

SECTION III.—FORECASTS.

FORECASTS AND WARNINGS FOR OCTOBER, 1916.

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GENERAL PRESSURE DISTRIBUTION OVER THE UNITED STATES AND CANADA, INCLUDING THE HAWAIIAN AND ALEUTIAN ISLANDS, ALASKA, AND THE MIDDLE ATLANTIC OCEAN.

Pressure was moderately low over the Hawaiian Islands from October 4 to 12, inclusive. Otherwise it was nearly normal.

Over the Aleutians pressure was generally low during the first half of the month, moderately high for two days, moderately low for six days, and quite high during the last week of the month, with a pronounced crest on the 25th.

Over northern Alaska low pressure predominated, with the greatest negative departure from the normal on the 3d and 4th. There was one principal system of high pressure that extended over Alaska generally on the 16th and 17th, and there were also minor ones on the 24th, 26th, and 30th. Over southern Alaska pressure was almost continuously high, with, however, an occasional depression, but only one of consequence, that of the 28th and 29th.

In the Pacific States the pressure distribution was much the same as over the Aleutians, but to a less marked degree, averaging above normal between the 6th and 23d, moderately low during the first week and moderately high during the last week of the month until the 29th, when a depression from Alaska appeared, marking the first winter storm type of the present season.

East of the Pacific States, except over northeast Canada, pressure averaged moderately high during the first and third decades of the month, while the second decade was a period of marked storm activity that also covered the Caribbean Sea and the Gulf of Mexico. Over northeast Canada pressure was generally low during the first half and high during the second half of the month.

Over the Middle Atlantic Ocean high pressure prevailed generally north of latitude 30°, while south of this parallel the tendency was subnormal, with periods of severe storm activity.

STORM WARNINGS.

On the evening of the 12th a moderate disturbance from the Canadian Northwest was central over eastern Lake Superior, with an eastward movement, and small-craft warnings were ordered to be displayed on the following morning over the Lower Lakes. The disturbance increased in intensity as it moved eastward, and moderate southwest to northwest gales occurred during the 13th over Lake Ontario and central and eastern Lake Erie. On the morning of the 13th, with the disturbance central over Ontario, southwest storm warnings were ordered from Delaware Breakwater to Eastport, and at 2:30 p. m. extended southward to Hatteras, N. C. Fresh to strong southwest to northwest gales occurred generally, diminishing after the morning of the 14th. At this time another Canadian Northwest disturbance was a short distance northwest of Lake Superior, and as the gradient was quite sharp to the southward small-craft warnings were accordingly ordered for the northern Upper Lakes region. Fresh to strong southwest winds occurred during the day.

The rapid succession of northwest disturbances continued, and on the morning of the 16th a low-pressure system of marked character was central over western Lake Superior, after having greatly increased in intensity and rate of progression since the preceding evening. Northwest and southwest warnings were at once ordered for the Upper Lakes, and at 2:30 p. m. southwest warnings were also ordered for the Lower Lakes. Moderate to fresh west and northwest gales occurred during the day over the Upper Lakes, continuing during the night and extending throughout the Lower Lakes region. At 8 p. m. of the 16th the storm was central over Georgian Bay, with undiminished intensity, and at 9:30 p. m. southwest storm warnings were ordered along the Atlantic coast from Delaware Breakwater to Eastport. Fresh to strong westerly gales occurred on the following day. At 8 p. m. October 17 there was another Canadian Northwest disturbance of marked character on the weather map, but this one had moved in a more southeasterly direction, and was thus central over western South Dakota. Small-craft warnings were therefore ordered displayed on the following morning on Lakes Superior and Michigan. The disturbance dissipated during the 18th, and the winds were only moderate, but, as pressure to the westward was rising rapidly, warnings of strong and colder northwest winds with snow were ordered at 5:30 p. m. on Lake Superior from Duluth to Ashland. The resulting winds were only fresh, although freezing temperatures and snow occurred.

The next Canadian Northwest disturbance appeared over northern Saskatchewan during the 23d, and at 9:30 p. m. small-craft warnings for fresh southeasterly winds were ordered to be displayed on the 24th on Lake Superior. The disturbance did not develop to any extent and only light winds occurred.

On the morning of the 21st there were evidences that a disturbance was approaching the extreme northern portion of Lower California. It spread slowly to the east-northeastward, and on the morning of the 23d was central over Arizona, with an arm of moderate depression extending over southwest Oklahoma. Pressure was quite high immediately to the northward, and on the morning of the 24th there were some indications of the dissipation of the disturbance. During that day, however, there was a redevelopment with a northeastward movement, and at 8 p. m. there was a well-defined center of depression over Iowa that promised a rapid increase in intensity. Southeast storm warnings were therefore ordered for Lakes Michigan and Huron, and from Detroit to Cleveland, the winds to become strong easterly, and to shift to northwest on the night of the 25th. On the morning of the 25th the storm was central over north Lake Michigan, with increasing southeast winds, and southwest warnings were ordered for the balance of the Lakes except western Superior. As pressure was falling rapidly to the eastward, southeast warnings, to be changed to southwest at sunset, were ordered on the Atlantic coast from Portland, Me., to Delaware Breakwater, Del. Special reports at noon of the 25th indicated strong northwest winds over west Lake Superior, and northwest warnings were ordered accordingly. Strong winds occurred over the entire district where warnings were displayed, but

none after the morning of the 26th, and the warnings on the Atlantic coast were lowered at 10 a. m. of that date.

On the morning of the 28th there was a slight depression over eastern Nebraska, with a northeastward tendency, and small-craft warnings for fresh southerly winds were ordered for the Upper Lakes. Although there was but little further development of the disturbance, fresh winds occurred as forecast.

FROST WARNINGS.

The frost warnings that had been issued on the morning of September 30 for the section from the Ohio Valley and Lower Lakes region eastward, were excellently verified on the morning of October 1, when marked high pressure prevailed over the northeastern quarter of the country, with the crest over the lower St. Lawrence Valley. As there was no prospect of an immediate change in the conditions, the warnings were repeated for the Atlantic States as far south as Virginia, and frosts again occurred as forecast on the following morning with light touches also in the mountain districts of Tennessee and North Carolina. Owing to cloud formation local warnings on the morning of the 2d were only partially verified on the 3d. On the morning of the 5th frost warnings for north and west Michigan were issued, following the passage of a moderate depression, but although the succeeding HIGH was of considerable magnitude frost occurred in Upper Michigan only. The still more moderate depression of the 8th was followed by a high pressure system of more marked character, with its crest farther to the northward than on the 5th, and warnings were issued for heavy frost in Michigan and light frosts in the north portions of Indiana and Ohio. Midday special observations indicated general clearing of the weather, and the warnings were therefore extended into northern and western Kentucky, southern Indiana, southern Ohio, western Pennsylvania, and western New York. Frosts occurred as forecast on the following morning (Oct. 10) except in Kentucky. Pressure was then generally high east of the Rocky Mountains, and frost warnings were issued for all portions of the Washington forecast district, except Florida and the southern portions of the East Gulf States. Heavy frost was forecast for the central and northern districts. Again frosts occurred as forecast as far south as Tennessee and North Carolina, but there was none to the southward owing to cloudiness induced by the low pressure over the Caribbean Sea and eastern Gulf of Mexico. The local frosts that occurred on the morning of the 12th for the Middle Atlantic States were also forecast, but not the light frosts that occurred in the southern Appalachians.

No frosts of consequence occurred from the 13th to the 20th, inclusive. On the morning of the latter date, when the great West Indian storm was central over south Lake Michigan, high pressure with killing frosts prevailed over the Southwest, and frost warnings were therefore ordered for the southern states generally, except along the Atlantic coast and in Florida (ordered for extreme northwest Florida at 1:50 p. m.), and warnings of freezing temperatures in the Ohio Valley and Tennessee. On the morning of the 21st conditions were almost exactly as had been forecast, the frost line extending to Pensacola, Fla., and the freezing temperature line into western Tennessee. Cold high pressure still continued in the Southwest, and general frost warnings were again issued, the frosts to extend on the morning of the 22d to the South Atlantic coast, except in central and southern

Florida. These forecasts were verified as were also those made on the morning of the 23d for the Atlantic States as far south as Georgia.

On October 25 another severe storm was passing eastward over the Upper Lake Region, with a following high-pressure system of great extent to the westward and southwestward, but with another depression approaching from the Canadian Northwest. On the morning of the 26th the crest of the high-pressure system was over the western Gulf States, and frost warnings were ordered from Maryland southwestward into central Mississippi. Frosts occurred on the following morning as forecast.

During the month frost warnings were issued as required for the cranberry districts of Massachusetts and New Jersey. Frosts occurred uniformly as forecast, and no frosts occurred without previous warning having been given.

WEST INDIAN STORMS.

Conditions were very active during much of the month over the Caribbean Sea, the West Indies, and that portion of the Atlantic Ocean south of latitude 35°, and several storms of hurricane character developed. Only one of these, however, reached the United States, and that one by way of the middle Gulf coast, an unusual course for the season of the year.

The first information of definite storm formation was obtained on the evening of October 2, when radio reports indicated the presence of a disturbance about 200 miles off the Georgia or South Carolina coast, and northeast storm warnings were immediately ordered from Norfolk to Charleston. More complete reports on the following morning indicated that center of the storm was off the Florida coast, farther south than had been first stated, and at 1 p. m. the northeast warnings were extended to Tybee Island and Savannah, Ga. At 8 p. m. October 3, there were some evidences of a further increase in the storm intensity, and the northeast warnings were continued from Norfolk to Charleston, and on the following morning at Tybee Island and Savannah, when the storm center was apparently a short distance off the Georgia coast. Up to this time strong northeast gales had been reported off the South Atlantic coast, and during the 4th moderate northeast gales occurred on the South Carolina and Georgia coast. By 8 p. m. of the 4th the storm had passed inland to northern Florida with greatly diminished energy, and the storm warnings were accordingly lowered.

The West Indian storm of October 7 to 12, 1916.

After a few days' respite another disturbance appeared in the vicinity of the Island of Dominica, the barometer at 8 a. m. October 7 reading 29.84 inches with calm air and rain falling. Notification was sent at once to the Windward Islands and to the United States Naval Radio Service, and special observations called for. Nothing of value was received during the day, but on the morning of the 8th it was apparent that the disturbance was near and east of Porto Rico and moving northwestward or northward. Advices to this effect were sent to West Indian points and to Weather Bureau stations on the Atlantic and Gulf coast and broadcast by United States Naval Radio. No further reports were received until the morning of the 9th, when the regular reports showed the storm to be still east of Porto Rico. Special evening reports afforded the first definite information as to the location of the storm center. These reports were to the effect that the storm center had passed over the Danish

West Indies, Santa Cruz reporting pressure of 29.42 inches at 3 p. m., with a gale, and St. Thomas, 29.26 inches at 6 p. m. This information was immediately given wide distribution over the water and along the coasts, and shipping warned to exercise great caution. By the morning of the 10th the storm had recurved slightly and had passed to the northeastward of Porto Rico. Nothing further was heard from the storm until the captain of the barque *Bellas* reported by mail that he had encountered it, in the form of a severe hurricane with southeast to southwest gales, on October 12 in latitude 27° 40' N., longitude 62° 20' W.

The storm of October 9 to 19, 1916.

The point of origin of the next disturbance is uncertain. After the passage of the previous storm, pressure continued to fall over the Caribbean, especially to the southward of Jamaica, and on the morning of the 11th there were observed the first evidences of distinct cyclonic circulation with a center apparently a short distance south of Jamaica. The disturbance did not then appear to be of severe character, and no reports that were received later tended to disprove this contention. By the morning of the 13th the center of disturbance had apparently moved to the western Caribbean, probably to about latitude 16° 30' N. and longitude 78° W. Advisory warnings were then distributed and special reports called for. During the succeeding 24 hours the storm appeared to greatly increase in intensity and at 11:30 a. m. passed very close to Swan Island, the barometer reading at that place being 28.94 inches, with the wind blowing with hurricane force from the north. At 9 a. m. the radio apparatus was put out of commission by the storm and it became impossible to send any further reports.

Wind direction and force, weather, and barometer readings at Swan Island are given in Table 1.

TABLE 1.—Observations at Swan Island.

Date.	Barom-eter.	Wind.		Weather.
		Dirac-tion.	Force.	
	Inches.		0-12.	
Oct. 13, 8 a. m.	29.74	ne.	1	Cloudy.
Oct. 13, 1:40 p. m.	29.70	n.	2	Do.
Oct. 13, 3 p. m.	29.70	n.	Do.	Do.
Oct. 14, 6 a. m.	29.37	n.	10	Raining.
Oct. 14, 7 a. m.	29.36	n.	10	Do.
Oct. 14, 8 a. m.	29.26	n.	10	Do.
Oct. 14, 9 a. m.	29.20	n.	12	Do.
Oct. 14, 11:30 a. m.	28.94	n.	12	Do.
Oct. 14, 12:30 p. m.	29.03	e.	12	Do.
Oct. 14, 1 p. m.	29.04	e.	12	Do.
Oct. 14, 3 p. m.	29.32	e.	12	Do.
Oct. 15, 8 a. m.	29.74	se.	8	Do.

The observer at Swan Island reported that the wind blew at the rate of at least 100 miles an hour at times and with hurricane force from 8 a. m. of the 14th until 3 a. m. of the 15th.

Warnings were, of course, immediately sent out broadcast, and all shipping warned to take every precaution for safety. No evening reports were received during the 14th, but the warnings of the morning were repeated, and again on the afternoon and evening of the 15th, the center at the latter time being placed not far south of the Yucatan Channel. On the morning of the 16th the storm center was apparently crossing the northern portion of the Yucatan Peninsula, moving northwestward or northward, and warning advices were again issued morning and

evening. During the night of the 16th-17th the storm passed into the Gulf of Mexico, and at 8 a. m. of the 17th was apparently central at about latitude 24° N., longitude 88° 30' W. Northeast warnings were then ordered on the Gulf coast from Carrabelle, Fla., to Bay St. Louis, Miss. All interested were advised to take every precaution for safety, and all shipping advised to remain in port. These warnings were repeated in the afternoon and again at night. A late radio report from the steamship *El Rio* showed that at 1 a. m. of the 18th the storm center was not very far from latitude 27° N., longitude 89° W., with a barometer reading of 28.98 inches and a heavy easterly gale. By 8 a. m. of the 18th the storm center was in the vicinity of Fort Morgan, Ala., with the tide 2 feet above normal at Pensacola, Fla. Hurricane warnings were then ordered displayed from Apalachicola, Fla., to New Orleans, La.; northeast storm warnings were also ordered along the Atlantic coast from Savannah to Cape Henry, and special warnings of approaching destructive gales were sent to interior points in northwestern Florida, western Georgia, Alabama, and Mississippi, with instructions to distribute the information widely. The storm then moved inland, the center passing almost directly over the city of Pensacola, Fla., at 10:30 a. m., 75th meridian time, when the barometer read 28.76 inches, with a wind of 48 miles an hour from the southeast and a tide 3 feet above normal height. At 10:12 a. m. the wind reached a 5-minute velocity of 114 miles an hour from the southeast, with an extreme velocity of 120 miles an hour from the southeast at 10:13 a. m., the anemometer going down at 10:14 a. m. After the lull attending the passage of the storm center the wind again increased from the west, reaching an estimated velocity of 120 miles an hour. After 11 a. m. the wind subsided to less than a gale.

Figure 1 is a reproduction of the automatic records of pressure, wind direction, and wind velocity at Pensacola during the passage of the storm.

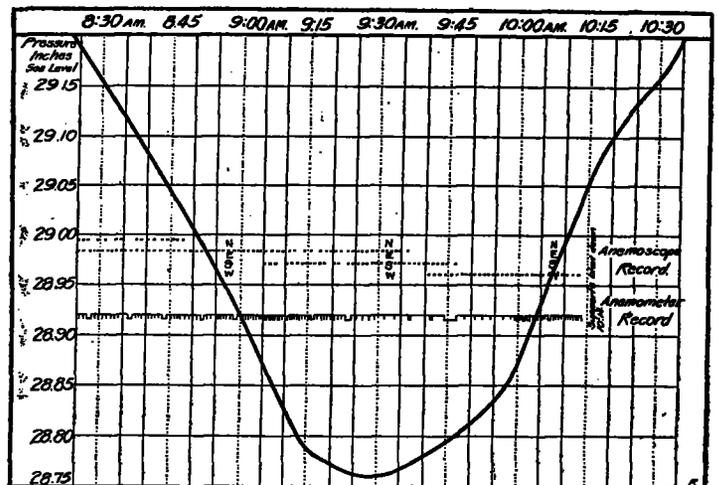


FIG. 1.—Graphs of pressure, wind direction, and wind velocity at Pensacola, Fla., during passage of hurricane of October 18, 1916. Anemoscope records dots at 1-minute intervals; anemometer records a tooth for every mile of wind, the pen is held down for the tenth mile.

At Mobile the lowest pressure was 29.22 inches at 8:35 a. m., 0.46 inch higher than at Pensacola. The wind velocity, however, was 115 miles an hour from the east at 8:25 a. m., practically the same velocity as at Pensacola, with an extreme velocity of 128 miles an hour from the east at 8:28 a. m., somewhat higher than at Pensacola.

Precipitation was not excessive in the vicinity of the storm center, but was torrential some distance away, both

to eastward and westward, Burrwood, La., reporting 11.88 inches during the 24 hours ending at 8 a. m., October 18. The storm center moved rapidly inland and the hurricane warnings were soon changed to storm northwest, the latter being lowered at 9 p. m.

The storm did little damage, comparatively speaking, as ample precautions had been taken on all sides, and furthermore, the storm moved so rapidly that its force in any one locality was soon spent. There was, however, one shipping casualty in the extreme western Caribbean with the loss of some 20 lives.

On the morning of October 15 the storm was central over Indiana, with a lowest reported pressure of 29.58 inches, and with marked high pressure and very steep gradients both to the northeastward and northwestward. Northeast and northwest warnings for strong winds and rain turning to snow were then ordered on the Upper Lakes, and southeast warnings for southerly gales on the Lower Lakes and on the Atlantic Coast from Hatteras to Eastport. Small craft warnings were also ordered from Wilmington, N. C., to Savannah, Ga. At 8 p. m., October 19, the disturbance covered the Upper Mississippi Valley and the Lake Region with indefinite formation, and with falling pressure to the northwestward. Warnings were therefore lowered from Cleveland, Ohio, westward, but were again hoisted on the following morning when the storm showed a remarkable redevelopment with a single center over extreme northeast Illinois, but as yet without strong winds. During the 19th southerly gales prevailed along the Middle Atlantic and New England coasts, and strong gales on the 20th over the Lower Lakes, with several casualties to shipping, attended by considerable loss of life. Over the Upper Lakes the winds were not so violent, and on the morning of the 21st the storm center had passed northeastward beyond the Province of Ontario.

Owing to the redevelopment of the storm, southwest warnings were again ordered at 3 p. m. of the 20th from Hatteras to Boston, and extended to Eastport at 10 p. m. Moderate southerly gales occurred as forecasted.

The subtropical disturbance of October 21, 1916.

On October 21 the pressure was again falling over the West Indies and the adjacent waters with a center of disturbance apparently in the vicinity of the western Bahamas. As the unsettled conditions persisted on the morning of the 23d, it was thought best to order northeast storm warnings from Fort Monroe, Va., to Charleston, S. C. As anticipated, the warnings were followed by fresh northerly gales that, however, did not quite extend to the coast stations. At 10 p. m., October 23, the warnings were extended to Jacksonville, radio reports indicating the necessity therefor. As there was little apparent change on the morning of the 24th, the northeast warnings were continued, as did also the gales, but by the morning of the 25th the winds had subsided, and the warnings were lowered.

Low pressure, however, persisted in Florida, the Antilles, and the Caribbean, and continued until the end of the month, necessitating frequent cautionary advices to shipping. While there was no definite center of disturbance located, moderate gales occurred at times over the western Caribbean.

DISTRICT WARNINGS DURING OCTOBER.

Chicago, Ill., forecast district—Following the passage of a shallow depression over the Lake Region, a high pressure

area, attended by temperatures below freezing, was advancing eastward over the Dakotas on the morning of the 5th, and frost warnings were issued for Wisconsin and portions of Nebraska and Kansas. However, no frost was reported on the morning of the 6th, except on the cranberry marshes of Wisconsin, where minimum temperatures ranged from 15° to 20°.

On the 9th an area of high pressure of great magnitude, with highest pressure 30.7 inches at Miles City, covered the western half of the country, with low pressure over the northeastern States. Warnings of a severe freeze were sent to the cranberry marshes and warnings of a heavy frost to practically all the eastern and southern portions of the district. Heavy to killing frost was almost general on the morning of the 10th, except in portions of Missouri and Kansas, and minimum temperatures of 6° to 11° were registered on the Wisconsin cranberry marshes. Warnings were again issued for Illinois on the 10th, and heavy to killing frosts occurred over most of the State the following night.

Frost warnings that were issued on the 13th for Kansas, portions of Nebraska, Iowa, Missouri, and Illinois were not verified, except in northeastern Illinois, on account of the rapid movement of the high-pressure area and the depression following from the northwest.

No further warnings of importance were issued until the 19th, when a disturbance was advancing rapidly northeastward over the Ohio Valley, followed by a strong area of high pressure and abnormally low temperatures from the northern Rocky Mountain region. Warnings of a hard freeze were issued for Kansas, and forecasts of "rain, turning to snow," for the States east and northeast of Kansas. The forecasts and warnings were fully verified. Freezing temperature and snow were reported as far east as central Illinois, where the snowfall was the earliest of record. Killing frosts having now occurred over the entire district, except eastern Missouri, eastern and southern Illinois, and extreme southeastern Wisconsin, warnings of killing frost were issued on the 20th for eastern Missouri and southern Illinois, and freezing temperature for Wisconsin and northeastern Illinois, where cloudiness was expected to continue. The warnings were not fully verified in Illinois. On the 21st warnings of frost were issued for the vicinity of Chicago and Milwaukee, and killing frost occurred the following night. All stations in the district, except Cairo, had reported killing frost by the 22d, where only light to heavy frost had occurred by the end of the month.

Fire-weather warnings were issued for southern Wyoming on the 3d.—*Chas. L. Mitchell, Assistant Forecaster.*

New Orleans, La., forecast district.—Frost warnings were issued on the 5th for northern and western Oklahoma and the northern portion of west Texas, which were expected to occur in connection with the southeastward movement of an area of high pressure over the Plains States. The high-pressure area moved southeastward with diminished intensity, causing a fall in temperature, but frost did not occur. Frost warnings issued on the 9th for Oklahoma and the northern portion of west Texas failed of verification because cloudy weather persisted in the southwestern quadrant of the high-pressure area which moved southeastward over the Plains States.

On account of the rapid southeastward movement of an area of high pressure from the Canadian Northwest, freezing occurred in the Texas Panhandle and northwestern Oklahoma on the 19th without warning.

Warnings issued on the 19th for freezing in Oklahoma, the northern portion of west Texas, the extreme northwest portion of east Texas, and the northwest portion of Arkansas, and frost for the remainder of Texas, except the southeast portion of east Texas, were verified. Warnings issued on the 20th for freezing in the northern and frost in the southern portion of the district were verified except that frost did not occur on the immediate coast.

Frost warnings issued on the 23d for Oklahoma and the northern portion of west Texas failed of verification because of the sluggish movement of an area of low pressure central on that date over the southern Rocky Mountain region.

Frost warnings issued on the 25th for the interior of the district and on the 26th for Arkansas and the interior of Louisiana were justified.

A special forecast was issued for the rice interests in Arkansas on Wednesday, the 11th, as follows:

Showers will probably extend over Arkansas by Friday.

Showers occurred as forecasted.

Special fire-weather forecasts were issued on the 28th as follows:

Oklahoma: Unsettled weather with southerly winds to-night, 15 to 25 miles per hour, shifting to west and north Sunday.

Arkansas: Unsettled weather with southeast to south winds, 15 to 25 miles per hour to-night, shifting to west and northwest Sunday night.

The wind probably exceeded 15 miles per hour.

No storm warnings were displayed on the west Gulf coast except at stations on the Louisiana and the eastern coast of Texas on the 17th and 18th in connection with the tropical hurricane which moved inland in the vicinity of Mobile, Ala., during the forenoon of the 18th. While verifying wind velocities were not recorded at New Orleans, conditions were such as to fully justify the display of the storm and hurricane warnings. Advisory warnings were received from the central office daily from the 13th until the hurricane moved inland, giving the location and probable movement of the disturbance. The advices were telephoned to ship agents, radiographed to ships at sea, and telegraphed to all coast stations. Shipping heeded the warnings generally and when the hurricane had moved inland on the 18th about 20 steamers, some of which had delayed sailing since the 13th, were waiting to be advised that it was safe to proceed to sea. The steamer *Edward L. Hines* of New Orleans was wrecked by the hurricane off the coast of British Honduras on the night of the 14th. We have been unable to ascertain how many of the crew were drowned.

All small craft on the middle Gulf Coast, being warned in time, put into safe harbors, so that loss to shipping on the open Gulf was reduced to a minimum.

Special forecasts were issued for Shreveport, La., on account of the State fair held at that place November 1 to 6, as follows:

October 28: Generally fair weather is indicated for Shreveport for Sunday, Monday, Tuesday, and Wednesday; temperature changes will not be marked.

October 31: Fair weather is indicated for Shreveport Wednesday, Thursday, and Friday. There will not be much change in temperature.

Fair weather prevailed during the periods covered by the above forecasts and temperature changes were slight.—*I. M. Cline, District Forecaster.*

Denver, Colo., forecast district.—Warnings of heavy frost in localities in western Utah were issued on the 3d. Heavy frost occurred in the vicinity of Salt Lake City. By the morning of the 4th an anticyclonic area had spread eastward over the northern Rocky Mountain region and a barometric depression occupied the Denver district.

Warnings of heavy frost were issued for Colorado and Utah. They were verified. At 8 a. m. on the 5th the crest of the high area had increased and overlay Wyoming and the Dakotas. At the same time the southwestern depression had moved rapidly southward to northern Mexico and warnings of frost and freezing temperature were accordingly issued for the district, excepting Arizona. These warnings failed of verification owing to the eastward movement of a low-pressure area from the South Pacific, which moved rapidly inland and caused rain and warmer weather over the greater part of the district. On the 7th warnings of frost were issued for parts of Colorado, Arizona, and Utah. Killing frost occurred at Modena, Utah, and the temperature fell 14 degrees in western Colorado, but cloudy skies prevented the formation of frost in large portions of the areas for which frost was predicted. Heavy frost warnings were issued on the 15th for limited areas in Colorado and Utah and in northern and eastern New Mexico. Heavy frosts were reported in south-central Colorado and northern New Mexico only. The morning map of the 18th showed a depression of considerable intensity central over southeast Colorado, with high-pressure to the northwestward over Montana and British Columbia. Freezing temperatures and rain or snow were forecast for northeast Colorado, and at 8 p. m. warnings of snow, possibly heavy in eastern Colorado, were distributed. Warnings of freezing temperature in northwest Colorado and Utah and temperatures 10 degrees below the freezing point in southeast Colorado, were also distributed. The warnings were verified. On the 19th advices of freezing temperature in Colorado and heavy to killing frosts in eastern New Mexico were issued. This warning was fully verified. Killing frosts were reported at Santa Fe and Roswell, New Mexico. On the 22d advices of temperatures below the freezing point, with snow, were issued for northeast Colorado. The warning was justified, freezing temperature and snow being confined to the northeast part of the State. Freezing temperature warnings were also issued for Colorado, northeast New Mexico, northern Arizona and Utah on the 23d and for Utah on the 28th, and were verified.

Special forecasts, covering 60 hours in advance in most cases, were issued for the sugar-beet districts of Colorado beginning on the 12th. Special extended forecasts for the potato districts were also issued daily after the 16th. These special forecasts were generally successful, and proved of much benefit during the harvesting period. The following extract from a letter received from the manager of the Great Western Sugar Co., Greeley, Colo., under date of October 20, 1916, indicates their value to affected interests:

We appreciate very much the telegraphic forecasts we are receiving daily from your office. These forecasts were of a great deal of value to us during the recent storm in handling of harvest conditions.—*Frederick W. Brist, Assistant Forecaster.*

San Francisco, Cal., forecast district.—The unsettled and showery condition which prevailed at the close of September continued with but slight interruption during the first decade of October. During this period rain fell at intervals in all portions of the district, and the warnings issued were satisfactory.

This period of wet weather occurred during the height of the raisin curing season and when a large portion of the bean crop had just been cut and was drying in the fields. Both crops were badly damaged. Although the trays were stacked, the damp weather continued so long, that mold formed and damaged most of the crop. The beans were too green to stack and were therefore dis-

colored and otherwise damaged.—*G. H. Willson, District Forecaster.*

Portland, Oreg., forecast district.—October was a remarkably dry month in this district. It was not until near its close that general rains occurred, and they did not extend into southern Idaho. During the long dry period, low pressure areas were mostly of the Alberta type, with occasionally one of the South Pacific or Colorado type. They passed eastward either too far north, or too far south to influence the weather in this district, which was controlled for the most part by high pressure areas.

Heavy frosts formed on the 4th, 5th, and 6th, and they brought the growing season to a close, except near the coast. These frosts were predicted 24 hours in advance of their occurrence. Frost warnings were also issued on the 17th, 18th, and 24th. The first two were verified, but the one issued on the 24th was a failure, owing to an unexpected fall in pressure which was attended by a rise in temperature.

During the dry spell there were several days with east winds which dried the soil very rapidly. Forest fires were numerous in logged off sections, but they caused very little damage to green timber. The atmosphere for many days was disagreeably smoky, and the soil was too hard to permit of the usual amount of fall plowing and seeding being done.

The first North Pacific storm made its appearance on the morning of the 28th, and warnings for same were ordered at the entrances to the Strait of Juan de Fuca, and the Gulf of Georgia early that morning, and extended to the remaining stations in this district the evening of the same day. The warnings were continued the next morning at the most exposed stations. The storm of the 28th was followed by another North Pacific storm which required warnings the morning of the 30th, and they were sent to all stations in this district. All the storm warnings were fully verified.

During the night of the 28th the schooner yacht *La Viagera* was blown ashore at Shannons Point, which is 3 miles from Anacortes, Wash. This vessel was blown 30 miles from her course before going ashore, but no lives were lost. The schooner *Grays Harbor*, at 12:30 p. m. October 30, lost her tiller (?) during a terrific gale, when she was 6 miles off Grays Harbor bar. She was later picked up by a tug and towed into the harbor at Astoria, Oreg.—*E. A. Beals, District Forecaster.*

FORECAST DISTRICTS OF THE UNITED STATES.

[Weather Bureau, Washington, Oct. 20, 1916.]

Weekly forecast districts.

On resuming its system of weekly forecasts in 1915 the bureau published¹ a sample weekly forecast with an outline map of the districts into which the United States is divided in preparing those forecasts. To-day there is presented a slight revision of the map of districts for the weekly forecasts together with the detailed description of the districts.

North Atlantic States.—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, and eastern New York (the portion of the State east of longitude 76°).

Middle Atlantic States.—Eastern Pennsylvania (west of longitude 77° 30'), New Jersey, Delaware, Maryland, District of Columbia, and Virginia.

South Atlantic and East Gulf States.—North Carolina, South Carolina, Florida, Georgia, Alabama, and Mississippi.

West Gulf States.—Louisiana and Texas.

Ohio Valley and Tennessee.—Tennessee, Kentucky, West Virginia, western Pennsylvania (west of longitude 77° 30'), Ohio and Indiana.

Region of Great Lakes.—Western New York (west of longitude 76°), Michigan, and shores of Lake Ontario, Lake Erie, Lake Huron, Lake Michigan, and Lake Superior.

Plains States and Upper and Middle Mississippi Valleys.—Illinois, Wisconsin, Minnesota, Iowa, North Dakota, South Dakota, Nebraska, Missouri, Kansas, Oklahoma, and Arkansas.

Rocky Mountain and Plateau Regions.—Wyoming, Montana, Idaho, Colorado, New Mexico, Nevada, Utah, and Arizona.

Pacific States.—Washington, Oregon, and California.

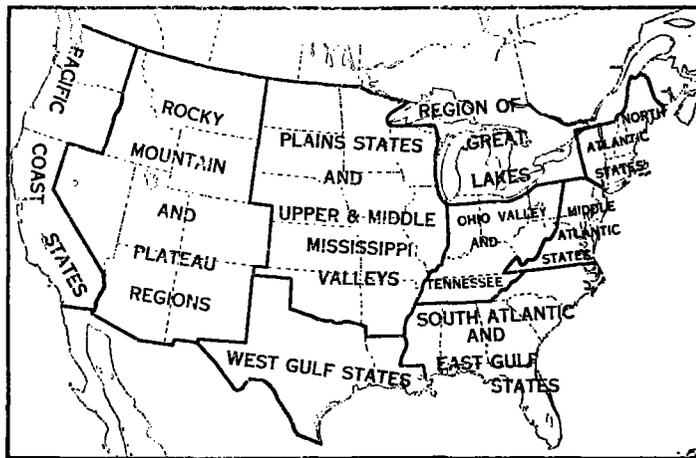


FIG. 1.—Districts used for the weekly forecasts.

Daily forecast districts.

In preparing the daily forecasts the following districts are referred to:

North Atlantic States.—Northern New England (Maine, New Hampshire, and Vermont), southern New England (Massachusetts, Rhode Island, and Connecticut), and eastern New York (the portion of the State east of longitude 76°).

Middle Atlantic States.—Eastern Pennsylvania (east of longitude 77° 30'), New Jersey, Delaware, Maryland, District of Columbia, and Virginia.

South Atlantic States.—North Carolina, South Carolina, Georgia, and eastern Florida (as defined in paragraph 432).

East Gulf States.—Western Florida (as defined in paragraph 432), Alabama, and Mississippi.

West Gulf States.—Louisiana and Texas.

Ohio Valley and Tennessee.—Kentucky, West Virginia, western Pennsylvania (west of longitude 77° 30'), Ohio, and Indiana.

Lake Region.—Western New York (west of longitude 76°), Michigan, lower Lakes (Ontario and Erie), and upper Lakes (Huron, Michigan, and Superior).

Upper Mississippi and Missouri Valleys.—Illinois, Wisconsin, Minnesota, Iowa, North Dakota, South Dakota, and Nebraska.

Central Plains States and Middle Mississippi Valley.—Missouri, Kansas, Oklahoma, and Arkansas.

Northern Rocky Mountain States.—Wyoming, Montana, and Idaho.

Southern Rocky Mountain States.—Colorado and New Mexico.

Southern Plateau States.—Nevada, Utah, and Arizona.

Pacific States.—Washington, Oregon, and California.

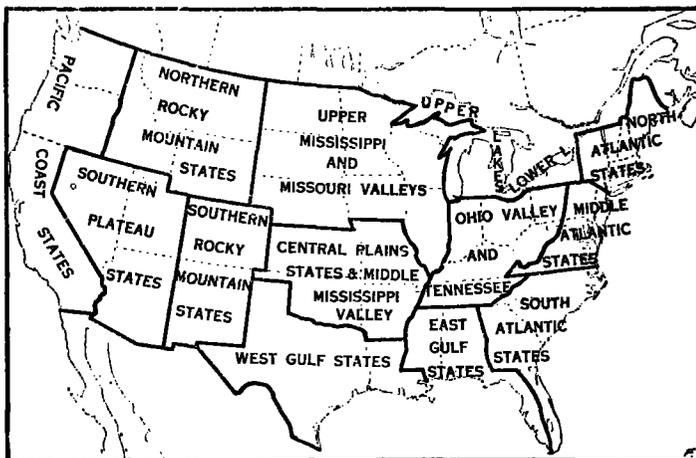


FIG. 2.—Districts used in the daily forecasts.

¹ MONTHLY WEATHER REVIEW, April, 1915, 48:155.