

east Gulf states, from the upper Lake region westward to eastern Oregon and Washington, and from the upper Missouri valley southward to eastern Colorado and central New Mexico; elsewhere the precipitation was in excess of the January average. The greatest deficiencies occurred on the North Carolina coast, where they exceeded five inches, and on the middle coast of the Gulf of Mexico, where they exceeded four inches. The greatest excesses were noted in the middle Mississippi and lower Ohio valleys, where they exceeded five inches, and where in central Indiana they were more than seven inches; and on the Pacific coast, south of the Columbia River, where they exceeded four inches, and where, at Los Angeles, Cal., they amounted to more than five inches. At stations in New York, Arkansas, Tennessee, Indiana, Ohio, Michigan, Minnesota, Illinois, Missouri, Indian Territory, Colorado, Utah, Washington, and southern California, the precipitation was the greatest, while at stations in Pennsylvania, Virginia, North Carolina, Georgia, Florida, Alabama, Louisiana, and North Dakota, it was the least ever reported for January. The greatest depth of snowfall reported for the month was two hundred and twenty-nine inches at Cisco, Cal.; one hundred and ninety-four inches were reported at Towle's, Cal., and one hundred and sixty-nine inches at Emigrant Gap, Cal. During the latter half of the month about one hundred and twenty miles of the Central Pacific Railroad crossing the summit of the Sierra Nevada range of mountains was blockaded by snow. This was the heaviest snow blockade ever known on the Central Pacific Railroad. In the northern counties of Nevada the excessive snowfall entailed great loss to the cattle-

men, and it is estimated that fully fifty per cent. of the live stock was lost on account of starvation and exposure.

Destructive floods occurred in the early part of the month in southern Missouri, eastern Arkansas, and northern and eastern Texas, destroying property to the value of millions of dollars, and streams in south-central and western Illinois and southern Indiana overflowed their banks, causing much damage to property and loss of live stock. About the middle of the month the smaller streams in western Pennsylvania and West Virginia overflowed their banks, doing much damage. During the latter part of the month warm rains melted a large amount of snow in the Sierra Nevada and Siskiyou mountains in northern California, causing streams to overflow, washing away railroad bridges and levees, filling cuts, flooding towns, and causing land-slides, and in the San Joaquin Valley and southern California heavy rains caused streams and canals to overflow, causing washouts, and flooding large tracks of country. Navigation was not entirely suspended on Lakes Michigan and Ontario, where the trips made by vessels were the latest on record, and the Straits of Macinac were still open to navigation on the 31st.

A remarkable feature of the month was the enormous quantity of Arctic ice encountered near Newfoundland and the Grand Banks. Ice records for the last eight years show that but small quantities of Arctic ice have been reported for January in the region referred to during that period, and that during the present winter there has been practically no interruption of the southward flow of icebergs and field ice from the region north of Newfoundland.

#### ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean atmospheric pressure for January, 1890, as determined from observations taken daily at 8 a. m. and 8 p. m. (75th meridian time), is shown on chart ii by isobars. The difference between the mean pressure for January, 1890, obtained from observations taken twice daily at the hours named and that determined from hourly observations, varied at the stations named below, as follows: At Boston, Mass., New York City, Washington City, Savannah, Ga., Buffalo, N. Y., Cincinnati, Ohio, Saint Louis, Mo., New Orleans, La., and Galveston, Tex., the mean of 8 a. m. and 8 p. m. observations was higher by .009, .010, .010, .007, .002, .005, .001, .001 and .003, respectively, and at Saint Paul, Minn., Dodge City, Kans., Denver, Colo., Santa Fé, N. Mex., Salt Lake City, Utah, and San Francisco, Cal., the mean of the observations taken at these hours was lower by .001, .006, .006, .012, .002, and .013, respectively, than the true mean pressure. At Chicago, Ill., and Memphis, Tenn., the mean pressure obtained from the 8 a. m. and 8 p. m. observations corresponded with that determined from hourly observations.

For January, 1890, the mean pressure was highest from the Atlantic coast between the twenty-eighth and thirty-fifth parallels northward to eastern Tennessee, where it rose above 30.30, the highest mean reading, 30.34, being noted at Augusta, Ga. From this region there was a decrease in mean pressure northeastward to eastern Nova Scotia, where it fell below 30.05, and northward to the northern part of the upper Lake region, where the mean values were below 30.10. An area of relatively high mean pressure occupied the middle Missouri valley, with included readings above 30.25, whence there was a gradual decrease in mean pressure westward to the area of lowest mean pressure for the month, which occupied the north Pacific coast, where, from the mouth of the Columbia River northward, the mean values fell below 29.85.

A comparison of the pressure chart for January, 1890, with that of the preceding month shows that there has been an increase in pressure over the entire country, save along the immediate west Gulf coast where the means for the current month corresponded with, or were slightly lower than, those

for December, 1889. The most marked increase in pressure occurred in the middle and upper Missouri and Saskatchewan valleys, where it amounted to more than .20 of an inch. In the current, as in the preceding month, the mean pressure was highest over the south Atlantic and the more eastern of the eastern Gulf states, and the increase in mean pressure in that region was about .05 of an inch. The lowest mean pressure, for each of the months referred to, was noted on the north Pacific coast, where the changes were slight. A notable feature in connection with the pressure changes was the appearance, for the current month, of an area of high pressure over the middle Missouri valley, with values above 30.25, where, for December, 1889, the mean readings averaged about .20 of an inch lower.

The mean pressure was generally above the normal east of the Rocky Mountains, except in the lower Rio Grande valley; it was also above the normal on the south Pacific coast and over the southern plateau region. The mean pressure was below the normal along the middle and north Pacific coasts, over the middle and northern plateau regions, and over north-western Montana and the British Possessions to the northward. The greatest departures above the normal pressure were noted in North Carolina and Georgia, where they amounted to .16 and .15 at Charlotte and Augusta, respectively, and the most marked departures below the normal pressure occurred on the north Pacific coast, where they equalled or exceeded .15 near the mouth of the Columbia River.

#### BAROMETRIC RANGES.

The monthly barometric ranges at the several Signal Service stations are shown in the table of miscellaneous meteorological data. The general rule, to which the monthly barometric ranges over the United States are found to conform, is that they increase with the latitude and decrease slightly, though somewhat irregularly, with increasing longitude. In January, 1890, the monthly ranges were greatest over the northeastern part of lower Michigan and in eastern New England, where they exceeded 1.50, whence they decreased southward to less than .20 over southern Florida, to less than .30 along the east Gulf coast, and to less than .70 on the west Gulf coast, and

westward to less than .70 in southeastern Wyoming, whence they increased to more than 1.10 on the north Pacific coast. Along the Atlantic coast the monthly ranges varied from .15 at Key West, Fla., to 1.59 at Eastport and Portland, Me., and Nantucket, Mass.; between the eighty-second and ninety-second meridians, .25 at Cedar Keys, Fla., to 1.55 at Alpena, Mich.; between the Mississippi River and the Rocky Mountains, .66 at Cheyenne, Wyo., and .67 at Galveston, Tex., to 1.38 at Moorhead and Saint Vincent, Minn.; in the Rocky Mountain and plateau regions, .44 at Fort Grant, Ariz., to 1.16 at Walla Walla, Wash.; on the Pacific coast, .49 at San Diego, Cal., to 1.17 at Fort Canby, Wash.

A notable feature of the distribution of mean pressure for the month was the unusually large range in pressure from the Atlantic to the Pacific coasts. On the north Pacific coast the mean pressure was more than .15 below the normal, and on the south Atlantic coast the mean readings were more than .15 above the normal for January, giving a range of more than .45 between the Atlantic and Pacific coasts, and a range of more than .40 between the middle Missouri valley and the Pacific coast. The greatest ranges in mean pressure previously noted for January occurred in 1886, when there was a range of more than .40 between an area of high pressure over Manitoba and an area of low pressure on the north Pacific coast, and in January, 1888, when there was a range of more than .50 between an area of high pressure over the Missouri Valley and an area of low pressure over the Gulf of Saint Lawrence, and a range of more than .30 from the Missouri Valley to the north Pacific coast.

#### AREAS OF HIGH PRESSURE.

Eight areas of high pressure were observed during the month of January within the limits of the stations of observation, seven of which first appeared in the northern Rocky Mountain region, and the eighth moved southeastward from the Hudson Bay region over northern New England. The areas first observed in the northern Rocky Mountain region moved southeastward until the centre of greatest pressure reached the central Mississippi valley, none passing to the south of the thirty-sixth parallel of latitude. In passing over the eastern half of the continent the direction of movement was generally to the eastward, with an inclination to the north of east as the centre approached the coast. All passed off the coast to the north of Cape Hatteras, except one of minor importance which covered the plateau regions and disappeared by gradual decrease of pressure. The average rate of movement was thirty-one miles per hour, while the maximum rate was fifty-four and the minimum eleven miles per hour. Generally the areas of high pressure observed during the month were of less intensity than those usually observed during January; they were also less numerous and their mean track was farther to the north than usual. The following is a general description of the more marked meteorological features attending each area of high pressure during its transit over the region of observation:

I.—The month opened with this area central far to the north of Montana, while a barometric trough extended from Lake Superior southward to Texas. The pressure continued to increase in the extreme northwest during the 1st and 2d, when the maximum, 31.12, occurred in the Saskatchewan Valley, which was the highest barometric reading observed during the month. This high area extended slowly southeastward over the upper Mississippi and Missouri valleys during the 3d and 4th, the centre of greatest pressure remaining north of the stations of observation. An area of low pressure moved eastward from the California coast over the plateau region and a second depression developed over the Lake region, and were apparently forced to the south and eastward, respectively, as this high area advanced to the south and eastward during the 5th and 6th. While the movement of the principal area was to the southeastward over the Missouri Valley, the secondary formed to the eastward north of the Lake region during the night of the 3d and passed southeastward over the Saint

Lawrence Valley and New England, disappearing to the east of the coast line during the 5th. In its movement southward this area was apparently divided, one portion covering the eastern slope of the Rocky Mountains while the other moved slowly southward, covering the plateau regions. These conditions continued until the 7th, when the more easterly area disappeared, apparently uniting with the one then central over southern Idaho, which remained almost stationary until the 10th, when it was replaced by an area of low pressure.

II.—The 8 p. m. weather chart of the 9th gave the first indication of the advance of this area from the north of the Saint Lawrence Valley. The a. m. report of the 10th indicated that the centre was passing southeastward and was near to and northwest of Father Point, Quebec. The cold northerly winds which prevailed over New England on the 10th and 11th were attended by snow, but the temperature rose rapidly as this area passed eastward during the 12th.

III.—Was central north of Montana on the 10th. It moved rapidly southward, covering the entire Rocky Mountain regions by the 12th, attended by one of the most pronounced cold waves observed during the month. It was preceded by an area of low pressure which formed over Texas and passed rapidly northeastward over the lakes, and a combination of these conditions resulted in unusual temperature gradients over the central Mississippi valley. On the afternoon of the 12th the temperature was above 60°, with rain in eastern Missouri, while it was snowing with a temperature of 12° in western Missouri. Destructive local storms occurred on Sunday, the 12th, in the central valleys, and the wind increased greatly in force when it shifted to westerly, a maximum of fifty-six miles per hour occurring at Saint Louis, Mo., 48 miles at Cairo, Ill., and 44 miles at Springfield, Ill., during the night of the 12th. On the morning of the 13th this area covered the regions from Texas northward to the Missouri Valley. It passed eastward over the central valleys on the 13th, and over the middle Atlantic states and New England on the 14th, attended by lower temperature, but the thermal changes were much less in the eastern portions of the United States than those previously referred to.

IV.—Was central north of Montana on the 14th, when an area of low pressure was moving eastward over the Rocky Mountain region. The cold air from this area moved rapidly southward over the Rocky Mountain regions and eastern slope, forcing the depression rapidly eastward over the Lake region, and causing a cold wave to extend southward to the Gulf coast, where the temperature fell to freezing on the 16th and 17th. The highest pressure remained north of Montana until the morning of the 16th, when this area covered the central valleys, the maximum pressure being 30.79 at Leavenworth, Kans. A norther occurred over Texas and extended eastward over the Southern States, although the temperature did not fall to freezing in northern Florida. It was generally below freezing in Georgia and the other south Atlantic states. The movement of this area was directly east from Missouri to the middle Atlantic coast. It covered the eastern portion of the United States on the 17th and 18th, attended by generally fair weather. The centre passed to the east of the coast line on the 17th, when the temperature rose slowly over the eastern half of the United States, attending the movement of this area to the eastward over the Atlantic.

V.—Appeared to the north of Idaho on the 16th where it remained almost stationary until the 20th, after which it passed rapidly southeastward over Montana to eastern Nebraska, where it was central on the morning of the 21st, causing a cold wave generally over the states of the Mississippi and Missouri valleys. The fall in temperature was most marked and sudden from Missouri southward to Texas and northern Louisiana. The centre of greatest pressure passed from eastern Nebraska to northern Indiana from the 21st to the 22d, the area being extended and covering the entire country east of the Rocky Mountains. On the morning of the 23d it had reached the middle Atlantic coast, but the pressure was

decreasing rapidly, owing to the advance of a storm from the upper lake region.

VI.—When the preceding area covered the eastern portion of the United States, number vi was advancing from the region north of North Dakota, and a slight area of low pressure was over eastern Dakota, separating the two areas of high pressure. The atmospheric movement was unusually rapid during the 23d. The low pressure above referred to moved eastward over the lakes and developed considerable energy, while the high area moved rapidly southward, covering the central valleys and extending southward to the Gulf coast by the afternoon of the 23d. Although the movement was rapid and the area well defined, it was not attended by unusual changes in temperature. After reaching the lower Missouri valley it moved eastward, following the general course of those previously described, reaching the lower Ohio valley on the 24th and eastern North Carolina on the 25th. It disappeared apparently by a gradual decrease of pressure, as the easterly movement apparently ceased when the centre reached the Atlantic coast.

VII.—Although the pressure was relatively high over the central plateau and Rocky Mountain regions on the 26th, reports indicate that this area developed to the north of Manitoba previous to the 27th, during which date it passed over Minnesota and thence eastward over the upper lake region, extending southward to the Gulf and south Atlantic states. It was attended by generally fair weather, but produced no marked changes in temperature. As it approached the south Atlantic states strong northeasterly gales occurred from Hatteras, N. C., southwestward over Florida, while northerly gales occurred on the Atlantic coast north of Hatteras.

VIII.—This area probably developed on the Pacific coast north of the stations of observation. At 8 p. m. on the 29th a well-marked area of low pressure covered Montana, with heavy snows to the north of that state and general rains on the Pacific coast. The telegraphic reports of the 30th indicated a rapid increase in barometric pressure at northern Rocky Mountain stations, and on the following day this area had moved southeastward, covering the northwestern states at the close of the month.

#### AREAS OF LOW PRESSURE.

Twelve areas of low pressure appeared within the field of observation during the month of January. The average rate of movement of these areas was unusually rapid, being forty miles per hour, while the maximum was fifty-four and the minimum twenty-two miles per hour. The general direction of movement was easterly while passing over the eastern half of the continent, those appearing in the higher latitudes moving more directly to the east than those farther to the southward. The direction of movement on the Pacific coast was also to the eastward, but in passing over the Rocky Mountain range there was an apparent tendency to change direction to the southward, this southern movement being usually attended by areas of high pressure to the north or northeast of the depression. The mean track of these areas was to the north of those usually observed in January, no area of low pressure having been traced south of the forty-second parallel and east of the Mississippi, while only one appeared on the eastern slope of the Rocky Mountains south of Kansas.

The following is a general description of the weather conditions attending these depressions:

I.—At the opening of the month this disturbance was apparently forming in the northern portion of a barometric trough which extended from Lake Superior southwestward to the Rio Grande Valley, while a second depression covered the central Rocky Mountain region. An area of high pressure and a cold wave to the north of Montana moved rapidly southward, causing this disturbance to increase in energy, and move rapidly to the eastward, and at the same time forcing the depression which was over the Rocky Mountain region to the westward. In moving eastward over the Lake region during the 2d, this de-

pression was attended by heavy rains in the Ohio and lower Mississippi valleys and general rains throughout the eastern half of the country. The pressure decreased at the centre of disturbance during the easterly movement, the lowest observed barometric reading, 29.46, occurring at Anticosti, Gulf of Saint Lawrence, on the night of the 2d, where the barometer fell .64 of an inch in twelve hours. This storm was attended by high westerly winds in the Lake region, and strong southwesterly gales in the lower Saint Lawrence valley and in northeastern New England and off the New England coast.

II.—This disturbance developed in the north Pacific and was observed off the north Pacific coast during the 2d, although the location of the centre is not fixed until the afternoon of the 3d, when it was near the north California coast. There was an apparent southerly movement during the 2d and 3d, probably due to the presence of the extended area of high pressure which existed to the northeastward. On the 4th it passed over the central plateau region as an extended depression, but after reaching Colorado on the 5th it was forced southward over New Mexico, where it was quickly replaced by the advance of an area of high pressure from the northward.

III.—The 8 a. m. report of the 5th indicates that this disturbance had its origin near to and north of the upper lake region. It developed quickly in advance of a cold wave, and moved eastward to the Maritime Provinces at an average velocity of forty-four miles per hour. The rapid easterly movement of this depression was attended by a rapid decrease in pressure at the centre, the fall in the barometer at Chatham, N. B., in twelve hours during the 6th being .66 of an inch. It passed eastward over the Atlantic during the 7th, followed by northwesterly gales, the velocity at Anticosti, Gulf of Saint Lawrence, on the morning of the 7th, being fifty-two miles from the west. It was also followed by a cold wave in the Saint Lawrence Valley and northern New England on the same date.

IV.—This disturbance existed to the north of North Dakota on the 7th. Its movement eastward could be readily traced from telegraphic reports, but the location of its centre could only be approximately given, owing to the high latitude over which it passed. It was the most northerly disturbance traced during the month over the centre of the continent, but its course was to the south of east, which carried its centre over the Saint Lawrence Valley in the vicinity of Quebec where it was located on the afternoon of the 8th, on which date its influence was felt as far southward as the thirty-fifth parallel. Strong westerly gales occurred on the middle Atlantic and New England coasts and in the Lake region during the 8th and 9th. The weather cleared quickly over the Northern States as it passed eastward, and while the area of precipitation was large the amount was very slight. On the morning of the 9th the centre of disturbance was near Halifax, N. S., where the barometer was reported 29.12. The same reading was observed at Sydney, O. B. I., attended by easterly winds. This was apparently the most severe storm of the month off the New England coast, the wind reaching a maximum velocity of forty-six miles at Eastport, Me., and sixty-eight miles at Block Island, R. I.

V.—Was first observed far to the north of Montana on the 8th. It moved slowly southeastward, developing but slight energy, and becoming greatly extended in an east and west direction. On the morning of the 10th a barometric trough extended from Lake Michigan westward to Idaho, the barometer being lowest in northern Colorado. The 8 p. m. report of the 10th showed a well-defined area of low pressure covering Colorado, bounded by the line of 29.60, while the isobar of 29.70 also inclosed it, but extended to the eastward over Iowa and Missouri, the barometric gradient being very slight in the eastern portion of the disturbance, while it was much more marked to the north and northwest. The 8 a. m. report of the 11th exhibited a marked contrast between the meteorological conditions then existing and those reported eight hours previous. The centre of lowest pressure had been transferred from eastern Colorado to southern Wisconsin, where

the pressure had decreased .44 of an inch in twelve hours. While the track of number v, exhibited on chart i, indicates that this disturbance passed from eastern Colorado to the upper lake region in twelve hours, the reports from stations in the lower Missouri valley indicate that possibly a new development occurred during the night in this section and was forced to the northeastward, while the original disturbance moved southwestward and then southward over the Rio Grande Valley, finally resulting in conditions which favored the development of the storm which followed. This storm attained its maximum energy during the first twelve hours of its existence, and after reaching the Lake region it moved eastward, becoming greatly extended, and the pressure increasing rapidly at the centre. It passed over New England as a feeble disturbance during the night of the 11th, apparently becoming less clearly defined as it advanced eastward.

**VI.**—The barometer was low over the Rio Grande Valley on the 11th, while an extended body of cold air covered the northern and central Rocky Mountain slopes. This cold air moved southward to northern Texas by the morning of the 12th, while warm southerly winds prevailed over the states of the Mississippi Valley as far north as Missouri. On the morning of the 12th this disturbance was central in the eastern portion of Indian Territory, where the temperature was 68°, while in northern Texas it had fallen to 18°. During the following twelve hours it moved northward to the southern portion of Lake Michigan, where the barometer fell from 30.02 to 29.28, with a temperature above 60° from the Lake region southward to the Gulf, and below 20° over the eastern Rocky Mountain slope from Minnesota and the Dakotas southward to Indian Territory. This storm continued its northeasterly movement during the succeeding twenty-four hours, the pressure decreasing at the centre, but the inclosed area became more extended after passing the Lake region. It was attended by destructive local storms in the states of the central Mississippi and Ohio valleys, a dry norther in Texas, and gales in the Lake region and along the Atlantic coast. The minimum barometric pressure, 28.94, observed during its transit occurred at Anticosti, Gulf of Saint Lawrence, on the afternoon of the 13th.

**VII.**—This disturbance formed over the central plateau region during the 13th, replacing the area of high pressure which was central over that region during the night of the 12th. It first moved slowly southeastward, extending over the southern and central Rocky Mountain regions, and then rapidly eastward, covering the Mississippi Valley during the night of the 14th. The area of precipitation accompanying this disturbance included the entire country east of the Rocky Mountains. The principal area of low pressure moved eastward over the Lake region, while a secondary formed in the southern portion of the barometric trough, which, after passing eastward to the Mississippi Valley, was rapidly replaced by the area of high pressure which followed. After passing the lower lake region the barometer fell rapidly as the centre passed over New England and thence northeastward, the storm apparently reaching its maximum intensity during the night of the 16th, when central over Nova Scotia. Severe gales occurred on the Atlantic coast north of Hatteras, N. C., the winds reaching their maximum velocity after shifting to westerly. This disturbance passed to the east of Nova Scotia during the 17th, causing severe gales on the north Atlantic.

**VIII and IX.**—Was a slight disturbance which probably originated on the Pacific coast, or formed as a secondary over the plateau region during the 17th, following a severe storm which extended over the north Pacific coast during the two preceding days. After passing eastward to the central Rocky Mountain region during the 18th, it was apparently forced to the southward by an area of high pressure, and although the principal disturbance could not be traced after the 19th, the disturbance traced as number ix formed in the lower Missouri valley in the northeast portion of the barometric trough which attended this disturbance. The rapid southerly movement of cold air over the eastern slope of the Rocky Mountains

apparently separated the secondary from the principal area of low pressure, and while the secondary moved northeastward with increasing energy, the former was replaced by an area of high pressure. The low area traced as number ix moved first to the northeastward over the upper lake region, apparently reaching its maximum energy while central north of Lake Huron, where the barometer fell from 29.92 to 29.36 during the night of the 20th. It passed rapidly eastward from this region, reaching northeast New England by 8 p. m. of the 20th, and it apparently increased in energy while passing over Nova Scotia. The a. m. report of the 21st indicated the lowest barometric reading observed during the transit of this storm, while the centre was to the east of, and near, Sydney, C. B. I.

**X.**—Formed over the central Rocky Mountain region on the 22d, the barometric pressure being at that time low on the north Pacific coast. It passed northeastward to Lake Superior on the 22d, where the direction of movement changed to the south of east, the disturbance passing over the Saint Lawrence Valley and New England on the 23d, after which it disappeared quickly to the eastward without causing any marked disturbance within the region of observation, although the winds attained a maximum velocity of forty-six miles on Lake Erie when the centre was near Toronto, Ont., and light snows occurred throughout the Lake region and in New England and New York.

**XI.**—This disturbance originated on the north Pacific coast, where the pressure was decidedly below the normal from the 21st to the 23d, attended by heavy rains from central California northward, and severe southerly gales on the north Pacific coast. The disturbance remained almost stationary until the 23d, after which it passed eastward to the Rocky Mountains and then southward to southeastern Montana, becoming greatly extended while passing over the eastern slope of the Rocky Mountains. On the morning of the 26th two centres of disturbance were observed, one over the upper Mississippi valley and the other over Colorado. The 8 p. m. report of the same date indicated that the disturbance over the upper Mississippi valley had passed eastward to the lower lake region as a feeble disturbance, attended by light rains, while that over Colorado had been replaced by an area of high pressure. This storm moved southeastward from the lower lake region to the southern New England coast, and probably this direction of movement continued beyond the coast line. It was followed by moderate gales from the north at stations on the coast from Hatteras, N. C., to Block Island, R. I., on the night of the 27th.

**XII.**—This storm also had its origin on the north Pacific coast, where it was central on the morning of the 29th. Heavy gales occurred on this coast during the preceding day, and the disturbance probably originated over the north Pacific. It passed rapidly eastward, and in twenty-four hours the centre had reached northern North Dakota. The easterly course continued during the 30th, and by the morning of the 31st it was central north of Lake Huron as a well-defined area of low pressure, including in its limits the northern states east of the Mississippi. General rains occurred in the lower lake region, New York, and New England, but the amount of precipitation was slight, and the northeasterly course of the storm carried it beyond the limits of the United States, causing the weather to clear rapidly over the rain-area previously named.

In the following consolidated table, showing the principal characteristics of the areas of high and low pressure which appeared over the United States and Canada during January, 1890, the dates upon which the respective areas of high and low pressure were first observed are given, together with the location of their centres when first and last observed, their duration, in days, and the maximum velocity of the wind during their passage. The second part of the table shows the maximum abnormal changes in pressure in twelve hours noted during the passage of each area of high or low pressure, together with the maximum abnormal changes in temperature, and the maximum velocity of the wind resulting therefrom. The pub-

lication in succeeding numbers of the MONTHLY WEATHER REVIEW of tables giving similar data will furnish valuable material for determining the normal movement, rate of progress, intensity, and duration of areas of high and low pressure, and a study of the record of abnormal pressure changes in connection with the abnormal temperature changes and maximum

wind-velocities will be of great value in the current work of this office in calculating the changes in temperature and the maximum wind-velocity which will probably attend the eastern movement of areas of high and low pressure which appear over the western part of the country, and which are first located by the telegraphic reports of this Service.

TABLE I.

Barometer.	First observed.			Last observed.			Duration.	Velocity per hour.	Maximum abnormal changes in pressure in twelve hours, with maximum abnormal changes in temperature and maximum wind velocities in connection therewith.									
	Date.	Lat. N.	Long. W.	Lat. N.	Long. W.	Rise.			Station.	Date.	Fall.	Station.	Date.	Miles per hour.	Direction.	Station.	Date.	
High areas.	0	0	0	0	0	Days.	Miles.	Inch.										
I.....	1	55	118	38	99	6.0	11	.46	Quebec, Quebec.....	7	44	Kansas City, Mo.....	5	30	nw.	Omaha, Nebr.....	5	
Ia.....	1	50	79	49	70	1.0	38	.62	Father Point, Quebec....	3	29	Keokuk, Iowa.....	2	46	nw.	Anticosti Island, G. of S. L.	4	
Ib.....	1	52	112	49	117	4.5	108	.34	Salt Lake City, Utah.....	7	24	Winnemucca, Nev.....	5	46	sw.	Ft. Assiniboine, Mont..	10	
II.....	10	53	74	43	60	1.5	30	.52	Anticosti Island, G. of S. L.	10	37	Quebec, Quebec.....	9	40	ne.	Block Island, R. I.....	10	
III.....	10	55	112	43	63	4.5	41	1.10	Alpena, Mich.....	13	36	Indianapolis, Ind.....	13	48	nw.	Fort McKinney, Wyo.....	11	
IV.....	14	54	112	41	63	4.0	24	.88	Yarmouth, N. S.....	17	29	Keokuk, Iowa.....	15	36	nw.	Sandy Hook, N. J.....	17	
V.....	16	56	117	37	77	7.0	17	.78	Parry Sound, Ont.....	20	44	Rockliffe, Ont.....	16	56	nw.	do.....	22	
VI.....	22	55	107	35	77	2.5	41	.44	Saint Paul, Minn.....	23	26	Palestine, Tex.....	20	58	nw.	do.....	24	
VII.....	27	53	100	36	76	2.0	40	.62	Cheyenne, Wyo.....	26	20	Dubuque, Iowa.....	23	44	n.	Hatteras, N. C.....	28	
VIII.....	30	54	121	48	97	1.0	54	.66	Sault de Ste. Marie, Mich.	31	43	Moorhead, Minn.....	27	44	nw.	Atlantic City, N. J.....	27	
Mean.....	54	105	40	80	3.4	31		.64		33			47					
Low areas.								Fall.		Rise.								
I.....	1	47	93	49	55	2.0	42	.48	Chatham, N. B.....	1	36	Chatham, N. B.....	1	48	sw.	Sydney, C. B. I.....	2	
II.....	3	40	125	33	105	3.0	22	.26	Cheyenne, Wyo.....	4	17	Cheyenne, Wyo.....	3	48	sw.	Fort Canby, Wash.....	3	
III.....	5	48	83	48	55	1.5	44	.66	Chatham, N. B.....	6	16	Toledo, Ohio.....	5	52	w.	Anticosti Island, G. of S. L.	7	
IV.....	7	55	106	45	62	2.0	47	.54	Winnipeg, Man.....	7	30	Helena, Mont.....	7	68	nw.	Block Island, R. I.....	9	
V.....	8	54	115	43	67	4.0	36	.58	Quebec, Quebec.....	8	8	Quebec, Quebec.....	8	8	w.	Buffalo, N. Y.....	8	
VI.....	11	30	100	52	66	2.0	54	1.18	Moorhead, Minn.....	9	28	Rochester, N. Y.....	11	56	w.	Cheyenne, Wyo.....	9	
VII.....	13	40	111	46	62	3.5	30	.68	Halifax, N. S.....	13	37	Montreal, Quebec.....	13	84	w.	Buffalo, N. Y.....	13	
VIII.....	18	41	116	39	104	1.0	30	.18	Yarmouth, N. S.....	15	16	Nashville, Tenn.....	15	54	nw.	Sandy Hook, N. J.....	16	
IX.....	19	40	94	47	57	2.0	45	.64	Cheyenne, Wyo.....	19	15	Fort Elliott, Tex.....	19	42	w.	Pueblo, Col.....	19	
X.....	22	43	106	43	67	2.0	52	.52	Halifax, N. S.....	20	20	Portland, Me.....	20	64	w.	Buffalo, N. Y.....	20	
XI.....	23	50	125	40	71	3.5	37	1.00	Albany, N. Y.....	23	28	Fort Sully, S. Dak.....	22	46	sw.	do.....	23	
XII.....	29	48	125	50	71	2.5	46	.58	Marquette, Mich.....	23	28	La Crosse, Wis.....	24	60	w.	Cheyenne, Wyo.....	25	
Mean.....	45	108	45	70	2.7	40		.61	Calgary, N. W. T.....	24	31	Medicine Hat, N. W. T.....	29	64	sw.	Fort McKinney, Wyo.....	25	
									Father Point, Quebec....	31	44		29	64	s.	Fort Canby, Wash.....	29	
										26			57					

**NORTH ATLANTIC STORMS FOR JANUARY, 1890 (pressure in inches and millimetres; wind-force by Beaufort scale).**

The paths of the depressions that appeared over the north Atlantic Ocean during January, 1890, are shown on chart i. These paths have been determined from international simultaneous observations by captains of ocean steamships and sailing vessels received through the co-operation of the Hydrographic Office, Navy Department, and the "New York Herald Weather Service."

Twelve depressions have been traced for January, 1890, the average number traced for the corresponding month of the last seven years being 9.7. The greatest number of depressions previously traced for January was twelve, in 1884 and 1887, and the least number was seven, in 1886. Of the depressions traced for the current month six advanced eastward over Newfoundland, three passed eastward between Newfoundland and the forty-second parallel, and three first appeared over the ocean. Of the nine depressions that moved eastward from the American continent, four were traced to the British Isles, as were also two of the storms which first appeared over the ocean. The depressions generally pursued a uniform east-northeast course, and, while the tracks were more southerly than during the preceding fall and winter months, no storms were located south of the fortieth parallel. Over the western part of the ocean the severest storms occurred on the 3d, 7th, 9th, 10th, 17th, and 28th, when the pressure fell to, or below, 29.00 (737), and the wind attained hurricane force; on the 14th, 21st to 23d, 25th, and 26th, heavy gales were reported in that region. At Saint John's, N. F., the gale of the 7th was accompanied by snow and rain; that of the 10th by a heavy snow storm; that

of the 17th by snow, sleet, and rain; and on the 21st a blinding snow storm prevailed all day. Over mid-ocean severe storms prevailed throughout the entire month, the 4th, 5th, 15th to 18th, 22d to 24th, 28th, and 29th being dates for which pressure falling to, or below, 29.00 (737) and gales of hurricane force were noted; on the 24th pressure below 28.30 (719) was indicated, and an extreme reading of 28.08 (713) was reported. Stormy weather prevailed over and near the British Isles on the 3d to 6th, 9th, and 14th to 27th; on the 5th a heavy gale prevailed over Great Britain and Ireland, causing many wrecks and much damage; from the 18th to 26th the barometer continued very low over the British Isles, falling to 28.97 (736) at Leith, Scotland, on the 19th, on which latter date a terrific storm raged over Ireland and the more northern and western parts of Great Britain and caused much damage to property and shipping.

The movements of areas of high pressure over the north Atlantic Ocean during the month were as follows: On the 1st the pressure was highest over Nova Scotia, and an area of high pressure extended thence to the West Indies and the Azores. By the 2d the area of high pressure had settled southward and was central off the south Atlantic coast, where it remained until the 3d, and by the 4th the pressure was highest over the middle Atlantic states and the area of high pressure over the ocean had apparently contracted to the westward of the fiftieth meridian. By the 6th this area had moved to the vicinity of Bermuda, whence it apparently moved eastward. On the 10th an area of high pressure was central over the lower Saint Law-