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INTRODUCTION.

This REVIEW treats generally the meteorological conditions of the United States and Canada for April, 1887, and is based upon reports of regular and voluntary observers of both countries. 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, on which also appears the distribution of icebergs and field ice reported. In tracing the centres of the paths of these storms, data from the reports of two hundred and ten vessels have been used. Unusually severe weather prevailed in the trans-Atlantic routes and west of the fortieth meridian during the first and second decades of the month. Dense fog prevailed during a considerable portion of the month along the southern edge of the ice region.

On chart i for this month are traced over the United States and Canada the paths of thirteen areas of low pressure; the average number for April during the past fourteen years is 10.3. The depression of the 22-23d in its progress from the Indian Territory to northern Michigan was accompanied, especially in Kentucky, southern Indiana, and Ohio, by unusually severe thunder-storms and heavy rains, with tornadoes at widely separated points in various parts of the country; in the upper lake region heavy snow and high wind prevailed. The depression which was central in the Ohio Valley on the morning of the 18th was attended in that and surrounding districts by an unusually heavy snowfall for the season.

The mean pressure of the month is very nearly normal in all districts, except Michigan, Wisconsin, Minnesota, and Dakota, where departures as large as .10 below occur.

No considerable departure from the normal temperature

occurs in any district except the central Mississippi and lower Missouri valleys, where the month has been from 2°.0 to 5°.9 warmer than the average April. In the Lake region and along the Atlantic coast the temperature is slightly below normal, in the central and western districts generally slightly above.

In the southeastern quarter of the country very little rain has fallen, the region of greatest deficiency extending from central Texas eastward to the south Atlantic coast.

In the preparation of this REVIEW the following data, received up to May 20, 1887, have been used, viz., the regular tri-daily weather-charts, containing data of simultaneous observations taken at one hundred and thirty-three Signal Service stations and twenty-four Canadian stations, as telegraphed to this office; one hundred and sixty-four monthly journals; one hundred and sixty-five monthly means from Signal Service stations; twenty-four monthly means from Canadian stations; two hundred and eighty-four monthly registers from voluntary observers; fifty-five 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, Arkansas, Illinois, Indiana, Kansas, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New England, New Jersey, North Carolina, Ohio, South Carolina, and Tennessee; and of the Central Pacific Railway Company; trustworthy newspaper extracts, and special reports.

ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean pressure for April, 1887, determined from the tri-daily telegraphic observations of the Signal Service, is shown by isobarometric lines on chart ii.

The area of highest pressure covers the greater part of the north Pacific coast region and is bounded by the isobar of 30.05; within this line the mean pressure of the month varies from 30.07 at Olympia, Wash., to 30.10 at Roseburg, Oregon. From this isobar the pressure decreases in all directions, except to the westward, until in the central districts of the country the comparatively low pressure of 29.90 and less is reached. From the central districts eastward it increases, attaining in the south Atlantic and east Gulf states a mean of 30.05 or above. In Maine and the adjacent Canadian Provinces the pressure is comparatively low, ranging from 29.86 at Sydney, Cape Breton Island, to 29.94 at Portland, Me. In the plateau region and eastern slope of the Rocky Mountains the pressure is also low as compared with districts in the southeastern quarter of the country and on the Pacific slope.

The departures from the normal pressure are given in the table of miscellaneous meteorological data, and are also shown on chart iv by lines connecting stations of equal departure. In New England, the middle Atlantic states, and lower lake region the pressure of the month is about normal, small departures

both above and below occurring in these districts; from thence westward, north of the fortieth parallel, as far as the eastern boundary of Idaho and Utah it is below the normal; in the upper lake region, Minnesota, Wisconsin, and Dakota the deficiency is quite large, the mean pressure at a number of stations being .10 or more below the normal. In all parts of the country south of the fortieth parallel the pressure is generally slightly above the normal, but the excess is very small, except in southeastern Texas where departures as large as .07 and .09 occur. In California the pressure is about normal; on the north Pacific coast excesses varying from .04 in the northern part of Washington Territory to .08 in southern Oregon occur.

As compared with the pressure of the preceding month, March, 1887, a very large decrease occurs in all parts of the country, except New England, the Atlantic states, and Florida. In the Missouri and upper Mississippi valleys the pressure for April is .20 to .26 below that of March. Along the Atlantic coast the pressure is above that of the preceding month, .10 and over in New England and the Canadian Maritime Provinces, and .01 to .06 in the more southerly districts. In Florida, the east Gulf states, and the north Pacific coast the mean pressure of the two months is about the same.

BAROMETRIC RANGES.

The monthly barometric ranges at the various Signal Service stations are given in the table of miscellaneous data. The largest ranges occur in the northeastern quarter of the country; the smallest in Florida, the Gulf States, Arizona, and California. In the Lake region, and over the country east of the Mississippi River, the barometer attained its greatest height on the 8th or 9th and reached its lowest readings on the 18th or 29th. At stations in the Missouri and upper Mississippi valleys the barometer reached its lowest point on the 22d or 30th. The following are some of the extreme ranges:

Greatest.		Least.	
	Inch.		Inch.
Mount Washington, N. H.	1.71	San Diego, Cal.	0.30
Albany, N. Y.	1.58	Yuma, Ariz.	0.35
Boston, Mass.	1.55	Los Angeles, Cal.	0.36
New Haven, Conn.	1.54	Key West, Fla.	0.36
Portland, Me.	1.53	Fort Grant, Ariz.	0.40
Block Island, R. I.	1.53	Prescott, Ariz.	0.54
New London, Conn.	1.52	Cedar Keys, Fla.	0.54

AREAS OF HIGH PRESSURE.

Seven well-defined areas of high pressure were observed during April. Four were first observed on the Pacific coast; two appeared to the north of Montana, and one was central over the Saint Lawrence Valley at the opening of the month, it having previously passed eastward north of the United States. The general direction of movement of these areas was to the northward along the coast line when central west of the Rocky Mountains, this northerly movement continuing until the centre reached the forty-fifth or fiftieth parallel, where the general course changed to southeasterly. Four areas of high pressure were traced to the southeast from the northern Rocky Mountain region over the eastern slope. After reaching the central valleys their courses changed to easterly and inclined slightly to the north, this inclination increasing as the high areas approached the Atlantic coast line. Three areas of high pressure apparently disappeared within the region of observation, or before reaching the coast, and only two of the seven areas observed during the month passed over the Atlantic.

I and II.—The first telegraphic weather chart of the month exhibited two areas of high pressure—one extending over the Maritime Provinces, and the other central on the Pacific apparently to the west of central California, but extending well to the eastward over the plateau regions. The first of these high areas passed to the eastward during the 1st and disappeared rapidly during the 2d in advance of the severe storm from the south Atlantic coast which reached Nova Scotia by the 10 p. m. report of the 2d. During the 1st, 2d, and 3d the area of high pressure (ii) referred to as central over the Pacific moved slowly northward along the Pacific coast or probably to the northeast from the Pacific, the reports from coast stations indicating that the centre of greatest pressure was far to the west of the coast line until the 3d. While this area covered the north Pacific coast a secondary area of high pressure appeared to the north of Dakota and, extending southward, apparently united with this area on the 4th on the central slope of the Rocky Mountains. After these areas united the southeast movement continued, carrying the centre to the Mississippi Valley near the mouth of the Missouri River on the morning of the 5th. At this point the direction changed to the northeast and it passed over the lower lakes during the 6th and 7th, being central in New England on the morning of the 8th. This area extended southward during the 9th and 10th, covering the entire coast, but the pressure at the centre decreased with the southerly movement, and it finally disappeared by gradual decrease of pressure while central in the south Atlantic states on the 11th, after having crossed the continent and being under observation ten days.

III.—On the afternoon of the 10th this area of high pressure appeared north of Dakota. It was central north of, and near,

Lake Superior on the morning of the 11th, after which it moved eastward to the Saint Lawrence Valley, where it remained almost stationary during the 12th, 13th, and 14th, and disappeared without passing beyond the stations. The pressure increased at the centre of this area with the easterly movement until the 14th, when the pressure declined, without any apparent motion of translation.

IV.—When the preceding area extended over the Saint Lawrence Valley, high area number iv was approaching the northern California coast from the west. On the 13th it was located to the southwest of Oregon; on the 14th it passed to the east of the coast line and was central in Washington Territory, from which point it passed southeastward to Dakota and thence moved northeastward over Manitoba, being last located as central near Fort Garry on the morning of the 16th. The curve showing the direction pursued by the centre of this area is of the same general character, but less extended, as those traced across the entire continent.

V.—This was a slight area of high pressure which was observed in the northern Rocky Mountain region on the 19th. It extended over the middle and southern Rocky Mountain slopes on the 20th, and over the Atlantic coast states on the 21st, the pressure not exceeding 30.3 at any time within its limits, and generally it was below 30.2.

VI.—When the preceding area was central on the middle Rocky Mountain slope number vi appeared to the west of California on the afternoon of the 20th. The pressure increased at the northern Pacific coast stations during the 21st and 22d, and this area remained almost stationary in this region until the 25th, when it disappeared.

VII.—This area appeared to the west of Oregon on the 30th and extended over the north Pacific coast at the close of the month.

The northerly movement of high areas on the Pacific coast during this month is a feature to be considered in connection with the Pacific coast weather predictions. The only case observed during the month of a high area appearing to the north was that observed on the last day of the month, and the charts for May show that while the pressure increased to the southward the general movement was first to the northeast and then to the southeast.

AREAS OF LOW PRESSURE.

Thirteen areas of low pressure have been traced upon the tri-daily weather charts of April, 1887. Of these, six probably originated to the west of the Rocky Mountains north of the forty-fifth parallel. Four were first observed in the southern or central Rocky Mountain regions, and two apparently developed in the Gulf of Mexico, or on the Florida coast. The last storm of the month had its origin to the north of Montana, and during the 29th and 30th moved almost directly southward along the Missouri Valley. The most marked feature of this storm was the sudden change of direction of movement from southward to northward, thus carrying the storm-centre out of the limits of observation to the west of Lake Superior.

The following table shows the latitude and longitude in which each area of low pressure was first and last observed and the average hourly velocity of each:

Areas of low pressure.	First observed.		Last observed.		Average progress in miles per hour.
	Lat. N.	Long. W.	Lat. N.	Long. W.	
No. I	50 00	123 00	50 00	98 00	37.0
II	29 00	79 00	47 00	61 00	40.0
III	39 00	103 00	45 00	66 00	30.0
IV	52 00	116 00	49 00	104 00	25.0
V	53 00	116 00	53 00	102 00	25.0
VI	40 00	109 00	49 00	85 00	30.0
VII	47 00	116 00	43 00	97 00	23.0
VIII	32 00	104 00	43 00	75 00	23.0
IX	33 00	105 00	43 00	92 00	30.0
X	47 00	117 00	47 00	81 00	34.0
XI	27 00	90 00	47 00	62 00	48.0
XII	53 00	113 00	45 00	70 00	25.0
XIII	53 00	105 00	43 00	100 00	25.0

Mean hourly progress, 31.1 miles.

I.—This low area was central north of Washington Territory on the morning of the 1st, and moved directly east, with but little energy, crossing the Rocky Mountains north of Montana, and disappearing while central over Manitoba, leaving an extended trough of low pressure to the southward, covering the region from the upper lakes to Arizona. Within this extended depression developed the low area described in this REVIEW as number iii.

II.—This storm probably had its origin in the Gulf or near the Florida coast line; it did not develop much force until the centre reached the middle Atlantic coast. The movement to the northeast was unusually rapid, and the intensity of the storm increased until it passed over Nova Scotia, the most severe gales occurring on or near the New England coast during the night of the 2d. The lowest barometer reported at land stations was 28.93 at Halifax, Nova Scotia, on the morning of the 3d, although vessel reports show still lower readings near the centre of disturbance when the latter was near the New England coast. This storm was confined to the immediate coast, but the cold northerly winds of the north and west quadrants were accompanied by light snows as far south as South Carolina on the 1st, and along the middle Atlantic and New England coasts on the 2d, the snows increasing and becoming heavy in northern New England.

The following notes from Signal Service observers relate to this storm:

Kitty Hawk, N. C.: continuous heavy rain and strong northeasterly wind prevailed on the 1st. At 8.10 p. m. a velocity of forty-five miles per hour was recorded. On the 2d light snow fell for a few minutes in the early morning; wind northwest veering to westerly.

Block Island, R. I.: light snow fell in the early morning of the 1st and continued until 3.30 p. m., followed by cloudy weather and northeast winds which increased to a gale of forty miles per hour. During the storm the schooner "Pathfinder" was driven ashore and became a total loss. On the 2d the gale continued, wind northeast backing to northwest, maximum velocity fifty-six miles per hour. Heavy snow fell during the greater part of the day.

Vineyard Haven, Mass.: heavy snow or rain, with high northeasterly winds, prevailed during the 1st; on the 2d the wind blew with increasing force, prostrating telegraph poles and blowing ashore at this point ten vessels, some of which were considerably damaged.

Wood's Holl, Mass.: northeasterly winds and heavy snow prevailed during the night of the 1st-2d and continued until 4.30 a. m. of the 3d; estimated maximum velocity of wind, seventy miles per hour. The snow drifted in places to a depth of six feet.

Nantucket, Mass.: heavy snow and rain, with high easterly and northeasterly winds, prevailed on the 1st and 2d; maximum velocity of the wind, fifty-three miles per hour, on the 2d. A number of telegraph poles were blown down and the schooner "Mattie W. Atwood" driven ashore.

Eastport, Me.: on the 2d the mercury fell rapidly, temperature steady; at 9.35 a. m. snow began falling, and changed to sleet at 6 p. m. A heavy northeasterly gale prevailed during the entire day, reaching at 6.20 p. m. a velocity of fifty miles per hour; gale ended at 11.40 a. m. of 3d.

III.—On the 2d the pressure was unusually low in the Rocky Mountain districts and thence northeastward to the upper lake region during the presence of low area described as number ii, and by 7 a. m. of the 3d this disturbance was clearly defined as central in eastern Kansas, the low area to the north having been replaced by a rapid increase of pressure in the upper Missouri valley and Manitoba. From eastern Kansas the course of the centre of this low area was to the northeast over the upper lake region, the disturbance increasing in energy and diminishing in area as it approached, the most rapid barometric gradient being in the west quadrants, owing to the rapid increase of pressure to the westward and a decrease of pressure at the centre as the storm moved to the eastward. It passed eastward of the upper lakes on the 4th, followed by severe westerly gales and light snows; the centre apparently crossed the Saint Lawrence River near Quebec during the night of the 4th, moved thence slowly to the northeastward, accompanied in the Maritime Provinces by severe gales, which continued during the 5th and 6th.

The following notes show the severity of this storm:

Des Moines, Iowa: on the 2d the barometer fell rapidly, but pleasant weather prevailed; on the 3d the mercury rose as rapidly; the wind changed to northwest and blew a gale of thirty-two miles per hour. Snow fell for fifteen minutes between 3 and 4 p. m.

Chicago, Ill.: at 8.35 p. m. of the 3d a southerly gale set in and continued until midnight; greatest velocity twenty-five miles per hour. On the 4th the wind blew a gale from the west or northwest until 7 p. m.; greatest velocity thirty-eight miles. Heavy snow fell from noon until midnight.

Mackinaw City, Mich.: an easterly gale, with rain and hail at intervals, prevailed during the night of the 3d-4th; at 6.35 a. m. the wind subsided and shifted from east to southwest. At 7.15 a. m. it began blowing with increasing force, and during the afternoon gradually shifted to west and northwest; maximum velocity of the 4th, forty-four miles per hour, from the east, at 3.45 a. m. Snow fell from 7.15 a. m. until 11.45 p. m. The gale continued until 6.30 a. m. of the 5th.

Milwaukee, Wis.: on the 4th light snow fell from 7.45 a. m. to 4.45 p. m. and from 7.10 to 7.45 p. m. At 1 a. m. a northwesterly gale set in and continued until 10.30 p. m., attaining at 5.47 a. m. a velocity of forty-four miles per hour. The high wind destroyed a number of signs, windows, etc.

Buffalo, N. Y.: cloudy weather and low, rising barometer prevailed on the 4th. A gale from the southwest set in at 1.30 a. m., and reached at 11.40 a. m. the velocity of thirty-five miles per hour. On the 5th the barometer continued rising, temperature falling rapidly, wind veering toward the west and blowing a gale until 8.20 p. m.; maximum velocity, forty-four miles per hour, at 2.55 a. m. Light snow fell from 9.40 a. m. and until 3.20 p. m.

IV.—This disturbance probably originated in the north Pacific, but its centre was first located at 10 p. m. of the 4th north of Idaho. At this report the barometer continued low on the north Pacific coast, and the charts indicate that this was a secondary depression which formed to the eastward of the coast range. During the 5th it passed eastward along the fiftieth parallel to northern Dakota, after which it disappeared by a gradual increase of pressure without further easterly movement, and causing no marked atmospheric disturbance while within the limits of the stations of observation.

V.—This disturbance also originated in the Pacific, but it has not been traced to the westward of the Rocky Mountain range. It was at no time central south of the northern boundary of the United States, and passed eastward from the region north of Montana during the 6th and 7th, disappearing to the north of Dakota after reaching the one hundred and second meridian, leaving an extended area of low pressure in the central Rocky Mountain regions, within which developed the disturbance described as number vi.

VI.—On the afternoon of the 8th a barometric trough extended from Minnesota southwestward to Utah, and also to the northward over Manitoba. This condition continued until the morning of the 9th, when a well-defined area of low pressure extended from Colorado northward to western Dakota. By midnight of the 9th the centre of disturbance had reached eastern Dakota, accompanied by severe local storms and general rains in the upper Missouri valley and Dakota. After passing northeast of Minnesota it apparently united with an extended area of low pressure then covering the Saint Lawrence Valley, but its centre could not be located after passing to the eastward of Lake Superior.

VII.—The telegraphic report at 10 p. m. of the 9th showed that the barometric pressure over the plateau region was from .2 to .4 below the normal, the region of lowest pressure being the eastern portion of Washington Territory and Oregon. The succeeding reports of the 10th indicate a southeasterly movement, and by midnight the centre of disturbance had reached eastern Colorado, where the pressure was below 29.5, the isobars bounding the disturbance extending to the northeast in the direction of an area of high pressure which was then north of Minnesota. This high area moved southeasterly over the Lake region, and, after retarding the movements of low-area vii, caused it to disappear in the Missouri Valley by a gradual increase of pressure. When this disturbance was central in western Colorado on the afternoon of the 10th the barometer at the centre was below 29.4; the gradient was rapid to the northeast and southeast and very high winds were reported from Texas northward to Nebraska, giving indications of the approach of a storm of considerable energy, but the succeeding reports show that it did not materially change the weather conditions east of the Mississippi.

The following notes from observers relate to weather conditions prevailing during the presence of low areas vi and vii:

North Platte, Nebr.: on the 8th brisk to high south and southeast winds pre-

vailed, attaining at 3.40 p. m. a velocity of forty miles per hour. The weather was warm and oppressive, and, owing to the dry state of the soil, dense clouds of sand and dust filled the air. During the 9th and 10th the wind continued, blowing a gale from the south and southeast, reaching a maximum velocity of fifty-two miles per hour on the 9th and forty on the 10th. On the night of the 10-11th the gale was accompanied by a heavy thunder-storm, and the wind attained a velocity of fifty miles per hour, blowing down chimneys, wind mills, telegraph poles, etc.

Yankton, Dak.: on the 8th clear weather and high temperature prevailed, with high southerly winds, which attained a velocity of forty-three miles per hour. On the 9th the southerly wind reached a maximum velocity of forty-six miles per hour, and was accompanied by clouds of dust.

Moorhead, Minn.: on the 7th a southeasterly gale set in at 8.30 a. m. and continued throughout the day, and until 4.15 p. m. of the 8th, maximum velocity forty-six miles per hour. Shortly after noon of the 9th the wind again became high, blowing from the south with a maximum velocity of forty-six miles per hour; the gale ended at 7 p. m. During the afternoon, while the gale was at its height, a thunder-storm, with heavy rain, began; several houses were struck by lightning. A number of chimneys and roofs were blown off by the gale.

Marquette, Mich.: during the night of the 8-9th the wind blew hard from the southwest, reaching at 4.26 a. m. a velocity of thirty-seven miles per hour; at 7.37 a. m. of the 9th the wind changed to west and attained a maximum velocity of thirty-two miles. Warm weather prevailed, highest temperature, 82° 0. On the 10th also the wind blew hard from the west.

VIII.—This depression developed in western Texas, where it was first located on the morning of the 12th. It first moved directly northward to Colorado, where it was located on the morning of the 13th, and thence to southeastern Dakota, which point it reached on the morning of the 14th, and where the course changed to the eastward, passing over Iowa and northern Illinois during the 14th, causing general rains near the centre of disturbance throughout its entire course. The rains extended southward over Missouri and Arkansas, and over the states north of the Ohio River. The centre of disturbance passed eastward of Lake Huron during the 15th, and the rain extended eastward to the Atlantic coast. After reaching the Saint Lawrence Valley near Montreal a secondary disturbance developed on the middle Atlantic coast and moved northeastward along the coast parallel to the coast line, developing considerable energy off the New England coast during the 16th. After the formation of this secondary depression the primary area in the Saint Lawrence Valley immediately disappeared.

IX.—This disturbance also developed in the Southwest, and was probably central in New Mexico on the afternoon of the 16th. It moved eastward over Texas and Arkansas to the central Mississippi valley on the 17th, causing general rains in the region of drought in northern Texas. The rains extended eastward over the Southern States and Ohio Valley during the 18th, and snows were reported from New England westward to northern Indiana. This disturbance apparently reached its maximum energy while passing over Kentucky and West Virginia. On the morning of the 18th, when the centre of disturbance was near Louisville, Ky., the barometer fell to 29.31, and on the afternoon of the 18th the barometer fell to 29.27 at Pittsburg, Pa. The rains were very heavy in Tennessee and the Ohio Valley, and destructive local storms occurred in West Virginia and adjoining states during the 17th and 18th. The centre of disturbance apparently moved over Virginia, and after reaching the Atlantic coast near Norfolk, Va., it passed rapidly to the northeast, causing severe northeasterly gales along the middle Atlantic and New England coasts during the 18th and 19th.

The following, selected from a number of similar notes, will serve to show the character of this storm:

Sandusky, Ohio: brisk variable winds and cloudy weather prevailed on the 17th. On the 18th hail began falling at 2.30 a. m.; at 7.30 the precipitation changed to heavy snow which fell all day, accompanied by high winds from the east in the morning, backing to northerly in the afternoon. The snow and gale ended at 5.45 p. m. The storm did considerable damage to wharves, and several washouts on the railroads along the bay and lake were reported.

Toledo, Ohio: a heavy northeasterly wind set in at 1.55 a. m. of the 18th, barometer falling very rapidly. At 3.16 a. m. the wind reached a velocity of twenty-seven miles per hour; at 5 a. m. thirty-six miles, at which rate it continued until 7.30 a. m., when, increasing, it reached its maximum velocity, fifty-two miles per hour, at 8.25 a. m. The wind continued high until 5.58 p. m. Snow fell during the greater part of the day. Several fences and signs were blown down, and a yacht was broken from her anchorage and capsized.

Nashville, Tenn.: on the 18th the pressure fell until 5.40 a. m. when it

stood at 29.40; at 6.40 a. m. the pressure began rising rapidly. Heavy rain fell during the greater part of the day, with brisk wind veering from south to southwest, and at 5.35 a. m. to west; maximum velocity twenty-seven miles per hour. At Chattanooga the storm was more severe; in the early morning a thunder-storm and destructive tornado occurred, damaging property to the extent of \$6,000. High southwest and westerly winds continued until 8 p. m.

Knoxville, Tenn.: a heavy rain storm, with thunder and lightning and high southwesterly winds, set in during the early morning of the 18th and continued until 7.15 a. m.; maximum velocity of the wind thirty-six miles per hour.

X.—This area of low pressure was central in the eastern portion of Washington Territory on the morning of the 20th. It moved first directly eastward, crossing the Rocky Mountain range in Montana, and afterwards to the southeastward. After the midnight report of the 20th the area of low pressure became extended, and a secondary formation was observed in southwestern Kansas on the afternoon of the 21st while the original disturbance was central in southwestern Dakota. The area of low pressure to the southward developed great energy, and moved northeastward over the upper lake region during the 22d and 23d, while the area to the northward disappeared by an increase of pressure. Destructive tornadoes occurred in Missouri, Kansas, and Arkansas on the night of the 21st, in the southeast quadrant of this storm. The rain-area extended over the greater portion of the United States east of the Rocky Mountains, the heaviest rains occurring in Tennessee, the lower Ohio valley, and in southern Missouri. The barometer fell at the centre of this disturbance as the area moved eastward over the upper lake region, and the minimum pressure, 29.07, was observed at Mackinaw City, Mich., on the morning of the 23d, when the centre was near that station. It disappeared over the Saint Lawrence Valley on the 23d, followed by cold and freezing weather in the Northwest.

The following notes from observers are of interest:

Chattanooga, Tenn.: a thunder-storm, with heavy and light rain and low pressure, prevailed from 8.20 p. m. of the 21st until the early morning of the 23d. On the 22d the rainfall was heavy. At 6 p. m. the wind veered from south to northwest; at 6.45, from northwest to east; at 8.15, from east to south; and at 9 p. m., from south to southwest.

La Crosse, Wis.: the barometer fell rapidly during the night of the 21st-22d; weather threatening, wind shifting to east, and becoming fresh. During the afternoon a heavy thunder-storm, with high northerly wind, occurred. The gale continued until 10.15 a. m. of the 23d; maximum velocity, forty miles per hour. Snow fell during the night of the 22-23d.

Mackinaw City, Mich.: on the 22d the barometer fell rapidly, temperature stationary, light rain from 10 a. m. until 7.30 p. m., when it began falling heavily. At 11 a. m. an easterly gale set in and continued throughout the day, maximum velocity, forty-four miles, at 6.15 p. m. Dense fog prevailed from 9 p. m. until midnight. Snow fell during the greater part of the 23d. At 9 a. m. the wind shifted to southwest, afterward to northwest, and blew a gale, attaining at 3 p. m. a velocity of thirty-four miles per hour.

XI.—The centre of this disturbance is approximately located in the Gulf of Mexico, to the south of New Orleans, La., on the night of the 24th. It was a disturbance of slight energy and not clearly defined, except as an area of rain, until it reached the middle Atlantic coast at midnight of the 25th, when northerly gales were reported from Chincoteague, Va. It passed rapidly along the middle Atlantic and New England coasts and Nova Scotia during the 25th, causing severe gales, and apparently increasing in energy until it passed northeast of the Maritime Provinces.

XII.—This storm was central far to the north of Montana on the afternoon of the 26th, and it probably developed to the west of the Rocky Mountains. On the morning of the 28th it was central north of Dakota, the barometer being below 29.30 at Q'Appelle, Northwest Territory, near the centre of disturbance. The southeasterly movement of this depression continued until the centre reached Lake Erie on the afternoon of the 28th. General rains prevailed east of the Mississippi as far south as the Gulf States on the 28th. After reaching Lake Erie the course changed to the eastward and the disturbance passed over New York and New England, the storm apparently reaching its maximum energy on the New England coast during the night of the 29th. A marked feature in the movement of this depression was the sudden change of direction to the northward after reaching the New England coast. At the close of the month this disturbance was apparently

central in the northern portion of New England, but the barometric pressure at the centre had increased from 29.11 to 29.44 within twenty-four hours.

The following notes, as to this storm, are of interest:

Columbus, Ohio: on the 28th heavy rain fell from 3 to 9 a. m., with thunder-storm from 5 to 6.10 a. m. At 11.55 a. m. a westerly gale set in, it suddenly increased in velocity at 1.25 p. m. and blew at the rate of forty-six miles per hour; the rainfall was very heavy. The gale continued, with occasional gusts of high velocity, until 7 p. m. Property in the city was damaged to the extent of \$2,000. At Cincinnati the wind blew from the northwest at the rate of forty-eight miles per hour, and was accompanied by heavy rain. The rainfall was heavy at Louisville, Ky.; highest velocity of wind forty miles.

Pittsburg, Pa.: on the 28th rain fell from 7.50 a. m. until 6.30 p. m., and heavily from 10.30 to 11.30 p. m. For a few minutes after 11 p. m. hail fell. Brisk southwesterly winds prevailed, reaching a velocity of thirty miles per hour at 11.15 p. m. The pressure at 3 p. m. stood at 29.27, this was the lowest reading since January 9, 1886. The total rainfall of the twenty-four hours ending 7 a. m. of the 29th was 2.56 inches.

Lynchburg, Va.: on the 28th the barometer fell rapidly until 3 p. m. when it stood at 29.40; southerly shifting to brisk northwest winds. Between 3 and 4 p. m. a thunder-storm moving from west to east, and accompanied for a few minutes by hail, occurred. During the afternoon the wind attained for a few minutes the velocity of thirty-six miles per hour. In Amherst county the storm exhibited unusual violence and the rain was heavy. Near Riverville a

tobacco house was blown down and one person killed. Reports from a number of places in the state show that the storm was widespread and severe.

Variety Mills, Nelson Co., Va.: the storm accompanying the depression of the 28th was very destructive in this vicinity. At 3 p. m. a heavy mass of clouds approached from the northwest and rain began falling heavily, accompanied between 3.30 and 4 p. m. by hail. Shortly after the rain began falling a gale set in, unroofing several buildings and prostrating trees.

Hatteras, N. C.: on the morning of the 28th high west and southwest winds prevailed. During the afternoon a heavy thunder-storm with high wind occurred, maximum velocity forty-nine miles per hour. The wind continued high on the 29th; maximum velocity, forty miles per hour, from the west.

XIII.—The complete history of this storm will be found in the REVIEW for the succeeding month. It was central north of Montana on the 29th and passed almost directly southward to northern Nebraska, where it was central at the close of the month, the general form of the depression being elliptical and extending from Colorado to northern Minnesota, and the lowest isobar being 29.3. The barometric gradient was greatest to the westward, the pressure increasing quite regularly to the north Pacific coast, where it had reached 30.4, showing a barometric range of 1.23 inches between the upper Missouri valley and eastern Oregon.

NORTH ATLANTIC STORMS DURING APRIL, 1887.

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

The paths of the depressions that have appeared over the north Atlantic Ocean during the month are determined, approximately, from international simultaneous observations furnished by captains of ocean steamships and sailing vessels; abstracts of ships' logs and other data collected by the Signal Service agencies at the ports of New York, Boston, and Philadelphia; reports received through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs furnished by the proprietors of the "New York Maritime Register," and from other miscellaneous data received at this office up to May 21, 1887.

Eleven depressions are traced over the ocean and the Canadian Maritime Provinces, the tracks largely predominating, as in March, 1887, to the southward and southeastward of Nova Scotia and Newfoundland. Four storms passed northeast from Nova Scotia; three moved eastward to the south and southeast margin of the ice region, where they remained nearly stationary as areas of low pressure during periods of from two to nine days. Two depressions appeared in European waters and apparently passed south of east over the continent; one is first charted over mid-ocean, and one moved westward north of the Azores and united with an area of low pressure off the southeast edge of the Banks of Newfoundland. But one depression is traced from American waters to the European coast.

The general character of the weather over the north Atlantic Ocean was unusually severe during a greater portion of the first two decades of the month. From the 1st to the 5th, inclusive, gales of hurricane force were encountered off the coast of the United States. From the 12th to the 16th, inclusive, gales of exceptional violence prevailed over, and to the eastward of, the Banks of Newfoundland. During the last decade of the month the weather conditions in the trans-Atlantic routes were more settled, although strong gales were experienced over the western portion of the ocean from the 26th to the 29th. The depressions attained greatest force west of the thirty-fifth meridian, which fact may be attributed to the high temperatures reported in the waters of the Gulf Stream in the vicinity, and somewhat to the northward of, the thirty-fifth parallel, whereby the storms which passed over its surface acquired material for the development of great energy. Barometric pressure was high over, and to the eastward of, the Banks of Newfoundland until the 3d, when a depression advancing from the southwest caused a decided fall in the barometer over the Banks and Maritime Provinces. On the 4th a rapid decrease in pressure over the ocean northwest of the

British Isles indicated the presence of a storm-area which apparently passed eastward over Scotland into the North Sea by the 5th. The barometric pressure over mid-ocean fluctuated until the 12th, after which it continued generally low until the 26th, attending the presence to the westward of areas of low pressure. During the last four days of the month the barometer was high over mid-ocean and slowly rising in the vicinity of the British Isles.

For April, 1886, thirteen depressions were traced, of which, one was the continuation of an area of low pressure traced on the North American continent; one was traced on the coast of Ireland; one originated northeast of the Bahamas; one appeared in the Gulf of Saint Lawrence; one developed near Charleston, S. C., and the remaining depressions first appeared over the ocean east of the fiftieth meridian, between the thirty-seventh and fiftieth parallels. The direction of movement of the depressions was greatly diversified, and their positions extended from N. 37° to 55°, and from W. 50° to the European coast. An additional noteworthy characteristic of the storms of that month was their exceeding slow rate of progression.

As compared with the corresponding month of previous years, the number of depressions which appeared during April, 1887, was somewhat less than the average for the month, while their direction of movement and position did not differ materially. A noticeable and unusual feature was the continuation, during a greater portion of the month, of severe disturbances to the eastward and southward of the Banks of Newfoundland.

The following are brief descriptions of the depressions traced:

1.—This depression was central in about N. 38°, W. 13° on the 1st, with central pressure ranging below 29.60 (751.8), whence it apparently moved eastward to the Mediterranean Sea.

2.—This depression was a continuation of land-area number xi traced for March, 1887, which passed off the coast of the United States in about N. 35° during the evening of March 31st. On the morning of April 1st the storm was central in N. 37°, W. 72°, with fresh to strong gales over a limited area. By the 2d the centre of depression had advanced northeast to N. 40°, W. 69°, with central pressure about 29.30 (744.2) and an appreciable increase in energy. By the 3d the storm-centre had passed northeast to the south coast of Nova Scotia, accompanied by gales of great violence and very low barometric pressure. From this position the depression moved northeastward over Newfoundland beyond the region of observation.

The following special reports refer to disturbances accompanying the passage of this depression: