

5°, at Dolly Varden Mines, Colo., and 8° at Alma and Breckenridge, Colo. At one or more stations in Minnesota, Colorado, Arizona, Washington Territory, Louisiana, and Maine, respectively, the maximum temperature was as high or higher than previously noted for September, while at one or more stations in Florida, Texas, Illinois, Iowa, Kansas, Montana, Indian Territory, Arizona, Utah, Idaho, Oregon, and Washington Territory, respectively, the minimum temperature fell as low or lower than reported for September of preceding years. Damaging frost was reported in Nebraska on the 2d; in Minnesota on the 6th, in Wisconsin on the 16th, in Iowa on the 17th, in Iowa, Michigan, and Wisconsin on the 18th; in Iowa and Wisconsin on the 19th, in Michigan and Ohio on the 22d, in New York on the 23d, in Kansas on the 24th, in Michigan, Nebraska, and Iowa on the 27th; and light frost was reported as far south as the Carolinas, northern Georgia, northern Alabama, central Texas, southern New Mexico, east-central Arizona, central Nevada, and northern California. Killing frost was seasonable in the districts where it occurred.

The heaviest rainfall reported for September, 1889, was 16.71 inches, at Lehigh, Ind. Ter., and the rainfall exceeded ten inches in southern Florida, north-central and eastern Texas, southeastern Kansas, central Kentucky, central New Jersey, southeastern Pennsylvania, and central Virginia. In western Arizona, a greater part of California, in west-central Kansas, east-central Minnesota, western Nebraska, western Nevada, south-central Oregon, and northwestern Utah, no rain fell. The rainfall was generally below the average for the month in the Rocky Mountain and plateau regions, and on the Pa-

cific coast, while to the eastward of the Rocky Mountains the rainfall was very unevenly distributed, large excesses and marked deficiencies occurring in adjoining states and districts. The greatest deficiencies occurred on the south Atlantic coast, in west-central Mississippi and thence southwest to the Gulf coast, where they were more than three inches. In the middle Saint Lawrence valley the rainfall exceeded the average by more than five inches, while in extreme southeastern New York, southeastern Tennessee, and in the upper valley of the Red River of the North the excess was more than four inches. In the south Atlantic states, the Lake regions, the upper Mississippi valley, the northeastern slope of the Rocky Mountains, and in the plateau regions there was a deficiency of rainfall for the current and the preceding month. Snow fell in September, 1889, as far south as extreme northern Texas, where three inches were reported at Folsom on the 23d.

Navigation on the Mississippi River above Dubuque, Iowa, was reported practically closed during the latter part of the month on account of low water. Noteworthy auroral displays were noted at Mount Washington, N. H., 8th; Saint Vincent, Minn., 18-19th, and Eastport, Me., 22d. Damaging drought was reported in parts of eastern Maine, Alabama, Ohio, Michigan, Dakota, and Nevada. Extensive forest fires occurred in Dakota, Michigan, Maine, Colorado, Montana, Oregon, and northern California, and large prairie fires in Minnesota and Dakota. Brilliant meteoric displays were observed at Greensborough, Ala., and Lexington, Ky., on the 24th, at Chattanooga, Tenn., on the 25th, and at Las Vegas, N. Mex., on the 29th.

ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean atmospheric pressure for September, 1889, 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 September, 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 Washington, D. C., New York, N. Y., Boston, Mass., and Chicago, Ill., the mean of the 8 a. m. and 8 p. m. observations was higher by .007, .005, .007, .004, respectively, than the true mean pressure, while at Saint Louis, Mo., the mean of the observations taken at these hours was the same as that determined from hourly observations.

The mean pressure for September, 1889, was highest from Missouri and Arkansas eastward to the Atlantic coast, at stations on the New England and Nova Scotia coasts, and from the north Pacific coast east and southeast over the valleys of the Columbia and Snake rivers, where it rose above 30.05. From the Saint Lawrence Valley, the lower lakes, and the southern portion of the upper lakes southward to the Gulf of Mexico, over a greater part of the middle and northern plateau regions and the middle eastern slope of the Rocky Mountains, and on the Pacific coast north of the fortieth parallel the mean values were above 30.00. The mean pressure was lowest in the lower Colorado valley where it fell to 29.82 at Yuma, Ariz., and in the British Possessions north of Dakota and Montana, where a reading of 29.85 was reported at Qu'Appelle, N. W. T. The mean pressure fell below 29.90 along the northern boundary of the United States between the eighty-fifth and one hundred and tenth meridians, and from the lower Colorado valley northwestward over California to the lower Sacramento valley.

Compared with the pressure chart for August, 1889, a decrease in pressure is shown east of the one-hundredth meridian, save on the Atlantic coast from Massachusetts northward, while over the Rocky Mountain and plateau regions there was an increase in mean pressure. The greatest decrease in pressure occurred over the eastern part of Lake Superior, where it amounted to .10, and the greatest increase over the middle and

northern plateau regions, where the mean values were .15 to .19 higher than for the preceding month. In August the mean pressure was highest from the Ohio Valley eastward and south-eastward to the Atlantic coast, where it rose above 30.10, while for the current month the highest values were noted in the east-central and extreme northwestern parts of the country, where they were above 30.05. The area of low pressure central in August over the Colorado valley contracted in area, and an increase in mean pressure of about .05 occurred in that region. There was also a slight increase in mean pressure in the British Possessions north of Montana and Dakota.

Compared with the normal pressure for September the mean pressure was generally below the normal east of the plateau regions, except in areas in New England, the Canadian Maritime Provinces, Florida, Missouri, and Arkansas, where the readings corresponded with or slightly exceeded the normal values. Over the plateau regions and along the Pacific coast the mean pressure was above the normal. The greatest departures below the normal pressure occurred at stations along the Atlantic coast between the thirty-sixth and fortieth parallels, and from northern Dakota eastward over Lake Superior, where they exceeded .05, and the most marked departures above the normal were reported in the middle and northern plateau regions, and on the Pacific coast north of the Columbia River, where they were more than .05.

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 September, 1889, the monthly ranges were greatest in northern New England, where they exceeded 1.00, whence they decreased southwestward to less than .40 over southern Florida and to less than .50 on the west Gulf coast, and decreased westward to the Pacific coast where they varied from less than .40 on the

southern California coast to more than .70 north of the Columbia River. Along the Atlantic coast the extreme ranges varied from .32 at Key West, Fla., to 1.05 at Eastport, Me., and 1.10 at Mount Washington, N. H.; between the eighty-second and ninety-second meridians, .42 at Cedar Keys, Fla., to .92 at Alpena, Mich.; between the Mississippi River and the Rocky Mountains, .48 at Brownsville and Corpus Christi, Tex., to .98 at Saint Vincent, Minn.; in the plateau and Rocky Mountain regions, .32 at Fort Grant, Ariz., to .75 at Boise City, Idaho; on the Pacific coast, .39 at San Diego, Cal., to .78 at Port Angeles, Wash.

AREAS OF HIGH PRESSURE.

Seven areas of high pressure were observed within the limits of stations of observation during the month of September, 1889. Five of these areas first appeared on the north Pacific coast; one approached stations from the centre of the continent; and one was first observed in the region southeast of Hudson Bay, where the two secondary areas of high pressure, which re-enforced that described as number ii, were also first observed. The average rate of movement was about twenty-three miles per hour, while the maximum rate was thirty-four miles, and the minimum nine miles per hour. The progressive movement was more rapid over the continent, while it was apparently retarded both over the Atlantic and Pacific coasts. Over the western half of the continent the direction of movement was generally to the southeast, while there was a tendency to change direction to east or northeast as they approached or moved eastward of the Atlantic coast line.

Of the high areas which were first observed on the Pacific coast, two were traced across the continent, and three disappeared by gradual decrease of pressure after reaching the centre of the continent. The average duration was four days and the maximum six and one-half days, and the average maximum pressure observed was 30.40 inches.

The following tables exhibit some of the more prominent characteristics of the high areas:

TABLE I.

No.	First observed.			Last observed.		Duration.	Velocity per hr.	Highest pressure.		
	Date.	Lat. N.	Long. W.	Lat. N.	Long. W.			Date.	Station.	Reading.
I.....	1	47	74	0	0	Days. Miles.	1	Rockliffe, Ont.....	Inches.	
II.....	2	48	129	44	61	3.0 11.0	7	Quebec, Quebec.....	30.44	
IIa.....	3	50	76	44	57	5.5 30.0	10	Sydney, C. B. I.....	30.26	
IIb.....	11	51	72	43	57	4.0 9.0	14	Halifax, N. S.....	30.48	
III.....	10	43	127	53	94	2.5 30.0	12	Qu'Appelle, N. W. T.....	30.46	
IV.....	12	44	128	48	83	4.0 34.0	14	Ft. Assiniboine, Mont.....	30.32	
V.....	15	47	125	40	93	3.5 30.0	15	North Platte, Nebr.....	30.42	
VI.....	20	54	99	45	55	6.0 17.0	18	Omaha, Nebr.....	30.26	
VII.....	23	47	124	35	72	6.5 20.0	25	Sydney, C. B. I.....	30.50	
							26	Halifax, N. S.....	30.56	
							24	Olympia, Wash.....	30.51	
							27	Leavenworth, Kans.....	30.40	
Mean.....		48	106	43	71	4.2 22.9				

TABLE II.

Number.	Maximum abnormal rise in pressure in twelve hours.			Maximum abnormal fall in temperature in twelve hours.			Maximum wind velocity.		
	Amount.	Station.	Date.	Amount.	Station.	Date.	Miles per hour.	Direction.	Date.
I.....	.16	New York, N. Y.....	1	0	Chatham, N. B.....	3	18	w.	2
II.....	.54	North Platte, Nebr.....	4	27	Fort Custer, Mont. Saint Paul, Minn.....	3 4	48	n.,nw	4
IIa.....	.14	Quebec, Quebec.....	9	8	Sydney, C. B. I.....	9	48	ne.	9
IIb.....	.14	Father Point, Que. Rockliffe, Ont.....	11	8	Halifax, N. S.....	12	60	ne.	11
III.....	.62	Bismarck, Dak..... Fort Sully, Dak.....	11	24	Fort Sully, Dak.....	11	42	nw.	10
IV.....	.38	Des Moines, Iowa.....	15	25	Denver, Colo.....	14	34	n.	15
V.....	.30	Bismarck, Dak.....	16	14	Moorhead, Minn.....	16	36	w.	17
VI.....	.30	Saugeen, Ont.....	20	19	Port Huron, Mich.....	20	36	nw.	21
VII.....	.42	Qu'Appelle, N. W. T.....	24	29	Fort Custer, Mont.....	22	48	nw.	24

I.—This area of high pressure was central north of the Saint Lawrence Valley on the morning of the 1st, or at the opening of the month, where the maximum pressure of 30.44 was observed at Rockliffe, Ont., at 8 a. m. It covered the entire region east of the Mississippi, while an area of decidedly low pressure was central north of Montana, and a second high area covered the north Pacific coast. It moved southward over New England and the middle Atlantic coast during the 1st and 2d, attended by clear and fair weather, and moved slowly eastward during the 3d and 4th, disappearing in advance of a storm centre which was passing eastward over the Lake region. The increase of pressure over Nova Scotia indicated that the movement was slightly to the north of east after passing beyond the limits of the United States.

II.—This area of high pressure was first observed west of Washington Territory on the 3d. Although the pressure had been previously high on that coast on the 1st, it decreased rapidly with the easterly movement, and the area of high pressure first named could not be traced east of the Rocky Mountains. It remained almost stationary on the north Pacific coast on the 3d, after which it extended eastward over the northern plateau region, remaining central in Idaho on the 4th, causing the first killing frosts in Wyoming and eastern Oregon on that date. It moved rapidly southeastward, crossing the central Rocky Mountain region during the night of the 4th, remaining central over Kansas during the 5th, but covering the greater portion of the country west of the Mississippi. Killing frost occurred at Cheyenne, Wyo., on the 5th, and light frosts throughout the Missouri Valley. It covered the central valleys on the morning of the 6th, and the northeast portion of the United States on the morning of the 7th, when it was central in northern New England, from which region it apparently moved directly eastward, passing over Nova Scotia, off which coast it was central on the afternoon of the 8th, the barometer remaining high, however, over the Saint Lawrence Valley, owing to the approach of a secondary area of high pressure, described as iia. This secondary moved slowly eastward during the 9th and 10th, and was central to the east of Nova Scotia on the 11th, when a second re-enforcement, described as iib, appeared to the north of the Saint Lawrence Valley, and after moving eastward during the 11th it apparently increased in energy and passed to the southward during the 13th and 14th, the movement being retarded after passing to the southeast of Nova Scotia. The accumulation of pressure in the northeast, due to these re-enforcements of high area number ii, apparently caused the tropical cyclone which was passing northward east of Hatteras to increase greatly in energy after passing the thirty-fifth parallel, and it also acted as a barrier, changing the course of the cyclone and actually driving it to the westward, although it is possible that a minor disturbance may have pursued a northeasterly course along the east margin of the Gulf Stream.

III.—This area of high pressure was apparently west of the north Pacific coast on the 8th and 9th, but it was first located as central near the coast of that region on the morning of the 10th. It followed rapidly the easterly movement of the extended low area which covered the plateau region on the 9th, and by the morning of the 11th it was central in the upper Missouri valley, extending from Lake Superior westward to the Pacific coast, attended by killing frosts in Washington Territory, Montana, and Dakota. The pressure increased during the easterly movement, and after reaching northern Dakota it moved northward and disappeared during the 13th to the northeast of Manitoba, and apparently extended the area of high pressure previously described as number iib.

IV.—This area also first appeared west of the north Pacific coast, and, as in the one previously described, the direction of movement was at first to the northeast until it passed the coast line near the forty-eighth parallel on the 13th, and after which it moved directly eastward to Montana, where it was central on the 14th, and where the direction of movement changed to the southward. During the 14th it covered the

northern half of the Rocky Mountain region, extending from the Missouri Valley to the Pacific coast. It was apparently drawn southward immediately to the west of a barometric disturbance which passed rapidly to the northeastward from Kansas during the 14th, and after reaching central Kansas on the 15th the movement was to the northeast over the same course previously followed by the preceding area of low pressure. It decreased in energy after reaching the central valleys, and disappeared to the north of, and near, the Lake region by a gradual decrease of pressure.

V.—This area was central on the north Pacific coast on the 15th, and apparently formed a continuation of the preceding area of high pressure which at that time covered the eastern Rocky Mountain region. It extended eastward over the north-west portion of the United States, being central in Montana on the morning of the 16th, from which region it apparently extended southward over the eastern slope, extending from the Rocky Mountains to the lake regions, the Ohio valley and Gulf states on the 17th and 18th, attended by frosts as far south as northern Arkansas and the lower Ohio valley. It extended over the central Mississippi valley and thence westward to the Rocky Mountains on the 19th, after which it disappeared by a gradual decline in pressure without further easterly movement.

VI.—First appeared to the north of Minnesota on the 20th, the pressure being relatively low, but the rapid development of a barometric disturbance in the Lake region, causing the barometer to fall to 29.20, gave a well-marked barometric gradient in the direction of this area of high pressure, within which at that time the observed barometric reading was not above 30.04. It moved directly southeastward from Manitoba to Virginia during the 20th, 21st, and 22d, covering the central valleys, and afterwards the eastern portion of the United States, attended by general fair weather and light frosts as far south as North Carolina on the 22d. After reaching the Carolina coast on the 23d the course of movement changed to the northward, and it was apparently central over the Maritime Provinces on the 25th, from which region it moved eastward, disappearing over the Atlantic in advance of a storm which was central over the Saint Lawrence Valley on the 26th. The barometric pressure within this area of high pressure was relatively low, but it increased slightly during its easterly movement, and attained its maximum on the day it disappeared to the eastward.

VII.—After remaining almost stationary on the north Pacific coast during forty-eight hours this area advanced slowly to the eastward and was central near Olympia on the 23d. It extended southeastward, covering the plateau regions during the 24th and 25th, and passed to the eastward of Colorado on the 26th. It was probably the most extended area of high pressure observed during the month, and on the 26th and 27th the greater portion of the entire country was within its limits, it being central in eastern Kansas and extending from the Atlantic to the Pacific coasts. The maximum pressure of the month was observed at Leavenworth when the centre was near that station. It advanced slowly eastward over the southern states, causing light frosts in Kentucky and Tennessee on the 28th. The pressure decreased gradually as it approached the coast, and it disappeared to the east of North Carolina on the 30th, and probably changed its direction to the northeast, the pressure on the Nova Scotia coast increasing from two to three tenths of an inch during the last two days of the month.

AREAS OF LOW PRESSURE.

Ten areas of low pressure were observed within the limits of the stations of observation during the month of September, although a number of these disturbances passed eastward north of the United States, and were attended by no marked change in weather conditions. Four of the areas of low pressure reached the Atlantic north of the fortieth parallel, and only one tropical storm passed over the southern portion of the United States, although the most severe storm of the month possibly had its origin in the tropics, but passed northward

over the ocean and developed its greatest energy after reaching the latitude of the middle Atlantic coast. The centre of this disturbance was at no time over the land, but was traced as an ocean storm, and the weather conditions attending its movements are exhibited on chart iv.

Generally the areas of low pressure observed during the month were more northerly than usual, and a number of secondary disturbances formed, which, owing to their brief duration, have not been traced as separate areas of low pressure.

The following tables exhibit the principal facts regarding these low areas:

TABLE I.

No.	First observed.			Last observed.			Duration.	Velocity per h'r.		Lowest pressure.		
	Date.	Lat. N.	Long. W.	Lat. N.	Long. W.	Days.		Miles.	Date.	Station.	Reading.	
I.....	2	52	111	47	83	3-0	15-0	2	Swift Current, N. W. T.	29.36		
II.....	5	53	100	52	89	1-5	16-0	5	Qu'Appelle, N. W. T.	29.42		
III.....	6	42	104	33	101	1-5	20-0	7	{ El Paso, Tex. Fort Elliott, Tex. }	29.70		
IV.....	9	45	110	52	96	1-0	37-0	10	Fort Buford, Dak.	29.62		
V.....	11	38	112	49	73	4-5	20-0	14	Marquette, Mich.	29.66		
VI.....	15	52	107	49	70	4-5	20-0	19	Portland, Me.	29.38		
VII.....	18	49	97	50	62	3-5	25-0	20	Anticosti, G. of St. L.	29.06		
VIII.....	19	52	113	50	62	7-5	14-0	22	Minnedosa, N. W. T.	29.28		
IX.....	22	58	90	38	73	2-5	23-5	23	Pensacola, Fla.	29.62		
X.....	28	52	121	50	87	2-5	26-5	30	Port Arthur, Ont.	29.24		
Mean.....		46	98	47	80	3-2	21-7			29.43		

* While within limits of stations of observation.

TABLE II.

Number.	Maximum abnormal fall in pressure in twelve hours.			Maximum abnormal rise in temperature in twelve hours.			Maximum wind velocity.		
	Amount.	Station.	Date.	Amount.	Station.	Date.	Miles per hour.	Direction.	Date.
I.....	.46	Qu'Appelle, N. W. T.	2	21	Qu'Appelle, N. W. T.	2	52	nw.	2
II.....	.34	{ Qu'Appelle, N. W. T. Calgary, N. W. T. }	5	23	Medicine Hat, N. W. T.	5	42	s.	6
III.....	.26	Pueblo, Colo.	6	24	Pueblo, Colo.	6	42	s.	6
IV.....	.32	{ Winnipeg, Manitoba. Denver, Colo. }	10	14	Fort Buford, Dak.	9	48	se.	10
V.....	.30	{ Dodge City, Kans. Portland, Mo. }	12	17	Denver, Colo.	12	42	s.	13
VI.....	.40	Sault Ste. Marie, Mich.	19	17	Bismarek, Dak.	15	50	nw.	19
VII.....	.40	Calgary, N. W. T.	20	29	Medicine Hat, N. W. T.	18	52	sw.	20
VIII.....	.40	Atlanta, Ga.	23	12	Chattanooga, Tenn.	24	44	se.	24
IX.....	.38	{ Medicine Hat, N. W. T. S't Ste. Marie, Mich. }	27	28	Swift Current, N. W. T.	27	56	sw.	29
X.....	.36		30						

I.—This depression was central north of Montana on the morning of the 2d, it having been preceded in that region by the area of low pressure which moved eastward during the 1st and disappearing to the north of Minnesota on the 2d. When this disturbance appeared an area of high barometer covered the eastern portion of the United States, and the pressure was relatively high over the central Rocky Mountain and plateau regions. The barometer fell rapidly during the 2d at the Rocky Mountain stations and the centre of the disturbance passed from north of Montana southeastward to southern Dakota, the depression being elongated in a north-easterly direction extending from Colorado to Lake Superior. This trough of low pressure was attended by rapidly rising barometer to the westward, the difference of pressure being seven-tenths of an inch between Dakota and Washington Territory. The advance of this area of high pressure from the westward divided the barometric trough into two disturbances, one of which passed eastward over Lake Superior, as indicated on chart number i, while the other was forced southward to the west Gulf states by the area of high pressure, and disappeared by a gradual increase of pressure.

II.—The area of low pressure previously described was last observed as central north of Lake Huron on the 5th at 8 a. m., the morning weather map of that date exhibiting an extended barometric depression to the north of the United States, within which there were apparently two centres of disturbance.

The 8 p. m. report of the same date indicated low barometric pressure along the northern boundary of the United States from the Saint Lawrence Valley to British Columbia, with the minimum pressure to the north of Dakota. The areas of high pressure covered the Atlantic coast districts and the region from the central Mississippi valley westward to the Rocky Mountain regions. During the 6th there was a general movement of these conditions to the eastward; the area of high pressure, advancing more rapidly and inclining to the northeastward, covered the northeastern portion of the United States on the morning of the 7th, and either forced low area number ii to the northward beyond the limits of observation or caused it to disappear by increase of pressure; the appearance of a barometric disturbance north of Montana on the 7th would indicate that the last-named condition obtained.

III.—This was a minor disturbance which formed in the trough of low pressure attending the low area traced as number ii; it formed over the central Rocky Mountain region and moved directly southward from Nebraska to Texas from the 6th to the 8th, and disappeared in western Texas on the last-named date without causing any marked change in the weather conditions, although light rains occurred throughout the west Gulf states on the 7th and 8th.

IV.—The 8 a. m. report of the 9th exhibited an extended barometric depression covering the plateau regions from Mexico to the northern boundary of the United States, while there were also indications that an area of high pressure was advancing eastward from the Pacific. The 8 p. m. report of the 9th showed a slight advance of the barometric disturbance to the eastward when it was first marked as central in northwestern Wyoming Territory. It moved rapidly to the northeastward during the succeeding twenty-four hours and disappeared to the north of Minnesota during the night of the 10th, there being no trace left of this depression on the a. m. weather chart of the 11th, which exhibited two areas of high pressure covering the northern portion of the country from the Saint Lawrence Valley to the Pacific coast.

V.—This depression originated over the southern plateau region, and was first observed as central in southern Utah on the afternoon of the 11th. It moved directly eastward during the 12th and 13th, passing over Colorado and reaching western Kansas on the morning of the 14th, when the advance of an area of high pressure from the north caused the defining isobars of this disturbance to become extended in a northeasterly direction, a narrow barometric trough attending this disturbance apparently bounding the southeast quadrant of the advancing high area when the latter was central in northern Montana, and the depression extending from New Mexico to Lake Superior. During the 14th the southeasterly movement of the area of high pressure caused a rapid transfer of the centre of this disturbance from Kansas to Lake Superior, the barometric trough advancing to the eastward and southward within which heavy rains occurred as it passed over the central valleys. The secondary disturbances which developed in the southern portion of the trough were quickly replaced by the advancing area of high pressure, while the centre of disturbance to the north advanced eastward from Lake Superior to the lower Saint Lawrence valley, where it disappeared on the 16th.

VI.—Appeared north of Montana on the 15th and passed southeastward to Minnesota as a disturbance of slight energy. The direction of movement changed on the 16th to the eastward, the centre passing over Lake Superior to the region north of Lake Huron, where it was located on the afternoon of the 17th. The lowest isobar of 29.90 extended southeastward over northern New England, and there were indications that a secondary disturbance would develop in that region. The easterly movement continued during the 18th, the pressure decreasing slowly at the centre, which on the afternoon of the 18th was near the northern portion of Maine, where the barometric pressure was about 29.76. During the night of the 18th this disturbance developed great energy over a small area on the east New England coast. The barometer fell four-tenths

of an inch at Portland in twelve hours, and severe gales occurred on the east and southeast New England coast. Attending this sudden development of energy in the southern portion of this depression, the barometer remained almost stationary to the northward, while the well-marked depression which was central on the New England coast on morning of the 19th passed quickly to the northward and could not be traced after the succeeding telegraphic report. Its rapid disappearance was probably due to the proximity of low area traced as number vii.

VII.—Appeared to the north of Dakota on the 18th when an area of high pressure covered the greater portion of the country, the latter being central in the upper Mississippi valley. The early movements of this disturbance can only be approximately traced, but it apparently moved southeastward from the 18th to the 20th, passing from the region far to the north of Dakota to the upper Saint Lawrence valley. As it approached the vicinity of Lake Huron it increased greatly in energy, causing severe westerly gales on the lakes during the night of the 19th. On the morning of the 20th the barometer had fallen to 29.20 at Parry Sound, Ont., when the centre of disturbance was near that station. After the centre of disturbance reached the upper Saint Lawrence valley on the afternoon of the 20th the direction of movement changed to the northeast, and the disturbance became greatly extended in area, the barometric pressure at the centre increased slightly during the change in direction of movement, but afterwards decreased until the minimum of 29.06 was reached at Anticosti, Gulf of Saint Lawrence, on the morning of the 22d, when severe westerly gales were reported over the Maritime Provinces.

VIII.—Apparently developed in the Rocky Mountain regions to the north of western Montana, where it was observed on the 19th. It passed slowly eastward north of the United States, and was apparently retarded in its easterly movement until it passed to the eastward of Lake Winnipeg. When central north of Minnesota the barometric pressure at the centre was below 29.28, when there were indications that this disturbance would cause decided changes in the weather conditions in the northern portion of the United States. It passed eastward, however, far to the north of the lake region, the pressure apparently increasing at the centre until the disturbance reached the lower Saint Lawrence valley, when a slight decrease in pressure was observed. Showers occurred throughout the Lake region, and on the Atlantic coast, attended by fresh and brisk westerly winds. After passing over the lower Saint Lawrence valley it was apparently joined by the disturbance traced as number ix, which passed off the middle Atlantic coast on the morning of the 26th, this storm having greatly decreased in energy, and by the afternoon of the 26th the two depressions had approached each other so that both were included within a barometric trough extending southward over New England and to the fortieth parallel. The easterly course apparently continued after the 26th, and it disappeared over the Atlantic during the 27th, the barometer continuing low, however, in and over the Maritime Provinces until the 29th.

IX.—Was the only tropical storm occurring during the month the centre of which passed over the continent. From numerous vessel reports and the accompanying data and descriptions prepared by Rev. Father Benito Viñes, S. J., the approximate course of this storm previous to the 22d is indicated on chart number i. While the regular telegraphic report would indicate that within a very extended area of barometric depressions two, and possibly three, disturbances may have existed, it is probable that the one traced as number ix continued its course as indicated, and certainly it is the only cyclonic disturbance observed in the Gulf which reached or passed over any portion of the United States. At 8 p. m. of the 22d this storm was apparently central near the mouth of the Mississippi to the southeast of Port Eads, La., but its presence could not be definitely determined at that report. Twelve hours later the centre had advanced to the vicinity of Mobile, Ala.; southeasterly gales were reported at Pensacola, Fla.,

while the wind was light and from the north at Mobile, Ala. The course continued northeasterly, passing over Alabama, northern Georgia, and central North Carolina during the succeeding twenty-four hours, attended by from two to three inches of rain at stations near the centre of disturbance, and southeasterly gales along the south Atlantic coast. The pressure increased slowly at the centre during the northeasterly movement with loss of energy, and when the disturbance reached the middle Atlantic coast the barometer at the centre was 29.88, and the greatest maximum velocity of wind was thirty-six miles per hour. As previously stated, it probably joined with low area viii in the lower Saint Lawrence valley.

Notes and extracts relative to the early history of this storm furnished the Chief Signal Officer through the courtesy of Rev. Father Benito Vines, S. J.:

Havana, Sept. 13th, 1.00 p. m.: some indications of cyclonic movements are observed in the South Sea. The centre remains approximately to the S. $\frac{1}{2}$ S. W. from Havana at a great distance. If the season were more advanced a storm from this quarter could be very dangerous; but being at present in the middle of September, it is probable that the present disturbance, following the general law of the trajectories formulated by me in the "Ciclono-copio de las Antillas para uso de los Marineros," is moving from the west to the south of the island.

Havana, Sept. 13th, 7.00 p. m.: the cablegram of Mr. Ramsden, which I received this evening, indicates a new centre of cyclonic disturbance south of Santiago de Cuba. This new storm appears to be more active and better organized than the one which is discovered south of Havana. It is very possible that the whole of these two simultaneous disturbances will constitute one vast depression in the South Sea, with two centres of cyclonic aspiration. Nothing is known at present regarding the direction of the trajectory of this new disturbance. The probability is that it advances to the west toward the vicinity of the Canal of Yucatan, and accordingly as its direction inclines more or less to the north of west, it will be felt with more or less intensity in the extreme western part of the island.

Santiago de Cuba, Sept. 13th, 10 a. m.: barometer 29.88; 2 p. m., 29.87; 3 p. m., 29.79; wind nne., velocity 15 miles; cirro-cumulus from ene., cumulus, high, from se.; cirrus from s. Holland Bay, wind n., gusts of wind; sea somewhat risen.

Havana, September 14th, 1 p. m.: the cyclonic disturbance of which I spoke in my first communication has come to us somewhat from the west; so that at present its centre remains approximately to the south-southwest. The ascending current in the centre of this disturbance is quite intense and rises to a great altitude, giving origin to brilliant solar halos. According to the cablegram just received the position of the centre of the other disturbance is apparently better determined and its position is approximately to the south-southeast of Santiago de Cuba and southeast of Jamaica. This confirms me in the opinion that the whole of these two disturbances forms a vast depression which embraces the whole of the South Sea. The case thus stated does not fail to present difficult complications hard to solve with the few observations which we have at our command. Already in Havana the upper currents are influenced by the other centre which threatens us in the southeast. In general, without doubt, it can be said that these vast depressions are not so much to be feared as the cyclones of a short radius. Besides, it must be remembered, as I have said before, that in these vast depressions the greater force of the wind and the squalls are not in the central region but on the outer edge. This explains, apparently, the interruptions of the telegraphic line in San Domingo, where winds from the 1st to the 2d quadrants have prevailed. While the cyclonic ring is advancing to the west the weather along the coast might become worse, with variable winds, squally and rainy weather, those from the northeast predominating and moving to southeast, with more or less intensity, according to the different localities that it strikes.

Santiago de Cuba, September 14th, 7 a. m.: barometer 29.82; wind ne., velocity seven miles per hour, cloudy, cirro-stratus from se., nimbus from ne. Jamaica: barometer 29.82, calm, covered, cirro-cumulus from ne. San Domingo: telegraph lines interrupted. Trinidad: last night, 13th, barometer 29.90; to-day rising; tempest from sw., sea agitated, wind increasing; Santiago de Cuba, 14th, 2 p. m.: barometer 29.80, wind ne., variable, velocity two miles per hour, light rain; 3 p. m., barometer 29.89, wind n., light rain. Island Barlovento: wind fresh se.; Saint Thomas, s.; Puerto Plata, ne. Cienfuegos, 2 p. m.: barometer 29.89, variable breezes ene., inclining to the n., cumulus from ne.

Santiago de Cuba, 15th, 7 a. m.: barometer 29.78, wind se., velocity five miles, variable, mists, nimbus from se.; continued rain, some strong gusts of wind from ene. at dawn; at 3 a. m., barometer 29.72; 3 p. m.: barometer 29.84, wind se., velocity three miles, variable, light rain, nimbus from se. and sse. Cienfuegos, 15th, 2 p. m.: barometer 29.72, wind nnw., gusts of wind ne.; 3 p. m.: barometer 29.76, wind ese, nimbus strong from ne. Quemado de Güines, 15th, 9.15 a. m.: 14th, 10 a. m., barometer 29.88, wind n.; suffocating heat; 10 p. m., barometer 29.80, wind n., slight breeze; in the evening stronger, like 13th; 15th, 4 a. m.: barometer 29.76, wind n., breeze; squalls from 1.30 a. m.; 8.30 a. m.: barometer 29.80, sky covered, light rain e. and s., great belts of dark cumulus, wind n. and ne. Santa Clara, 15th, 12.15 p. m.: barometer 29.45; wind light, from nne., with oscillations to the n. and

ne.; squalls in the morning; direction of the clouds from ne. to sw. Santa Clara, September 15th: barometer 29.41, with tendency to fall; wind nne.; sky covered; very dark and cloudy weather in the third and fourth quadrants; gusts of wind and rain. Pinar del Rio, September 15th: barometer 29.65; wind nnw.: cirro-cumulus from the n. Quemado de Güines, September 15th, 3 a. m.: barometer 29.80; wind ne., with slight gusts of winds and light rains; bad aspect of the sky to the se. and s.; at 3.25 p. m.: barometer 29.69; wind ne., slight gusts; light rains; cumulus low from ene.; in second quadrant, s. and w., followed by bad aspect of weather.

Havana, September 16, at 1 p. m.: the cyclonic disturbance which appeared on the 14th to the south-southwest of Havana moved towards us from the west. On the 15th in the morning the storm of Jamaica approached from the southeast, which was more intense and better organized than the former, and it increased in intensity. To-day it moves from the south toward the west. The direction of the trajectory is approximately to the west-northwest towards the coast of Texas. I consider the whole of these two disturbances, according to indications, to be an extensive area of low barometer which embraces the two cyclonic centres.

Havana, September 17th, noon: the central region of relative calm of the extensive area of low barometer, and the cyclonic ring of large clouds, winds, and squalls which surround this vast depression, of which I spoke in my former report, could not have been more marked yesterday evening, 16th; but while we in Havana were surrounded by a relative calm, the squalls ceased, the sky cleared up letting us see the solar disc encircled by halos, in the midst of a calm, with a suffocating, sultry heat and very low barometer; in Cienfuegos there was a cyclonic ring, with rising barometer, and heavy squalls from the south. The showers at dawn, with light winds and gusts, and some thunder, were owing, in my opinion, to the tail end of the Jamaica storm, the vortex of which was west-southwest. The clear weather which we had afterwards relates to the intermediate space between this storm and the cyclonic ring of the whole disturbance.

San Juan y Martinez, September 16th, 6 p. m.: barometer 29.72; cirrus clouds from s.; cumulus clouds to the w.

Havana, September 18th, noon: the nebulous edge of the latter portion of the depression has been crossing by Havana during the evening of yesterday the 17th, and last night, and this morning we find ourselves still in its outside portion. Yesterday evening we had brisk winds of 22 miles per hour, with gusts of 35 miles per hour; sky of a very stormy aspect and strong currents in the region of the rain-clouds.

Havana, September 19th, 9 a. m.: in the "Diario de la Marina" of to-day, in the section with the heading "The Weather," I read the following report, which confirms what has been said in relation to the vast depression which crossed to the south of the island in a direction to the nnw., toward the coast of Texas: according to telegram from Cayo-Hueso, received in the meteorological division, etc., the effects of the anterior edge of the depression must yesterday morning, the 18th, have been felt on the coast of Texas, while in Havana they were just receiving the outer edge of the following part (posterior part) of the nebulous disc of the same, so that the area of low barometer is very vast, since it embraces in its extremes the whole Mexican dominion and more. It is probable, in conformity to general laws of the trajectories in the different months, that this vast storm recedes on the coast of Texas, causing terrible inundations and disasters in an extensive zone. The steamboat "Mascotte," on its journey from Tampa to Cayo-Hueso, was on the evening of the 17th overtaken by hurricane winds from east shifting to southeast which finally acquired a velocity of sixty-five miles per hour. Cienfuegos, September, 19th, 2 p. m.: barometer 29.84; cirrus sky, cloudy, west; cirro-cumulus moving from west $\frac{1}{2}$ northwest; slight winds, south-southwest; 3 p. m., barometer 29.84. Quemado de Güines, September 18th, 2 p. m.: 18th, 10 a. m., barometer 29.88; wind south, breeze; at 1 p. m., barometer 29.80; wind south-southwest.

[By telegraph to the New York Herald.]

CITY OF MEXICO, October 4, 1889.—A full report of the great cyclone on Carmen Island, off the coast of Campeche, has been received. The cyclone started about 2 o'clock on the afternoon of the 18th ultimo, and was heralded by a rapidly falling barometer. It did not, however, gain its full strength until night. The wind then shifted from the west to due south with an impetuosity that caused the vessels in the Carmen harbor to drag their anchors. Masts were snapped and sails torn in shreds. The following morning the shores were strewn with wreckage, there being only one vessel—the "Jova Del Lobregat"—that weathered the great gale out of thirty-five vessels of all kinds in the port. When the storm commenced all of the schooners that had sought refuge at a point called Quintilla were also wrecked.

The hurricane uprooted great trees, which fell upon houses in Carmen, destroying in all over one hundred and damaging two hundred and fifty others. The big extract factory, the Parochial Church, and the new hospital were seriously damaged. The authorities are now busily engaged in removing the trees from the streets and searching the ruins for dead bodies. So far only one death from the storm is reported, the captain of the brigantine "Enrique," Mr. R. Alcali, who was killed on the shore.

The losses occasioned in the city by the storm are estimated at \$500,000. News of great destruction to other towns near Carmen is now coming in. Pariscada and Partido have suffered the loss of many houses. In the vicinity of the last named town all crops are a complete loss. In Aquada de Puerto Real, all the houses, with the exception of four, were destroyed by trees falling upon them. With the reports so far received the loss will not fall short of \$1,000,000.

X.—This disturbance probably originated on the north Pacific coast. It was central north of Washington Territory on the morning of the 28th, with severe southerly gales reported at the mouth of the Columbia River. These gales continued during the 28th, while the centre of disturbance apparently moved rapidly eastward, passing to the north of Montana and Dakota. After passing to the eastward of the Rocky Moun-

tains the pressure decreased at the centre, the barometer falling to 29.24 in Manitoba on the morning of the 30th. At the close of the month this depression was apparently central north of and near Lake Superior, the barometric pressure at Port Arthur, Ont., being 29.24 at 8 p. m. of the 30th, and brisk to high southwesterly winds were reported from the lake stations.

NORTH ATLANTIC STORMS FOR SEPTEMBER, 1889 (pressure in inches and millimetres; wind-force by Beaufort scale).

The paths of the depressions that appeared over the north Atlantic Ocean during September, 1889, 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." Descriptions of the storms that appeared over the West Indies, the Caribbean Sea, and the Gulf of Mexico have been received through the courtesy of the Rev. Father Benito Viñes, S. J., Director of the Magnetic and Meteorological Observatory of the Royal College of Belen, Havana, Cuba, and the thanks of this office are also due to co-operating observers in the West Indies and the Bermudas for reports rendered relative to these storms.

Seven depressions have been traced for September, 1889; the average number traced for the corresponding month of the last six years being 9.3. Of the depressions traced for the current month, two were continuations of areas of low pressure which first appeared over the North American continent; two were of tropical origin, one of which advanced from east of the Windward Islands to the Virginia coast from the 1st to 13th, and the other recurved northeast of the Windward Islands on the 4th and 5th and apparently passed thence northeastward to the Azores by the 11th; one depression, described under the heading "Areas of low pressure," advanced westward over the Caribbean Sea from the 13th to 17th, and from the 18th to 22d probably moved westward over Yucatan and recurved northward to the middle Gulf coast; three first appeared over mid-ocean; and two advanced from the Gulf of Saint Lawrence northeastward over Newfoundland and disappeared north of the region of observation. No storm traversed the ocean from coast to coast, and the movements of the depressions over the north Atlantic were irregular. Over the western portion of the ocean disastrous storms and unusually high tides occurred along the coast from New England southward to the Carolinas, attending the advance of the depression traced northwestward from the Windward Islands, and in the Gulf of Mexico a storm devastated the Campeche coast during the latter part of the second decade of the month. On the 19th a severe storm was central on the middle New England coast, while during the last decade of the month unsettled weather prevailed over New England and the Canadian Maritime Provinces, attending the passage of depressions over the Gulf of Saint Lawrence and Newfoundland. Over mid-ocean the pressure continued low, with fresh to strong gales, from the 1st to 13th, and from the 22d to 26th stormy weather prevailed north and northeast of Newfoundland and the Grand Banks. Over the eastern part of the ocean in the vicinity of the British Isles fair weather prevailed until the 8th, from which date until the 12th the influence of the depressions over mid-ocean was felt, and from the 19th to the 24th the pressure was low and the weather unsettled over and near the British Isles.

Compared with the corresponding month of previous years, the storms that appeared over the north Atlantic Ocean during September, 1889, were slightly deficient in number, although their slow and irregular movements over mid-ocean occasioned a continuation of stormy weather along the trans-Atlantic steamship routes throughout the greater part of the month. The storms traced over the north Atlantic in September for preceding years varied in number from five in 1883 to thirteen

in 1884. Well-defined and destructive September cyclones have averaged about one per year over the West Indies, their usual path being westward from or near the Windward Islands to the Gulf of Mexico where they recurved northward. Among notable September West Indian storms charted and described in the REVIEW are: 1882, storm appeared north of San Domingo on the 2d, moved westward over Cuba to the central Gulf where it recurved to the Alabama coast by the night of 9th, following the usual parabolic path. 1883: storm moved from off the eastern extremity of Cuba on the 6th northwestward over the Bahamas to the North Carolina coast by the 11th. 1886: storm off the west Gulf coast moved northward to the middle Texas coast from the 22d to 24th. 1887: one storm advanced from east of the Windward Islands on the 11th westward over the Caribbean Sea and north of west over the Gulf of Mexico to the Texas coast by the 21st, and one moved northeast from the western extremity of Cuba over the Bahamas. 1888: one storm moved from north of Puerto Rico on the 1st westward over Cuba and Yucatan to the Mexican coast near Vera Cruz by the 7th, a very unusual course, and one passed from the Bahamas westward over southern Florida where it recurved northward during the 8th and 9th.

The following are brief descriptions of the depressions traced for September, 1889:

1.—Vessel reports indicate that this disturbance existed to the eastward of the Windward Islands on September 1st, probably central in latitude N. 14°, longitude W. 57°. Later reports indicate that it moved westward, passing over Saint Christopher during the night of the 2d, where the barometer fell to 29.50 (749), with wind northeast. From 10.15 p. m. of the 2d to 12.45 a. m. of the 3d winds light and calm, with falling barometer. At 2 a. m. of the 3d, the barometer had fallen to 29.38 (746), and the wind had shifted to southwest, indicating that the centre of the disturbance had passed to the northwest of this island. The approximate course of the centre of this storm is given on chart i, and the meteorological conditions attending its movement from day to day are exhibited on chart iv, upon which are traced isobarometric lines for each two-tenths of an inch from observations taken at noon, Greenwich time, by steamships and sailing vessels, and observations taken at 1 p. m., Greenwich time, at land stations. In tracing the isobarometric lines bounding this disturbance care has been taken to accurately represent the data received, and lines over extended areas from which reports have not been received depend for their values on adjacent reports. It will be seen from chart iv that this storm was central near Saint Thomas on September 3d, there being an extended area of barometric pressure covering a greater portion of the West India Islands at noon of that date, while a second barometric depression covered the middle north Atlantic, and an area of high pressure extended along the coast of the United States from Georgia to New England. On the 4th the depression over the West Indies had moved slightly to the northwestward, and vessel reports show that severe storms were experienced over the ocean in latitude N. 22° 55' and 36° 55', longitude W. 55°. The centre of disturbance passed to the northwestward near the Island of Saint Thomas on the 3d, and was near to and north of the Island of Puerto Rico on the 4th. It was especially severe and caused much damage to crops over these Islands, but it did not extend over San Domingo and the Islands to