maggie," of Lakeside, had her fore-mast carried away and was swamped, the crew were rescued by the Life-Saving Service. The scow "W. O. Keys" and schooner "Bertha Crowell" went ashore near Marblehead and went to pieces. The tug "Charles Henry" had her rudder injured. At Erie the northwest gale commenced at 11.50 a. m. and ended before 4 p. m. At Buffalo the westerly gale set in at 12.13 p. m. and ended before 4 p.

m. At midnight on the 8th off-shore signals were hoisted on the Atlantic coast from Eastport to the Delaware capes and the next morning they were extended to Cape Hatteras and continued during the day. Northwesterly gales were experienced along the line of signal display.

VI.—The track of this storm as indicated on the chart was near the northern boundary of the United States. Commencing in Oregon on the 8th it passed into the Gulf of Saint Lawrence on the 12th. The departure from the normal at its centre averaged about .40 inch. On the morning of the 10th it was central in Manitoba. Another slight depression prevailed in Colorado, which apparently influenced the main centre so that its course was changed to slightly southeasterly and the two united in a single depression central in Minnesota, with a tongue of low pressure extending southwesterly into Colorado. During the 11th, while the depression was central over Lake Superior, gales occurred on that lake and near the Strait of Mackinac. But light rains accompanied this depression, which passed into the Gulf of Saint Lawrence on the 12th. On Lake Superior on the 10th and 11th the winds were strong from the southwest and reached 30 miles at Marquette. On Lake Michigan the winds were fresh and southerly except at the Strait of Mackinac where a southwest gale occurred on the afternoon of the 11th.

VII.—This depression was first central near Cape Flattery on the 12th and the morning of the 13th, with heavy rains and gales in the north Pacific coast region. The depression was below the normal about .52 inch. It skirted our northern boundary and was central in Manitoba on the 15th, and caused some precipitation during that date on the lakes and high winds on Lake Superior. The remainder of its course was easterly with a uniform speed and was unaccompanied by any remarkable features. Cautionary signals were ordered on Lake Superior in the early morning of the 14th. Southwest and west winds, brisk and occasionally high, occurred on Lake Superior on the 15th. Brisk south veering to northwest winds occurred in northern portions of Lake Michigan. On the early morning of the 15th signals were ordered for all stations on Lakes Michigan and Huron, a number of which were justified on the west Lake Michigan shore; the winds were also brisk on the east shore. A thunder-storm occurred near the Strait of Mackinac, moving north. On Lake Huron a brisk southwest wind prevailed, but signals were not justified.

VIII.—This depression developed from within a large barometric area below the normal and was first central in New England near Portland, Maine, on the morning of the 13th. Its movement was northeastward and its development was decided with its progress. Considerable rain with thunder-storms and calms or variable winds and tornado appearances preceded its development in New England, and rain accompanied its course. Within twenty-four hours it had moved over Newfoundland, and soon passed beyond observation; severe gales were reported in its path. Near Portland, Maine, a severe storm occurred, blowing down trees and unroofing houses, and at about noon of the 13th several vessels at Rockland dragged anchor and a house was blown from its foundation. At Eastport, Maine, a severe thunderstorm occurred, and the first snow of the season followed the passage of the depression.

IX.—On the morning of the 18th the pressure was below the normal in the northern sections of Dakota and Montana and northward; the depression also extended southwestward. The centre moved slowly southeastward, and during the 19th was felt in the upper lakes. While the centre was near Lake Superior a tongue of low barometer extended southwest to Colorado, and steep gradients prevailed over the upper lake region and decided southwesterly gales resulted. During the 20th high areas overlaid both the southeast and northwest sections, and the centre of low barometer was rapidly pushed down the Saint Lawrence valley. The zone of relatively low pressures continued during this date between the

high areas and developed into storm-centre number x. By midnight of the 20th the rapid movement of this low had pushed it beyond observation. On the afternoon of the 18th signals were ordered on Lake Superior, at Milwaukee, Grand Haven, and at the Strait of Mackinac. Signals were soon after ordered at all stations on the upper lakes to Port Huron. Gales were general but no disasters were reported.

X.—Low area number x was generated by the high areas on each side of it and out of a tongue of low pressure extending from ne. to sw. from Canada to Colorado. During the 20th, the pressure was very near the normal at the place of its formation, but there was a distinct cyclonic circulation in the upper Mississippi valley central over the state of Iowa. A decided cold wave was to the northwest of this storm and rain fell in advance of it. Gales commenced on the lakes and continued during the 20th to the 23d, with severe weather and numerous snow-storms. The rate of movement was greatest while passing over the lake region. The first snow of the season fell at most of the Lake Erie stations, while very rough weather was reported on that lake. Hail also fell at several stations in the path of the storm. On Lake Ontario the gales were very severe, and much damage might have been done except for the announcement by signal of its approach. On Lake Ontario, the schooner "Jessie Drummond," was damaged. The first snows of the season on Lake Michigan occurred while the influence of this low was felt. By midnight of the 22d, while this area was central in the lower Saint Lawrence valley, its central line of direction was changed slightly to the southeast and by the morning of the 24th it was no longer apparent. Signals continued at the stations on the lakes on the 19th, having been extended to include all lake stations, the dangerous conditions arising from low area number ix. not yet having passed away. The observer at Toledo reports that the signal was timely and of much benefit. The class of gusty or squally winds which prevail near his station on the approach and passage of low followed by high barometric areas, are those most dangerous and most feared. Hail accompanied the storm at most places on the lakes. On the Atlantic coast the storm was dangerous. Vessels bound for Eastport, Maine, were late and many detained. The signal was not justified by the wind velocity reached, but the observer reports that it was popularly considered justified.

XI.—A slight depression appeared in Manitoba with a cyclonic tendency on the midnight chart of the 23d. Its advance was preceded by cold threatening weather and snow. On the 24th, when near the upper lake region, severe gales occurred with rain and snow. During the 25th it rapidly moved eastward in advance of a "high," and died out upon reaching Maine. Its influence during the early part of the 25th was felt in the lower lake region by the occurrence of severe gales. Signals were ordered for this storm on the lakes as far east as Buffalo on the morning of the 24th. Signals were not justified by reported velocities on Lake Superior, but on Lake Michigan they were, where in some cases the winds were reported the severest of the season. On Lake Huron the schooner "Garret P. Smith" went ashore and was lost. At Detroit the southerly gale was severe and detained many vessels. On Lake Erie dangerous winds occurred and detained many vessels, and the signal was of benefit, but the registered velocities in some cases failed to show a verification. At Buffalo the signal was late, and it would have been better if the hoist of the previous day had continued, as many vessels, seeing no signal displayed, cleared the harbor but were compelled to return. On Lake Ontario the storm prevailed during the 24th and ended during the afternoon. As this depression passed off the Atlantic coast high northwest winds occurred, but no damage was reported, nor were the winds dangerous, as the high velocities generally lasted for a short time.

XII.—This depression first appeared north of Montana and took an easterly movement. During the 25th the pressure was below the normal in the districts west of the Missis-

issippi river, and by midnight distinct depressions could be seen central in Colorado and Manitoba, but by the morning of the 26th the centre in Colorado was no longer apparent, but that in Manitoba continued its easterly course. Rain preceded this disturbance in the Missouri and upper Mississippi valleys, and early on the 26th gales occurred on Lake Superior. During the 27th gales were frequent over the lower lakes while the centre was passing to the northward. Signals were ordered on the early morning of the 26th on Lakes Superior, Michigan and Huron, and later in the day extended to include Lake Ontario. In the afternoon signals were changed to northwest on Lakes Superior and Michigan. The observer at Escanaba reports damage done at Sturgeon Bay and that the gales were very severe in northern Lake Michigan. In the southern portion of the lake the winds were also dangerous. On Lake Huron the winds were dangerous but the reported velocities were not sufficiently high to justify signals. The signal displays were generally verified on Lake Erie by strong southerly gales. Southerly gales occurred on Lake Ontario during the night of the 26th and 27th. The winds became brisk on the Maine coast and in the Bay of Fundy as this depression passed to the north.

XIII.—This low area was first apparent with a depression in Montana at midnight of the 29th. Its course is shown on the chart, and while it passed into the lake region it was accompanied by a few gales and cloudy weather with rain. It is traced to Georgian Bay at midnight of the 31st, when the discussion closes. Signals were ordered at Duluth at the afternoon report of the 30th, and followed on all the lakes at midnight. They were changed to northwest on the 31st. These signals were generally justified by moderate gales.

XIV.—This depression suddenly appeared in Washington Territory at the afternoon observation of the 30th, by the morning of the next day it has moved to northern Montana. It moved thence as a slight depression during the 31st south-eastward, and by midnight it was central in the Missouri valley.

NORTH ATLANTIC STORMS DURING OCTOBER, 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 captains and agents 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," and from other miscellaneous data received at this office up to November 23d.

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

The probable paths of fourteen atmospheric disturbances are shown on the chart for October, 1884; of this number, seven were continuations of depressions which passed over the United States and Canada. The disturbances charted as 5 and 5a were tropical hurricanes, and were probably one and the same, but, owing to the absence of reliable data for the 10th and 11th, it has been deemed advisable to indicate their paths by separate tracings. That traced as 5a displayed great energy, causing much damage to shipping and other property, in and near the Bahama Islands during the period from the 12th to 16th.

During the first and second decades of the month, an area of high barometer occupied the ocean between W. 30° and the European coasts, and this appears to have checked the advance of some of the depressions, while the others have moved north-eastward at higher latitudes than usual. As regards the general character of the weather over the Atlantic north of 40° north latitude during October, 1884, it may be summarized as follows: 1st to 6th, moderate to strong gales, mostly from s. through sw. to wnw., with rainy or cloudy weather and high

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