

## SECTION III.—FORECASTS.

## FORECASTS AND WARNINGS FOR AUGUST, 1916.

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[Dated Weather Bureau, Washington, Sept. 19, 1916.]

## HIGHS.

During the month of August, 1916, nine highs, mostly of feeble intensity, passed east-southeast as shown by Chart II (XLIV-S6). The main path of the highs was southeastward through the Dakotas and the Middle Missouri Valley but after leaving that region they diminished greatly in intensity.

## LOWS.

Sixteen primary LOWS and one secondary, were charted during the month. This number includes two tropical cyclones, Nos. VIII and XIII of Chart III (XLIV-S7), but does not include the tropical cyclone of August 29-31 that passed westward over the Caribbean and apparently dissipated over the Yucatan Peninsula on September 1.

Practically all of the extratropical lows of the month passed eastward north of the Great Lakes and there was a marked tendency toward the development of a trough of low pressure extending to the southwest of the center of the low as soon as the latter passed the Great Lakes. In August 50 per cent of the lows which appear on the daily weather maps of the Weather Bureau have their origin in the Province of Alberta. The remaining 50 per cent have their apparent origin over the north Pacific Coast States, the northern and middle Rocky Mountain regions, respectively, or they may develop as secondary disturbances over the Central Valleys east of the Plains States.

The lows of the current month were largely of the Alberta type and their eastward movement after reaching the Missouri Valley was well to the northward of the Great Lakes. The north component of the lows and the fact that not a single disturbance developed in the Gulf and South Atlantic States or moved northeastward from that region are the prominent features of August weather in the United States.

*Tropical cyclone of August 12-18.*

Three tropical cyclones appeared during the month. The first, a portion of whose path is shown as No. VIII of Chart III, was first observed on the morning of the 12th in the vicinity of Barbados; it passed westward a short distance south of Jamaica on the 15th and into the Gulf of Mexico by way of the Yucatan Channel on the night of the 16th; it was approaching the south Texas coast on the morning of the 18th, and passed inland between Corpus Christi and Brownsville the afternoon and evening of the 18th.

Advices of the probable location and movement of this hurricane were sent to all Gulf ports beginning on the 13th and continuing twice daily until definite warnings were issued on the morning of the 18th. A notification of the approach of this storm was also wired to the commanding general at San Antonio, Tex. Some of these advices are published in District Forecaster Cline's report, page 463.

Six lives were lost by the foundering of the coastwise steamer *Pilot Boy* off Port Aransas, Tex.; three additional lives were lost by drowning along the coast near Corpus Christi, Tex., and six at various interior points, as a result of hurricane winds in the lower Rio Grande Valley.

Newspaper reports place the damage sustained in southwest Texas at \$1,800,000. The damage, while largely confined to coast regions, was more or less general over a wide area. In the interior, crops were badly damaged by wind and rain and windmills, fences, and barns were blown down.

Observer W. F. Lehman, in charge of the Weather Bureau office at Corpus Christi, makes the following report on the storm.

*Corpus Christi, Tex.*—The first indications of the approach of the tropical cyclone that visited the western Texas coast region on August 18, 1916, were observed at Corpus Christi on the night of the 17th. The barograph recorded a wavering line, scarcely differing more than one-hundredth from a straight line, from 7 p. m. till 12 midnight, instead of showing the usual rise of about six-hundredths of an inch between 7 p. m. and 10 p. m. The wind, which had been light to gentle easterly during the day, shifted to northeast about 10 p. m. and to the north at 11 p. m. A clear sky with a few strato-cumulus clouds had prevailed since 5 p. m. and was still clear at midnight. Cirrus and cirro-cumulus clouds from the east had been observed during the day, but their prevailing direction had been easterly since the middle of July.

In the early morning of the 18th the barometer began to fall slowly, and the wind, still from the north, increased from light at 1 a. m. to 22 miles at 7 a. m. Cloudiness also increased. Coming from the east, a layer of dense alto-stratus gradually advanced with a well-defined west front. At 5 a. m. about four tenths of clear sky could still be observed. The clouds soon assumed the shape and density of strato-cumulus, and at the time of the morning observation covered eight-tenths of the sky, with a sharply defined area of clear sky in the west.

The first light shower occurred at 7:45 a. m., and a thunderstorm, coming from the northeast and attended by moderate rainfall, passed over the city between 9:40 and 10:35 a. m. The wind, which had reached a velocity of 40 miles at 9:35 a. m., changed to light and moderate northeast during the passage of the thunderstorm, but soon resumed its north direction and squally character.

The barometer, after registering the usual thunderstorm nose, fell rapidly, and the wind increased in intensity, attended from 11:55 a. m. on by a steady rain which did not end until late at night. At 1:53 p. m. a maximum velocity of 64 miles was recorded with an extreme of 70 miles. The direction of the wind soon after changed to northeast and its velocity decreased to the force of a strong gale from 3 to 5:30 p. m.

The first squall of hurricane force occurred at 5:45 p. m. It was the beginning of straight east winds, veering occasionally between east-northeast and east by south. The barometer reached its lowest point, 29.05 inches—29.07 reduced to sea level—at 6:15 p. m., but the wind attained its highest velocities during the subsequent two hours and a half. Estimated maximum velocities of 90 miles were reached at 6:50, 7:18, 8:15, and from 8:40 to 8:50 p. m., the barometer rising rapidly after 6:45 p. m.

From 6:30 p. m. on all the meteorological notes except the barograph curve had to be recorded by eye observation or estimation, since the wind instruments were wrecked and the windowpanes in the instrument room were shattered, burying the mechanism of the automatically registering instrument under glass splinters. The barometer box was fixed solid to the wall, and as there was no safer place to take the barometers to—it was not thought that the windows in the other office rooms would hold out much longer—they were well protected and the room was closed up.

After 9 p. m. the wind subsided, and at 11:30 p. m. it shifted to a southerly direction. The wind continued to blow in gusts till late in the forenoon of the 19th and became light after 7 p. m. A period of unusually light winds and calms, lasting five days, followed the storm.

The total rainfall for the day amounted to 1.58 inches, but this record is unreliable, as much of the rain was blown straight across the roof of the building, and such quantities as fell into the rain gage were mingled with salt-water particles from the bay, only a block distant from the

office. The water drawn from the rain gage had a decidedly brackish taste.

From reports of reliable observers, gathered at this office, the storm center passed inland a little south of Riviera, situated 45 miles south of Corpus Christi. At this place the wind blew from the north until about 8 p. m. and after a half hour's easterly direction came straight from the south. At the office of the Santa Gertrudis ranch, at Kingsville, 14 miles north of Riviera, the aneroid barometer was carefully watched by Mr. J. B. Wright, the manager of the ranch, and he took the lowest reading of 27.70 inches at 8:15 p. m. This instrument showed, on comparison, that it registered three-tenths too low, and it was sent to this office for adjustment. After being adjusted two day's observations and comparisons failed to show any difference in readings between our station barometer and this aneroid.

Hurricane warnings were received and sent out early in the forenoon. Considering local weather conditions and the 7 a. m. barometer readings of regular Weather Bureau stations on the Texas coast, there could be doubt about the course of the storm. It was also expected that telegraph wires would go down early and that the storm, which few, if any, had apprehended only 12 hours before, would reach its fullest strength on the coast about sunset. The coast places were warned first. Some fishermen had already ventured out at dawn in the bay and the lagunes; of these two were drowned. Then warnings that a hurricane was approaching the Texas coast between Corpus Christi and Brownsville and that its full force might be expected sometime at night were sent out for dissemination to all places from Calhoun to Cameron Counties that could be reached by telegraph or telephone. Even as early as 10 a. m. about 20 of the addresses to be advised by telegraph could not be reached on account of wire trouble and had to be sent by telephone.

At 1 p. m. it was thought expedient to warn the city authorities that the worst might be expected between sunset and midnight and that people living in light frame houses should seek shelter in substantial brick buildings for the night. A volunteer brigade of about 100 automobiles was organized, and these were busy from 1 till 5 p. m. in bringing women and children from the outskirts of the city to the safer buildings of the business section. This work was greatly aided by the decrease in wind velocities between 3 and 5:30 p. m. City Hall, hotels, banks, and schoolhouses were filled with refugees, which, while not comfortable, felt at least safe and at ease.

Of the people that thronged the local office of the Weather Bureau during the day a surprisingly large percentage were visitors who had spent their last summer's vacation at Galveston and had come to Corpus Christi this year in order to escape another hurricane. It was the settled conviction of even the oldest inhabitants that Corpus Christi lay outside of the path of destructive storms. Thus many did not trouble themselves with protecting such property as could have been saved, and afterwards were glad that they and their families escaped with their bare lives.

Of the death toll exacted by the storm: six of the crew of the steamboat *Pilot Boy*, coming from Galveston, forewarned, perished when the boat was wrecked in the entrance of Port Aransas Harbor. The two fishermen mentioned before and a boy aged 14 complete the list of those drowned. The unidentified Mexicans were killed in Willacy County, and an aged Mexican and his wife were found dead in their demolished home 7 miles southeast of Alice, Jim Wells County. Three warnings had been sent to Alice and were acknowledged with thanks. The death of an unidentified Mexican woman was reported from San Diego, Duval County.

The property loss in the entire hurricane affected district is estimated at \$1,600,000, the cities of Bishop, Kingsville, and Corpus Christi being the largest sufferers. In Corpus Christi it was the water front that sustained the heaviest damage. All the wharves and most of the buildings on the wharves were destroyed, even the solid timber head of the municipal wharf was unfloored, taking down the storm-warning display tower. Hardly a property in Corpus Christi escaped without damage of some kind, and vegetation where not destroyed suffered heavily. Many of the picturesque salt cedars, the pride of Corpus Christi, were blown down.

There can be no question but that the storm was a fully developed hurricane with a central pressure at least 1 inch lower than that observed at Corpus Christi. The relatively low property losses along the coast must be ascribed to the rapidity with which the storm advanced and passed. Because of this rapidity of movement its chance of creating a big tidal wave were greatly diminished. Also it must be borne in mind that the whole length of the Texas coast is protected by sand islands stretching from the mouth of the Rio Grande to Galveston, with few inlets and sparsely settled.—*W. F. Lehman.*

After passing inland a short distance south of Corpus Christi, the cyclone continued to move in a west-northwest direction, reaching Del Rio, Tex., north latitude  $29^{\circ} 20'$ , west longitude  $100^{\circ} 53'$ , at about 7:30 a. m. local mean time August 19, with a minimum pressure of

28.69 inches. Since it passed Corpus Christi, 200 miles distant, 12 hours earlier, we may assign it a movement of about 17 miles per hour. The recovery of the pressure after the passage of the center of the storm was extremely rapid. By 10 a. m. the barometer was slightly higher than the value it had 24 hours previous. The next observing station in the path of the storm is El Paso, Tex., distant about 300 miles. The barograph at that and other stations in that vicinity do not show any trace of the storm in question; we must therefore consider that it dissipated over southwest Texas during the daylight hours of the 19th.

It is worthy of note that all three tropical cyclones of August, 1916, were characterized by remarkably small diameters and naturally extremely steep barometric gradients near the center only. Two of them surely, and possibly the third, passed into the eastern Caribbean with practically no premonitory signs, and by reason of their small diameters, and the fact that the centers did not closely approach any of the network of land stations except for a very brief period, the location of the center of the storm was in each case a very unsatisfactory matter.

#### *Porto Rican tropical cyclone of August 22, 1916.*

The history of the second tropical cyclone, charted as Low No. XIII, is enveloped in more or less obscurity. Advice of this storm was received from Observer F. E. Hartwell, official in charge, San Juan, P. R., who sent a special observation to the Washington office at 6 a. m., Tuesday, August 22, and later the following report—

*Tuesday, 22d.*—Hurricane of comparatively small diameter passed over Porto Rico this forenoon, vortex entering the island at about Naguabo and leaving between Arecibo and Isabella. Wind velocity at San Juan 90 miles per hour for about 45 minutes. Highest 10-minute period about 92 miles per hour. Much damage was done throughout the island, a million dollars being a conservative estimate of the money loss. Area of destruction was probably 45 or 50 miles wide and time of passing about two and a quarter hours. The rainfall at San Juan was comparatively light, no excessive falls occurring, and the total was less than 2 inches, but reports of as much as 7 to 9 inches have since been received from the interior of the island.—*F. E. Hartwell, Observer.*

The barogram for San Juan gave no indication of the approach of a disturbance until after midnight of the 21st, when it began to fall slowly. By 6 a. m. of August 22 the pressure was falling quite sharply, the lowest point, 29.44 inches, being reached at 7 a. m. Thereafter the rise was as rapid as the previous fall had been. By 8 o'clock the barometer was practically normal. After leaving Porto Rico on the morning of the 22d, the center of the storm did not approach any of the meteorological stations in the Bahamas or Cuba. Slight indications of its presence northwest of Haiti came to hand; continuous watch on the south Florida coast, while failing to show the presence of a tropical cyclone, did indicate the presence of a feeble disturbance east of the Florida peninsula on the 25th and 26th.

#### *Tropical cyclone of August 28–September 1.*

The third tropical cyclone of the month was indicated by cable reports from the Windward Islands on the morning of the 29th, as being south of and near Porto Rico. Mail reports just received show that an intense storm passed over Dominica during the afternoon and evening of the 28th. The hurricane advanced over the island with but little warning; a number of lives were lost and much property was destroyed on the northern and eastern sides.

Mr. W. A. R. Rawle, special meteorological observer at Roseau, furnishes the barogram reproduced as figure 1. Special interest attaches to this barogram, because it is typical of cyclones of extremely small diameter and rapid movement such as passed over Porto Rico, as detailed in the preceding paragraph. After passing to the westward of Jamaica on the 31st this storm was evidently dissipated over the Yucatan peninsula on September 1.

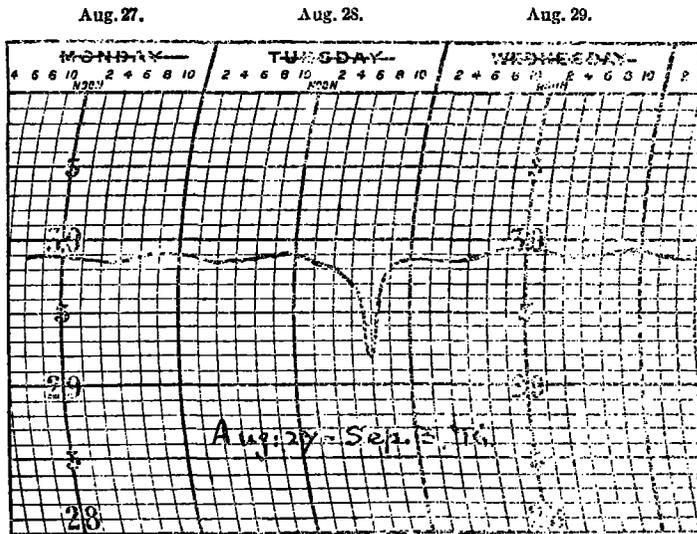


FIG. 1.—Barogram at Roseau, Dominica, Aug. 27-29, 1916.

Valuable reports of the cyclone of the 12th-18th were received by wireless from vessels of the United Fruit Co., especially the *Tenadores* and *Turrialba*, the former passing northward over the western Caribbean on the 16th and cutting the path of the hurricane at right angles and slightly to the rear of its center.

#### DISTRICT WARNINGS DURING AUGUST.

*Chicago district.*—Frost warnings were issued on the 13th and 27th for the entire cranberry marsh region of Wisconsin; for the marshes in central Wisconsin on the 26th; and on the 11th and 29th for the marshes of northwestern Wisconsin.

Fire-weather warnings for Minnesota were issued on August 9 and 10.—*Chas. L. Mitchell, assistant forecaster.*

*Denver district.*—The only warning issued during the month was that for frost in high places in Utah on the 18th.—*Frederick W. Brist, Assistant Forecaster.*

*New Orleans district.*—A small disturbance was central off the mouth of the Rio Grande Valley at 8 p. m. on August 5, and northeast storm warnings were ordered for the Texas coast stations at 8:30 p. m. The storm moved westward into Mexico and its passage was attended by storm winds on the Texas coast.

The only other feature of interest in this district during August was the tropical disturbance which moved inland near Corpus Christi, Tex., on the 18th.

Advisory warnings were received regularly on and after August 13 giving the location, probable intensity, and course of movement of the tropical disturbance.

On August 16 all vessels bound for the Yucatan Channel and Cuban ports were advised to delay sailing on account of the following advisory warning:

Advisory warning, 10 a. m. Tropical disturbance apparently central about 200 miles south of central Cuba, moving west-northwest. Storm is of greater intensity than indicated by earlier reports. It will doubtless reach the Yucatan Channel Thursday. Vessels bound for those waters should exercise caution.—*Henry.*

Advisory warnings were distributed on the 17th, and vessels were advised to delay sailing until further advised. Up to the night of August 17, 12 vessels, which had cleared from New Orleans, had anchored in the river in the vicinity of Pilottown and 8 to 10 steamers came into the river from the Gulf of Mexico to await further advices from the Weather Bureau, so that about 20 steamers were at anchor waiting for advices that it would be safe to proceed.

On August 18 the following warnings were issued:

Hoist northeast storm warnings, Texas coast, 7:40 a. m. Tropical disturbance probably moving north of west in west Gulf. Increasing winds with northeast gales and high tides to-day and to-night. Vessels bound from New Orleans to Cuban and Central American ports may proceed.—*Cline.*

Change to hurricane warnings 8:30 a. m., Corpus Christi to Brownsville. Center of disturbance as yet probably some distance east of western Texas coast.—*Henry.*

Some of the 20 vessels held at New Orleans would have encountered the hurricane in the Yucatan Channel and might have met the same fate as the *Admiral Clarke*, which was lost on the night of August 16. Vessel masters and agents who held their vessels until the routes were safe express the highest commendation for the manner in which the Weather Bureau kept them advised.—*I. M. Cline, District Forecaster.*

*Portland (Oreg.) district.*—August was, as usual, a quiet month in this district. Not so much rain fell as usual, but notwithstanding this fact there were few forest fires. No storm or small-craft warnings were issued and none was needed.

Fire-weather warnings were issued on the morning of the 19th, continued on the morning of the 21st, and concluded on the morning of the 23d. This series of fire warnings was the first issued this season; ordinarily it is necessary to issue them early in July.—*E. A. Beals, District Forecaster.*

*San Francisco (Cal.) district.*—Usually August is a very quiet month in this district and freer from rainy and unsettled weather than any other month. But August, 1916, was notable for the many periods of showery and unsettled weather in all sections. Warnings of showers were issued in southern California for the mountain sections on the 4th, 24th, and 26th, and were verified; but the light showers along the coast on the night of the 23d were not forecast.

In northern California the showers in the San Francisco Bay section on the 14th were not forecast and the warnings issued on the morning of that date were verified only in the mountain sections. The warnings issued on the 27th and 28th were verified in both northern California and Nevada.—*G. H. Willson, District Forecaster.*

*A special chart showing the hurricane tracks of the season of 1916 will be published in the December issue of the REVIEW.*

#### EXTENSIONS OF U. S. WEATHER BUREAU SERVICE.

The agricultural appropriation act for the fiscal year ending June 30, 1917, was approved by the President on August 11, 1916. It appropriates \$24,948,852 for continuing the work of the department and carrying out new legislation. This is an increase of \$1,977,070 over the appropriation for the fiscal year 1916; but this total does not include \$600,000 for printing and binding and a number of larger sums for many other specially indicated purposes.

The appropriation for the Weather Bureau is \$1,747,260, an increase of \$81,210 over the appropriation for 1915-16.