

PRECIPITATION.

During the early days of December generally fair weather prevailed, except light to moderate rain fell in portions of the Atlantic and North Pacific States. About the end of the first week moderate to heavy precipitation occurred in most eastern districts except the South Atlantic States; near the middle of the month considerable rain fell in the North Pacific States and snow from the Central Plains eastward, with heavy falls at many points in Pennsylvania and to the northward and eastward. During the next week rather heavy rain fell over the North Pacific States, but elsewhere little precipitation occurred. During the last week of the month moderate to light rain or snow fell in many sections, especially in the northern part of the country.

For the month as a whole the precipitation was light in most sections, and especially in southern districts, where, from the Plains States westward to the Pacific coast, large areas received no precipitation during the entire month, while the Great Plains, portions of the Mississippi Valley and of the Southeastern States received but small amounts.

In portions of the Ohio and lower Mississippi Valleys considerable precipitation occurred during the month, and along the Atlantic coast from the Carolinas northward there were moderate amounts, mostly in the form of snow. Snowfall was particularly heavy in the Ohio Valley, over portions of the Atlantic coast districts, and at points in the Lakes region.

In western Montana, and generally over Idaho, Washington, and Oregon, the precipitation was equal to, or above the normal; and occurred mostly as rain, save in the more northern portions and the higher mountains. A few sections of northern California had considerable rain or snow, but generally over that State the precipitation was markedly deficient, and the absence of any appreciable snow on the mountains at the close of the month was most unusual.

Snowfall.—Heavy snows occurred in portions of Pennsylvania, New York, and the New England States, and in general more snow fell east of the Rocky Mountains than is usual for December. In the far western mountains there was comparatively little snow; on the western slopes of the Rockies the amounts were generally light, and on the Sierra Nevada scarcely any snow fell, a condition probably unprecedented for December.

RELATIVE HUMIDITY.

The relative humidity for the month as a whole was above the normal in the Great Central Valleys, the northern Plains States, the far Northwest, the Lakes Region, New York, New England, and the Carolinas. Elsewhere there was relatively less moisture in the atmosphere than usually prevails in December, the deficiency being specially marked in the central and southern Plateau States.

GENERAL SUMMARY.

The unusually low temperature during most of the month in the districts to eastward of the Rocky Mountains allowed of little farm activity, and the heavy snow covering in portions of the Ohio Valley and eastern districts at times greatly hampered the transportation lines, and much inconvenience and actual suffering resulted from a lack of fuel and other necessary supplies.

In the southern districts severe cold caused more or less damage to winter oats and vegetables already above ground, and delayed the early planting of the usual outdoor truck crops.

In the far western districts the weather was unusually favorable for the first winter month. Outdoor work was possible during the greater part of the month, and winter vegetation made rapid growth. Pasturage of cattle was possible over considerable areas in the central and northern districts of this region, but in the southwest continued absence of moisture caused short and dry ranges, and much feeding was necessary.

A moderate covering of snow over the States east of the Mississippi during the greater part of the month afforded much needed protection to winter wheat, but there was little snow cover for this crop in the States between the Mississippi River and the Rocky Mountains, particularly over the more southern areas where wheat is grown.

In the far Northwest warm weather greatly favored the growth of wheat and the outlook for that crop was most promising.

Average accumulated departures for December, 1917.

Districts.	Temperature.			Precipitation.			Cloudiness.	Relative humidity.		
	General mean for the current month.	Departure for the current month.	Accumulated departure since Jan. 1.	General mean for the current month.	Departure for the current month.	Accumulated departure since Jan. 1.	General mean for the current month.	Departure from the normal.	General mean for the current month.	Departure from the normal.
New England.....	21.5	-8.7	-25.7	2.64	-0.80	-3.90	3.8	-2.4	74	-2
Middle Atlantic.....	28.1	-9.1	-22.5	1.93	-1.00	-4.50	5.7	-0.1	67	-8
South Atlantic.....	38.6	-8.5	-10.9	1.85	-1.60	-12.40	5.4	+0.5	78	+1
Florida Peninsula...	62.3	-3.6	-4.7	0.70	-1.30	-11.40	4.0	-0.6	73	-4
East Gulf.....	43.0	-6.1	-9.3	1.81	-2.70	-8.80	5.2	-0.3	75	-2
West Gulf.....	44.3	-4.8	-2.9	0.49	-2.40	-15.50	4.8	-0.4	74	0
Ohio Valley and Tennessee.....	26.4	-10.2	-29.6	1.50	-1.90	+0.30	6.5	+0.1	77	0
Lower Lakes.....	19.3	-9.1	-33.9	1.90	-1.00	-0.70	7.7	-0.1	80	+1
Upper Lakes.....	18.3	-8.2	-33.9	1.46	-0.60	-3.50	7.3	0.0	82	0
North Dakota.....	1.0	-10.8	-18.4	0.70	+0.10	-9.10	8.4	+2.8	86	+5
Upper Mississippi Valley.....	18.4	-8.9	-32.6	0.55	-1.10	-4.60	6.3	+0.3	81	+2
Missouri Valley.....	19.0	-7.9	-15.6	0.52	-0.50	-6.00	6.4	+1.1	80	+4
Northern slope.....	22.5	-1.5	-11.7	1.97	+1.10	-0.70	7.4	+2.1	74	+1
Middle slope.....	30.5	-2.4	-5.3	1.43	-0.60	-7.70	5.0	+0.8	68	0
Southern slope.....	42.3	-1.5	+7.2	0.02	-0.80	-8.90	2.5	-2.0	53	-15
Southern Plateau.....	50.4	+4.7	+3.7	T.	-0.60	-3.30	1.1	-2.1	40	-11
Middle Plateau.....	38.1	+6.8	-14.6	0.17	-0.80	-3.50	4.8	-0.3	57	-15
Northern Plateau.....	41.4	+9.3	+1.5	2.50	+0.80	-1.50	8.4	+1.5	74	-6
North Pacific.....	46.6	+4.5	+1.3	12.29	+4.90	-6.10	9.0	+1.2	89	-2
Middle Pacific.....	52.0	+3.5	+4.2	0.88	-0.40	-9.80	4.4	-1.1	74	+5
South Pacific.....	57.6	+4.5	+14.1	0.09	-2.00	-6.30	2.9	-1.4	64	-4

551.506 (261.7)

WEATHER CONDITIONS OVER THE NORTH ATLANTIC OCEAN DURING DECEMBER, 1916.

The data presented are for December, 1916, and comparison and study of the same should be in connection with those appearing in the REVIEW for that month.

Chart IX (xlv-120) shows for December, 1916, the principal storm tracks, the pressure, temperature, and prevailing direction of the wind at 7 a. m., 75th meridian time (Greenwich mean noon). Notes on the locations and courses of the more severe storms of the month are included in the following general summary.

PRESSURE.

The distribution of the average monthly pressure over the North Atlantic for the month, as shown on Chart IX, was unusual in some respects. There was no trace of the North Atlantic or Azores HIGH, the pressure rising gradually from the north coast of Scotland toward the Cape Verde Islands. The continental HIGH with a crest of 30.12 inches, was central near the eastern coast of Florida, the isobar of 30.1 inches, extending as far as the 67th meridian. The Icelandic LOW, with a minimum barometric pressure of 29.49 inches, was well developed and surrounded the Orkney Islands. A second LOW (29.55 inches) was central near St. Johns, Newfoundland, where the normal pressure is about 29.85 inches. The average pressure for the month was considerably below the normal over the greater portion of the ocean and the gradients were comparatively slight.

The pressure changes from day to day showed the usual marked winter variations, especially in the higher latitudes.

The following table gives for a number of selected 5-degree squares the average pressure for each of the three decades of the month as well as the highest and lowest individual readings reported during the month within the respective squares:

Pressures over the North Atlantic during December, 1916, by 5-degree squares.

Position of 5-degree squares.		Decade means.			Extremes.			
Latitude.	Longitude.	I.	II.	III.*	Highest.		Lowest.	
					Pressure.	Date.	Pressure.	Date.
•	•	Inches.	Inches.	Inches.	Inches.	Dec.	Inches.	Dec.
60-65 N	20- 25 W	29.92	29.78	29.24	30.13	2	28.91	28
60-65 N	5- 10 E	29.84	29.42	29.46	30.10	2	29.18	13
55-60 N	35- 40 W	29.96	29.96	29.27	30.22	9	28.90	28,30
55-60 N	0- 5 E	29.86	29.32	29.44	30.15	2	28.92	13
50-55 N	55- 60 W	29.77	29.62	29.47	30.12	4	29.00	29
50-55 N	10- 15 W	29.89	29.37	29.57	30.30	4	28.87	20
45-50 N	65- 70 W	29.84	29.63	29.87	30.30	4	28.90	23
45-50 N	40- 45 W	30.11	29.70	29.25	30.41	1	28.56	27
40-45 N	70- 75 W	29.93	29.78	30.05	30.40	27	29.30	16
40-45 N	55- 60 W	29.73	29.55	29.63	30.32	4	29.00	20
40-45 N	30- 35 W	30.29	29.69	29.62	30.40	9	29.37	21
40-45 N	10- 15 W	29.96	29.46	29.96	30.48	31	29.30	18,20
35-40 N	0- 5 W	29.85	29.70	30.17	30.44	28	29.50	11
30-35 N	70- 75 W	30.09	29.94	30.20	30.32	27,31	29.63	16
30-35 N	55- 60 W	29.98	29.97	29.99	30.30	5	29.69	9,16
25-30 N	95-100 W	30.02	30.04	29.98	30.40	15	29.63	20
25-30 N	80- 85 W	30.12	30.08	30.12	30.28	31	29.90	18
25-30 N	45- 50 W	30.01	29.96	29.99	30.12	3,5	29.73	16
25-30 N	15- 20 W	29.85	29.90	30.15	30.31	27	29.59	16
20-25 N	30- 35 W	29.99	29.96	30.07	30.18	27	29.72	18

* Mean of last 11 days of month.

The mean and extreme pressures presented in the above table are based on the daily pressure values, determined by interpolation for each square, on the MS. daily synoptic charts of the North Atlantic compiled by the Marine Section of the Weather Bureau.

GALES.

The number of days on which gales were reported during the month varied greatly over the different divisions of the ocean. In the waters between the 35th and 45th parallels, and the 50th meridian and the American coast, the greatest number recorded in any 5-degree square was 14, or 45 per cent, and the least 10 or a percentage of 32. These figures show that gales were much more numerous than usual in these waters, as the

normal percentage varies from 13 to 23. Outside the area defined these conditions were reversed, especially along the middle and eastern divisions of the steamer routes, where the number of days with winds of gale force was considerably less than usual.

On December 1 a LOW of 29.45 inches was central near latitude 42° N., longitude 61° W., and southerly gales of from 40 to 65 miles an hour prevailed over a limited area in the eastern quadrants. On the same day a HIGH with a crest of 30.45 inches was near latitude 45° N., longitude 40° W., while a second long and narrow area of low pressure of comparatively slight intensity extended from the 50th to the 63d parallels, its major axis being about 200 miles west of and parallel with the European coast. A number of vessels between the 40th and 45th parallels, and the 15th and 26th meridians, encountered westerly and northwesterly gales of from 40 to 55 miles an hour accompanying comparatively high barometric readings in some cases.

The first LOW moved rapidly northward, and on the 2d the center was near Cape Whittle, Quebec, where the barometer reading was 28.84 inches. The HIGH, with a crest of 30.38 inches, was now central near latitude 45° N., longitude 30° W., while the second LOW of the 1st was too far north to plot accurately, due to lack of observations; but its center was apparently in the vicinity of the Faroe Islands. A third depression of slight intensity occupied an extensive area between the north coast of Spain and the Canary Islands. Heavy winds prevailed over the greater part of the ocean between the 35th and 50th parallels, and one vessel near latitude 42° N., longitude 27° W., encountered a northeast gale of 75 miles an hour, while the barometer read 30.30 inches. At the same time the observatory at Ponta Delgada, Azore Islands, reported a northeast wind of 55 miles an hour. From December 3 to 5, inclusive, the weather conditions were comparatively featureless, with weak gradients and light to moderate winds, although a LOW of slight intensity existed from the 3d to the 7th in the vicinity of the Madeira and Canary Islands. On the 6th a LOW was central near Father Point, Quebec; fog covered the Gulf of the St. Lawrence, while moderate to strong northeasterly gales were encountered along the American coast between Hatteras and New York. This disturbance moved in a southeasterly direction, increasing in intensity, and on the 7th the center was near Halifax, where the barometer reading was 29.18 inches. Northwesterly gales prevailed over the area between the 35th and 42d parallels, the 60th meridian, and the American coast, while the winds over the remainder of the ocean were light to moderate.

During the next three days this LOW drifted slowly toward the southeast, decreasing in intensity, and on the 10th its center was near latitude 40° N., longitude 52° W. A few vessels reported moderate gales between the 55th and 70th meridians, on the 8th and 9th, while by the 10th the wind velocity had decreased over this area. On the 9th a LOW with a minimum reading of 29.06 inches covered the southern part of the Irish Channel. Northerly and northeasterly gales of from 40 to 65 miles were prevalent in the region between the 45th and 57th parallels, and the 10th and 25th meridians; and hail was reported by a number of vessels within these limits. On the 10th this LOW was central near Brest, France, having remained nearly stationary in intensity, and the general conditions of wind and weather had also changed but little. Between the 11th and the 14th there was, in the vicinity of the Canadian coast, an area

of low pressure that varied slightly in intensity as well as in extent from day to day. On the 12th there was a second LOW near Hatteras, and one vessel about 100 miles east of that point reported a southwesterly hurricane of over 90 miles an hour. On December 16th a LOW was central near Boston where the barometric reading was 28.52 inches. At the same time a HIGH, with a crest of 30.24 inches, covered the northern part of the Gulf of Mexico, while the waters adjacent to the American coast between Florida and Nova Scotia were swept by strong westerly and northwesterly gales which attained a maximum velocity of 75 miles an hour about 150 miles south of Halifax. A number of vessels off the eastern coast of Florida encountered northwesterly gales of 40 to 55 miles an hour.

On the 12th a second LOW surrounded the Azores Islands, the barometer at Ponta Delgada reading 29.44 inches. This reversal of normal conditions was responsible for the strong easterly and northeasterly winds in the vicinity of the steamer lanes, in place of the usual westerlies. During the next 24 hours the Canadian LOW moved toward the east and on the 17th its center was near latitude 45° N., longitude 56° W.; it had decreased in intensity and, the storm area contracted somewhat in extent, although strong gales still prevailed along the coast between Hatteras and Delaware Bay as well as in the region between the 40th and 45th parallels and the 50th and 65th meridians, where hail and snow also occurred.

On Chart III "Tracks of centers of Low Areas" (XLIV—145) in the MONTHLY WEATHER REVIEW for December, 1916, is shown a LOW (*I* on our Chart IX) that first appears on the chart near Dallas, Tex., on the morning of the 17th. This disturbance moved in an easterly direction with a uniform rate of translation, and on the 19th the center was near latitude 40° N., longitude 66° W. The storm area was limited in extent, although two vessels between the Bermudas and the 75th meridian reported westerly winds of 55 miles and 75 miles an hour, respectively. Low *I* continued its eastward movement and on the 20th was central in the vicinity of latitude 48° N., longitude 55° W.; heavy gales accompanied by snow still raged over a limited area between the 55th meridian and the American coast, although they did not extend south of the 40th parallel. During the next two days the LOW continued in its easterly course, and on the 22d the center was near latitude 43° N., longitude 33° W. On the 21st two vessels between the 40th and 45th parallels and the 55th and 60th meridians encountered winds of storm force, while on the 22d no specially heavy winds were recorded in this region. Low *I* then curved sharply toward the south and on the 23d recurved toward the east, probably passing over the Azores, as on the 24th the center was in the vicinity of Ponta Delgada. From there it took a northeasterly direction and on the 25th was central near latitude 42°, longitude 20°. Between the 22d and 25th the highest wind velocities within this area ranged from 40 to 48 miles an hour, one vessel about 200 miles west of Madeira recording the latter force on the 24th.

On December 22 a LOW (*II* on Chart IX) was central near the mouth of Delaware Bay, winds of from 50 to 65 miles per hour being recorded by vessels near by. This disturbance moved in a northeasterly direction and on the 23d the center was a short distance east of Father Point, Quebec, where the barometer reading was 28.86 inches. On the same day a HIGH with a crest of 30.26 inches covered the American coast between northern Florida and the Virginia Capes. Violent westerly gales

were encountered by vessels midway between these two areas, the velocity of the wind ranging from 50 to 75 miles an hour. The LOW then moved some distance toward the east, and on the 24th was central about 200 miles north of St. Johns, N. F., the wind still blowing with undiminished force over the same territory as on the day before. The disturbance continued on its easterly course and on the 25th the center was near latitude 48°, longitude 42°; the wind had decreased considerably in force, although two vessels experienced moderate westerly gales accompanied by hail. Low *II* then curved sharply toward the northeast, increasing in intensity, and on the 26th it was near latitude 50°, longitude 38°, where the barometric reading had fallen to 28.70 inches. At the same time a HIGH with a crest of 30.60 inches covered the greater part of the Province of Quebec, while a second HIGH of 30.19 inches was central near Madeira. The abnormally steep gradients between these HIGHS and Low *II* were responsible for the unusually large number of storms reported by vessels between the 25th meridian and the American coast. A maximum wind velocity of 65 miles an hour was reported by a vessel near latitude 40°, longitude 63°. During the next 24 hours *II* drifted slowly eastward while the two areas of high pressure remained nearly stationary. There was little change in the conditions of wind and weather during the following 24 hours, and on the 27th practically the entire ocean north of the 35th parallel was storm swept. The LOW then curved sharply northward, and on the 28th was in the vicinity of latitude 52°, longitude 33°. On the same date the Canadian HIGH of the 26th and 27th had moved rapidly toward the south and now surrounded Bermuda, where the barometric reading was 30.34 inches. The European HIGH had changed but little in position, although it had increased in extent, as the isobar of 30.3 inches extended from the coast of France to the Canary Islands. The storm area had contracted somewhat since the previous day, although moderate gales still prevailed over the greater part of the steamer lanes. On the 29th and 30th a LOW occupied an extensive territory immediately east of the Newfoundland coast; northwest gales with snow were recorded in the southwesterly quadrants, while east of the 40th meridian only moderate winds prevailed.

TEMPERATURE.

The mean monthly temperature of the air over the ocean was, as a whole, above the normal. In the northern part of the Gulf of Mexico, and in the waters adjacent to Canada and Newfoundland, the positive departures ranged from 5 to 8 degrees, while along the coasts of the United States and Europe they were somewhat less. Over a limited area between the Azores and the 50th parallel the temperature was either normal or slightly below, practically the same conditions holding true south of the 25th parallel.

The following table gives the departures at a number of Canadian and U. S. Weather Bureau Stations on the Atlantic and Gulf coasts.

	° F.	° F.	
St. Johns, N. F.	+6.0	Norfolk, Va.	-0.3
Sydney, C. B. I.	+5.1	Hatteras, N. C.	-0.2
Halifax, N. S.	+3.7	Charleston, S. C.	+1.7
Eastport, Me.	+1.3	Key West, Fla.	+1.6
Portland, Me.	+0.2	Tampa, Fla.	+3.5
Boston, Mass.	+1.0	Mobile, Ala.	+2.4
Nantucket, Mass.	-2.2	New Orleans, La.	+3.0
Block Island, R. I.	-1.8	Galveston, Tex.	+1.4
New York, N. Y.	-0.6	Corpus Christi, Tex.	+3.3

The lowest temperatures reported by any vessel during the month was 26° F., which occurred on the 26th in the 5-degree square that includes the eastern coast of Newfoundland. The highest for the same square was 39° F., recorded on a number of different days.

FOG.

The number of days on which fog was reported in the higher latitudes was considerably less than usual. Off the Banks of Newfoundland, where the greatest amount ordinarily occurs, it was observed on only 3 days, a percentage of 10, while the normal percentage for this region is from 30 to 35. The steamer lanes were practically free from fog, as none was reported west of the 35th meridian and north of the 35th parallel, and it was observed on one day only between the 35th and 40th meridians. In the lower latitudes fog was much more prevalent than usual; over the waters adjacent to the American coast south of Hatteras it occurred on from 1 to 5 days, and in the vicinity of the Azores also was recorded on 2 days.

HAIL AND SNOW.

Hail was observed on 3 days off the Canadian and Irish coasts, while over the remainder of the steamer routes it was recorded on from 1 to 2 days.

Snow was reported on 4 days in the square between latitudes 40°-45° and longitudes 55°-60°, but it did not occur on more than one day in any 5-degree square in mid-ocean or along the American coast.

The European coast was entirely free of snow.

Winds of 50 mts./hr. (22.4 m./sec.), or over, during December, 1917.

Station.	Date.	Velocity.	Direction.	Station.	Date.	Velocity.	Direction.
		<i>Mts./hr.</i>				<i>Mts./hr.</i>	
Block Island, R. I.	1	52	nw.	North Head, Wash.	13	52	s.
Do.	2	59	nw.	Do.	15	84	s.
Do.	8	59	e.	Do.	16	78	s.
Do.	9	54	w.	Do.	17	64	s.
Do.	13	60	e.	Do.	18	66	s.
Do.	14	76	e.	Do.	21	58	s.
Do.	28	54	nw.	Do.	27	52	s.
Buffalo, N. Y.	8	74	w.	Do.	28	52	s.
Do.	9	78	w.	Do.	29	50	se.
Do.	10	62	w.	Do.	31	58	s.
Do.	28	50	sw.	Pensacola, Fla.	8	57	s.
Canton, N. Y.	9	56	sw.	Pittsburgh, Pa.	8	51	sw.
Cheyenne, Wyo.	5	54	w.	Pocatello, Idaho.	12	50	sw.
Do.	13	56	w.	Point Reyes Light,			
Do.	17	53	w.	Cal.	14	50	nw.
Do.	18	53	w.	Do.	25	70	s.
Do.	20	62	w.	Do.	26	57	se.
Cleveland, Ohio.	8	66	w.	Do.	26	67	se.
Columbus, Ohio.	8	50	nw.	Portland, Me.	14	67	se.
Duluth, Minn.	9	52	nw.	Providence, R. I.	2	58	nw.
Do.	27	57	nw.	San Antonio, Tex.	7	51	nw.
Eastport, Me.	9	60	e.	Sandusky, Ohio.	8	50	w.
Do.	14	70	e.	Sandy Hook, N. J.	2	54	nw.
Erie, Pa.	8	55	se.	Do.	8	57	e.
Do.	9	50	sw.	Do.	9	58	w.
Hatteras, N. C.	10	54	w.	Do.	10	53	w.
Do.	29	50	n.	Do.	13	62	ne.
Do.	30	58	n.	Do.	14	65	w.
Helena, Mont.	17	56	sw.	Sault Ste. Marie,			
Lexington, Ky.	9	50	w.	Mich.	27	52	nw.
Mount Tamalpais,				Seattle, Wash.	18	52	sw.
Cal.	14	52	nw.	St. Louis, Mo.	9	51	nw.
Nantucket, Mass.	8	70	se.	St. Louis, Iowa.			
Do.	14	76	sw.	Tatoosh Island,			
New York, N. Y.	2	68	nw.	Wash.	13	58	sw.
Do.	8	50	w.	Do.	15	68	s.
Do.	9	62	w.	Do.	16	66	sw.
Do.	10	58	w.	Do.	17	52	sw.
Norfolk, Va.	9	50	w.	Do.	18	66	sw.
Do.	10	55	nw.	Do.	21	56	e.
North Head, Wash.	3	58	s.	Do.	23	56	e.
Do.	5	50	s.	Do.	28	52	s.
				Do.	31	80	s.
				Trenton, N. J.	14	52	nw.