

## TROPICAL DISTURBANCES, JUNE 1936

By I. R. TANNEHILL

[Weather Bureau, Washington, July 1936]

*June 11-17.*—This disturbance, the first of the season, was in evidence in the radio reports on June 11; in the extreme northwestern Caribbean Sea, pressure was below normal with some indications of a cyclonic wind system in the Gulf of Honduras. The reports at hand do not show more definite cyclonic development until 8 p. m. E. S. T., of June 12, when the center was near the northeastern tip of Yucatan. The report from Cozumel Island gave pressure 29.56 inches, wind northwest, light. The disturbance was then moving toward the north-northwest. After passing into the Gulf of Mexico it turned to the northeastward.

The center crossed the Florida Gulf coast about 20 miles south of Fort Myers at 1 a. m., E. S. T., on June 15. During the 15th its course lay slightly south of east across Florida. The center passed directly over Miami with a lull in the wind from 8:03 a. m. to 8:23 a. m. of the 15th.

At 3 a. m., E. S. T., of June 16, the S. S. *Mayari*, at about 26° N., 73° W., reported wind west, force 8, lowest barometer reading (2 a. m.) 29.57 inches.

The center of the disturbance was located at about 30½° N., 69½° W., at 7 a. m. of the 16th. Twelve hours later it was a short distance northwest of Bermuda, where the barometer read 29.48 inches with wind south, force 8. The rate of progressive movement of the disturbance on the 16th and late on the 15th was rapid.

At no time in its history is this disturbance known to have been of hurricane intensity. The highest wind velocity at Miami was 39 miles an hour from the northeast. Wind velocities of 30 to 40 miles an hour were estimated at points elsewhere on the mainland of extreme southern Florida. No extensive damage was caused by the winds. There were torrential rains of 8 to 15 inches in some places in southern Florida, flooding highways and lowlands and causing much inconvenience and some damage. There was some loss of livestock from drowning. A Coast Guard airplane while in search of small boats, fell in Tampa Bay on the morning of June 15 and three Coast Guard employees in the plane lost their lives.

The first advisory message was issued at 9:30 p. m., E. S. T., on June 12 and timely advices were continued at frequent intervals thereafter until the disturbance had passed well to the northeastward of Bermuda on the 17th. Storm warnings were widely disseminated in southern and western Florida on the morning of the 14th, nearly 24 hours before the center of the disturbance crossed the southern part of the State.

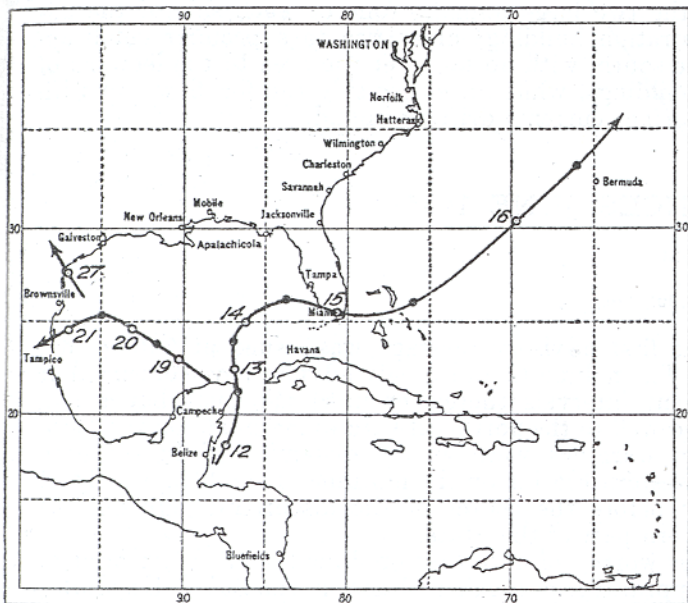
It is worthy of note that on June 8 and 9, just prior to the appearance of the disturbance in the Bay of Honduras, a tropical cyclone was reported in the Pacific Ocean off Guatemala. At 9:30 p. m. (local time) of the 8th the S. S. *Nordhval*, at about 13°45' N., 94°30' W., experienced increasing northeast winds. On the 9th when at approximately 13° N., 93° W., she reported east-southeast winds, force 9, barometer 29.18 inches (uncorrected). The wind then shifted to SE. and S., force 10, then to SSW., diminishing. This and other reports indicate that this cyclone was moving northeastward toward the coast of Guatemala on the 8th and 9th. While there are no further ship reports in the Pacific that connect this storm directly with the disturbance which appeared on the 11th in the Bay of Honduras yet there were heavy rains on the 9th and 11th in Yucatan, and British Honduras, with pressure and wind changes that indicate that this disturbance crossed to the Caribbean Sea.

*June 18-21.*—On June 18 squally weather was reported a short distance north of Yucatan without, however, any definite cyclonic circulation. Radio reports on the 19th indicated the presence of a tropical disturbance to the northwest of Yucatan. The disturbance moved in a northwesterly direction until the evening of June 20, when it was located approximately at 25° N., 95° W., after which it turned toward the southwest, crossing the Mexican coast between Brownsville and Tampico, probably near Sota la Marina.

There are no reports to indicate that this disturbance attained more than moderate intensity. The steamship *Louisiane* encountered the storm on the 20th and 21st and experienced wind force 8 from the north-northwest

with barometer reading 29.66 inches at 1 a. m., E. S. T., on June 21, at about  $23^{\circ}45' N.$ ,  $96^{\circ}35' W.$  The steamship *Arsa* at 1 p. m., E. S. T., on June 20, in latitude  $25^{\circ}20' N.$ , longitude  $94^{\circ} W.$  reported east wind, force 8, barometer 29.56 inches. At midnight (local time) of the 19th to 20th, the steamship *Cayo Mambi* near  $25^{\circ} N.$ ,  $90^{\circ} W.$  had wind east, force 8, barometer 29.68.

The first advisory was issued at 10 p. m., E. S. T., on June 19. Advices were continued at 6-hour intervals thereafter until the disturbance moved inland. During the 20th, storm warnings were hoisted on the Texas coast from Matagorda Bay to Brownsville. Special precautionary advices were issued because of the likelihood of many persons visiting islands and other exposed places along the coast during the week end. Although tides were somewhat above normal, the change in the path of the disturbance resulted in less severe conditions than had been anticipated.



June 26-27.—A tropical storm of small diameter appears to have developed near the coast between Brownsville and Corpus Christi on the night of June 26 to 27. The first indication of the disturbance was a rapid increase in the velocity of the wind from north by east at the Port Aransas Coast Guard station about 8 a. m., E. S. T. Pressure at that time was approximately 29.70 inches. By 9:45 a. m. the wind had reached an estimated velocity of 80 miles an hour from west-northwest. Lowest pressure was 29.32 inches at 10 a. m. Thereafter the barometer rose rapidly to 29.86 inches at noon. The following is quoted from the report of the official in charge of the Weather Bureau Office at Corpus Christi:

The calm center of the storm passed Aransas Pass between 11:15 a. m., and 11:30 a. m., (90th meridian time) and wind velocities from the NW. decreased from 80 m. p. h. to 15 m. p. h. within a few minutes, then increased to about 60 m. p. h. from the west. However, the wind soon decreased rapidly and the storm was practically

over at noon. The calm period lasted about 15 minutes at Aransas Pass. A quiet period occurred at Corpus Christi about noon. The clouds broke rapidly, and the sun shone for a few minutes, and the rain almost ceased. Wind velocities decreased from 36 m. p. h. at noon to 12 m. p. h. at 12:07 p. m., then increased rapidly to 26 m. p. h. at 12:15 p. m., and to 30 m. p. h. at 12:24 p. m. After that, except for a rather heavy shower at 12:30 p. m., and fresh to strong gusts of wind, the wind decreased to eight m. p. h. at 2 p. m. The rain ended at 1 p. m.

From Port Aransas the storm moved northwestward over the southern portions of Aransas, Refugio, and Bee Counties and into Live Oak County, with diminishing force. Its further movement to the vicinity of Eagle Pass was evidenced only by heavy to excessive rain.

No deaths or injuries were reported. Damage occurred chiefly in the area surrounding Corpus Christi Bay. Total damage was estimated at \$550,000, mostly to oil-refining property. There were severe crop losses in San Patricio County and in the extreme eastern portion of Nueces County.

Small craft warnings were hoisted in the Corpus Christi area at 9:15 a. m., C. S. T., of the 27th, northwest storm warnings at 9:40 a. m., C. S. T.; hurricane warnings from Corpus Christi to Matagorda Bay were ordered at 10:30 a. m., C. S. T.

The following is taken from a description of experiences in this storm by Leon Davis, master of the fishing vessel *Sea Gull*:

The *Sea Gull* left Port Aransas Friday morning June 26th for the snapper banks. Having reached a point 51 miles E. 1-2 N. from Port Aransas she anchored, the crew preparing to fish. The sea at that time was smooth, except for some chopiness, frequently occurring in the Gulf. A few cu. nb. appeared, all having rainbows at the top. About 9:30 p. m. the wind began to increase to a fresh breeze from the south; soon "scud" clouds appeared, with dashes of rain. This continued until 11 p. m., when the wind became a strong gale backing to east, and rain became steady and heavier. A whole gale was blowing at 2 a. m., with torrential rain, and between that time and 4 a. m. hurricane winds occurred, the direction E. and ESE., backing still farther to ENE. shortly after 4 a. m. The wind lulled somewhat after this, but continued to blow a whole gale most of the time. Hurricane winds again blew about 7 a. m. mostly E. and ENE. These hurricane winds continued, with some periods of intermission, until about 9 a. m. when the calm center reached the vessel. Suddenly the wind died down, the sun shone brightly, and the rain ceased. For a space of about a mile and a half, a clear circular area prevailed, the dense curtain of rain being seen all around the edge of the circle, and the roar of the wind being heard in the distance. Inside this clear circle the air was oppressive, and foul, with an odor like escaping gas; hot and cold puffs of wind blew alternately; there was a disagreeable feeling, like a scarcity of fresh air. Thousands of birds, both land and sea birds, milled about in this circle; also swarms of butterflies, and moths. Some of the birds fell exhausted on the deck of the boat. The barometer in this circle read 29 inches (29.16 inches, corrected). The heaviest seas of the storm occurred just before entering the center, and were as heavy as ever experienced by this crew in the Gulf of Mexico. After about 15 or 20 minutes the other side of the storm raged, winds now blowing from the W., WNW., NW., SW., and finally S. The storm died down with remarkable suddenness after the center passed, and by noon the storm was over, except for excessive roughness of the sea, which lasted all afternoon, and into the night, while the vessel was homeward bound. The wind and waves removed the paint from the hull of the *Sea Gull*. She almost capsized several times, only skillful handling preventing it. The maximum velocity occurred about 4 a. m., estimated 80 to 85 m. p. h. After the center passed wind did not exceed 70 m. p. h.

## TROPICAL DISTURBANCES, JULY 1936

By J. H. GALLENNE

[Weather Bureau, Washington, August 1936]

Two well-defined tropical disturbances occurred during July 1936. One crossed the Louisiana coast on the 27th; the other moved from the Atlantic through extreme southern Florida and passed inland east of Pensacola on the 31st. The synoptic weather map, Noon G. M. T., of July 27 is reproduced in chart IX, with the tracks of these two disturbances.

There were two other disturbed conditions originating over tropical waters, one during the period July 12 to 14, in the western Gulf of Mexico, and the other on July 22 near Puerto Rico; but neither appears to have developed more than slight intensity. The available reports do not show definite progressive movements to any considerable distances beyond the areas in which they were first observed.

*July 26-28.*—From the ships' weather observations taken at 7 a. m., E. S. T., on July 26, it was evident that there was a tropical disturbance in the southeastern portion of the Gulf of Mexico; and by 7 p. m. its position could be fixed, from ship reports, as being near latitude 26° north and longitude 89° west, with relatively slow movement in a northwesterly direction. At that time the disturbance appeared to be of slight intensity and confined to a small area, although there was a fairly definite cyclonic wind circulation. At 5 p. m. the S. S. *Davanger* near 26½° north, 88° west, reported squally weather, wind force 8, barometer 29.82 inches.

This depression moved on a north-northwesterly course during the next 12 hours, being located approximately 60 miles south of the coast of Louisiana, near the 90th meridian, at 8 a. m., E. S. T. of the 27th. At 7 a. m. the S. S. *San Gil*, at 28°15' north and 89°30' west, reported

south-southeast winds of force 5 (Beaufort scale) with barometer reading 29.76 inches.

During the early afternoon of the 27th, the disturbance moved inland over southern Louisiana. At Delta Farms, Lafourche Parish, the lowest pressure was 29.62 inches (corrected) at 1:30 p. m. E. S. T. This is the lowest barometer reading of record during the progress of the disturbance. It was accompanied by an estimated wind velocity of 50 miles an hour. At the New Orleans Weather Bureau Office, a short distance to the right of the path of the center, the lowest pressure was 29.74 inches, at 5 p. m. on the 27th. Advancing farther inland with a recurve to the northeastward, the disturbance moved into Mississippi and dissipated on July 28.

Storm warnings for the Louisiana coast were issued at 9:15 a. m. E. S. T. on July 27 and all interests were advised to prepare for storm winds and rising tides. The conditions which occurred during the afternoon were fully and accurately heralded in the bulletin disseminated by the forecaster at New Orleans at 12:30 p. m., E. S. T.:

July 27. Bulletin 12:30 p. m. E. S. T.: Tropical storm is turning northward and will move inland during next few hours over Lafourche and eastern Terrebonne Parishes, La., attended by shifting gales from Grand Isle westward to near Houma, La., with tides considerably above normal in area named.

There was no loss of life, and no important storm damage was reported.

*July 27-August 1.*—The history of this disturbance is not clearly shown by the observations until the morning of July 27 when a well-formed but weak cyclonic circulation was charted a short distance south of Cat Island, Bahamas. Progressing on a west-northwesterly course, with increasing intensity, the disturbance crossed Andros

Island at 5 a. m. on the 28th. The S. S. *Atenas* passed through a calm area between the hours of 6:15 p. m. and 7:15 p. m., E. S. T., on this date, while in the vicinity of latitude 25° north and longitude 80° west. The lowest barometer reported by this ship was 29.38 inches. At 7 p. m., E. S. T., the S. S. *Tiger*, a short distance from the *Atenas*, reported a barometer reading of 29.48 inches with a northwest gale of force 9 (Beaufort scale), clear weather, heavy rough sea, and squalls. An hour later, this same ship, giving her position as off Molasses Reef, reported clear sky, southwest gale, rising pressure, 29.54 inches.

With estimated wind velocities of 60 miles an hour near its center, the storm reached the southern tip of the Florida mainland about 30 miles south of Miami at 8 p. m. The Weather Bureau Office at Miami reported a maximum wind velocity of 44 miles an hour from the southeast, while the Miami Airport Station gave east-southeast winds of 49 miles an hour with gusts of 65 miles an hour.

Between 9:30 and 10 p. m., E. S. T., the storm center passed over Homestead and Florida City, maintaining a west-northwesterly course, with a progressive movement of about 10 to 12 miles an hour. The center then moved to the Gulf of Mexico; and at 8 a. m., E. S. T., of the 29th was located at approximately 26° north and 82°15' west.

The following is taken from the report of G. E. Dunn, forecaster at Jacksonville.

\* \* \* The center of the storm passed a short distance south of Everglades City where a barometer reading of 29.51 inches (possibly the barometer fell still lower later) was reported at 2 a. m. with 55 miles northeast wind. Following the passage of the axis of the center an abnormally high tide occurred and by morning the tide was 5.5 feet above mean low and the water was 18 inches deep in the streets of the town at normal low tide. During the forenoon winds of about 60 miles prevailed in the Boca Grande section but with little damage.

At 3:30 p. m. hurricane warnings were ordered north of Cedar Keys to Apalachicola and were later extended westward as the storm made no further recurve. As the storm approached the northwest Florida coast its rate of movement decreased and north of Cedar Keys and especially from St. Marks westward abnormally high tides were produced considering the size and intensity of the disturbance. This was probably due to the slow movement of the storm in this area, giving the wind ample time to pile up the water along the coast. \* \* \*

At 11 o'clock, E. S. T., on the morning of July 31, the storm had crossed the northwest Florida coast and was

centered over Valparaiso, a community on the northern shore of Choctawhatchee Bay, situated about 45 miles east of Pensacola. Reports from Valparaiso at 9 a. m. gave a barometer reading of 28.80 inches attended by east-northeast winds, estimated at 90 to 100 miles an hour. The barometric minimum, 28.73 inches, occurred there at 11 a. m., E. S. T. The calm center was over Fort Walton and Valparaiso about 1 hour and 20 minutes.

From the report of R. A. Dyke, forecaster at New Orleans:

\* \* \* The hurricane winds extended on the coast line for about 70 miles but when allowance is made for the angle at which the storm reached the coast, the hurricane winds may be accepted as covering a width of not much over 50 miles directly across the path of the storm. \* \* \*

As the storm moved in, the storm tide reached a height of approximately 6 feet at Panama City and Valparaiso. \* \* \*

With rapidly diminishing intensity, after passing inland, the storm continued to move northwestward, and was centered just north of Pensacola at 8 p. m., E. S. T., of July 31. It dissipated on August 1 over the southwestern portion of Alabama.

The Weather Bureau forecasters at Jacksonville and at New Orleans issued timely warnings and bulletins relative to the intensity and movement of this disturbance. The first advice was disseminated at 9:30 a. m., E. S. T., of July 27 and advisories and bulletins followed at frequent intervals thereafter, until the storm had dissipated. In all sections affected the display of warnings preceded the arrival of the storm by 12 to 24 hours. Reports indicate property damage was slight as the storm crossed the lower portion of Florida. In the vicinity of Valparaiso and in nearby coastal sections, property damage was placed at \$123,000, as a result of wind and storm tides. Quoting again from the report of G. E. Dunn:

The fishing boat *Keitchum* was apparently lost in the Gulf with 4 persons aboard but no other loss of life directly attributable to the storm in the Jacksonville district has been reported. Fortunately most of the sponge fleet was in port but the Coast Guard plane at St. Petersburg identified and warned 11 sponge and fishing vessels involving 40 persons and a total value of \$22,000 in the storm area. The *Keitchum* left port on the 23d before the first advisory was issued and was outside the area searched by the Coast Guard plane. \* \* \*

TROPICAL DISTURBANCES, AUGUST 1936

By WILLIS E. HURD

[Weather Bureau, Washington, September 1936]

Five tropical disturbances of the West Indian type occurred in the North Atlantic Ocean during August 1936. The earliest, that of the 9th-12th, which was of very slight intensity, was confined to the western Gulf of Mexico. The second, that of the 15th-19th, crossed the southern half of the Gulf, and locally developed some intensity during its westward passage. The third, that of the 20th-22d, originated east of the Bahamas, crossed northern Florida and thence, skirting the extreme northeastern Gulf coast, was of slight to moderate force only. The fourth disturbance, that of the 28th-30th, crossed the extreme lower portion of the Gulf, and was locally of considerable force on the 30th. Coincident with the final Gulf depression, reports were received on the 28th of a disturbance forming near 15° N., 45° W. This disturbance moved northwestward with rapid development. On the 31st, near 24° N., 56° W., winds of near hurricane force occurred. The storm thereafter moved into higher latitudes and on September 6-7 crossed the British Isles. A full description of this storm will appear in the September issue of the REVIEW.

Two tropical cyclones occurred off the west coast of Mexico this month. They are described on pp. 277-278.

The approximate tracks and positions of the centers of four disturbances are given in figure 1.

*Disturbance of August 9-12.*—The first definite signs of development of a cyclonic circulation, with light winds, appeared in the 7 p. m. ship reports of August 8 about 200 miles west-southwest of Port Eads. During the 9th the winds became somewhat more vigorous with forces of 4-5 (Beaufort scale), except that in one instance a moderate gale (force 7) from east occurred. This was radioed to the forecast centers by the S. S. *E. R. Kemp* (barometer 29.90) in 28.8° N., 92.1° W., and was the highest velocity reported during the life of the depression.

At 7 p. m. (e. s. t.) of the 9th the center of the disturbance was located near 28° N., 92° W., moving slowly in a westerly direction, accompanied by moderate to fresh winds. The center, with little apparent depression of the barometer, continued to move westward until the morning observation of the 10th, at which time it was located near 27½° N., 94° W. Thereafter, the course of the depression was south-southwest to southwest, unaccompanied by winds of known gale force, until, on the 12th, it entered the Mexican coast north of Tampico.

Beginning late on the 9th, and continuing until afternoon of the 12th, all interests were advised of the progress of the disturbance by advisories or bulletins issued at 6-hour intervals from the forecast center at New Orleans. Orders to hoist small craft warnings from Galveston to Corpus Christi were issued on August 10 at 3 a. m. (e. s. t.).

*Disturbance of August 15-19.*—This disturbance appears to have originated over the extreme northwestern part of the Caribbean Sea on the 14th, but available reports during the day showed only gentle winds and little depression

of the barometer. On the 15th the disturbed condition had moved northwestward, and at 6 p. m. local time was centered in approximately 23° N., 88° W. A report received subsequently by mail showed that at this time the S. S. *Caruto*, Tampico to Baltimore, 23°40' N., 88°35' W., experienced a north wind, force 5, barometer 29.73; at 6.50 p. m. (local time) the wind, of same force, had hauled to east, pressure 29.56. At 8 p. m., with rising barometer, the ship reported a southeast gale, force 9, thereafter diminishing.

The northwestward movement of the disturbance continued until the morning of the 16th with no increase in intensity so far as reports indicate. The highest wind during the day, according to mail reports, was of force 8, ESE., during squalls experienced by the S. S. *San Benito*

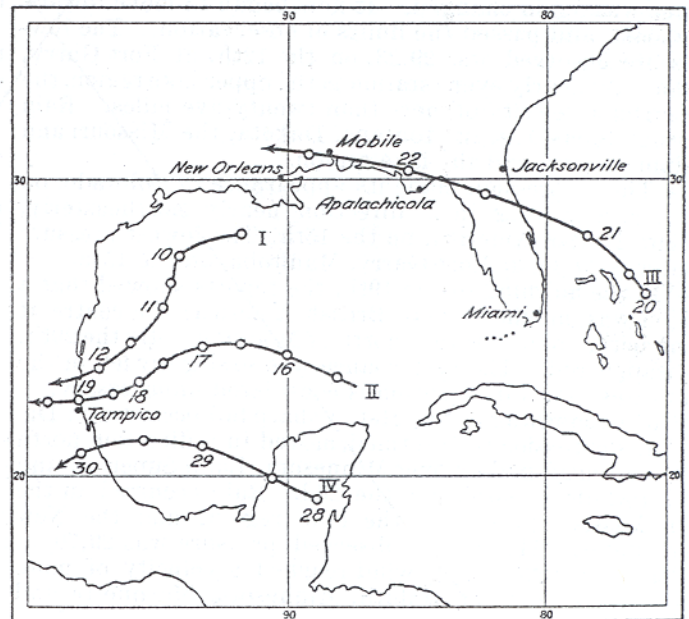


FIGURE 1.—Approximate tracks of tropical disturbances, August 1936.

between 4 and 7 a. m. (local time) near 24½° N., 90° W., lowest barometer 29.83.

The cyclone center, moving westward, was in approximately 24° N., 93° W., at 7 a. m. of the 17th, with winds of force 4-5 reported by ships at a considerable distance from the center. During the day the disturbance changed its course to southwesterly and at 7 p. m. (e. s. t.) was centered near 23½° N., 95° W. At this time the highest wind reported in connection with the disturbance was force 6, south, observed on the S. S. *Agwistar*, near 23° N., 94½° W.

The center continued to move southwestward until 7 a. m. of the 18th, at which time it was near 23° N., 96° W., and so far as reports indicate had meanwhile gathered energy. At this time the S. S. *San Ambrosia*, near

23° N., 95° W., had a south-southeast wind of force 8, attended by rain squalls of hurricane force, barometer 29.73; while the S. S. *Agwistar*, near 22½° N., 96½° W., had a west wind of force 7, barometer 29.62.

Thereafter the center moved toward west-southwest, then west, and passed inland a short distance north of Tampico on the morning of the 19th, accompanied by heavy rains. Quoting from the report of W. R. Stevens, forecaster on duty at New Orleans:

It is likely that the disturbance did not reach hurricane intensity although gusts and squalls of hurricane force probably occurred near the center. The highest velocity reported at Tampico was southwest 30 m. p. h. at 9 and 10 a. m., with lowest pressure 29.52 inches at 9 a. m. August 19.

From the morning of the 17th until the morning of the 19th, when the depression passed inland, frequent advisory messages and bulletins from the forecast center at New Orleans apprised all marine and other interests of the movements of the disturbance. On the morning of the 17th northeast storm warnings were ordered up from Brownsville to Corpus Christi, Tex., and southeast storm warnings northward from Corpus Christi to Matagorda.

*Disturbance of August 20-22.*—On the morning of August 20, slightly falling pressure, with cyclonic circulation, over and northeast of the northern Bahama Islands was evident on the weather map. By 7 p. m. (e. s. t.), although no low center could yet be located, a more vigorous cyclonic circulation was established over the region between approximately 25°-30° N., 75°-80° W., with ships' reports showing wind-forces of 4-6, on the Beaufort scale.

At 7 a. m. of the 21st, observations from a number of ships showed the development of a small cyclone center close to 28° N., 78° W., with accompaniment of fresh to strong winds, highest force 6, with lowest barometer 29.71 inches.

Quoting from the report of Grady Norton, forecaster on duty at Jacksonville, Fla.:

The center passed inland between Titusville and Daytona Beach, Fla., at about 5 p. m. of August 21. The barometer fell to 29.60 inches at Titusville, with winds from west and southwest 40 to 55 miles per hour as the center passed. Squalls of about 30 miles per hour occurred northward beyond Jacksonville along the coast, but at Jacksonville, which is about 18 miles inland, the highest wind was only 25 miles per hour (extreme 27). All warnings were lowered at 8:30 p. m. when the disturbance was over the interior of northern Florida diminishing in intensity.

No appreciable damage was caused by the storm according to early reports, and no loss of life occurred. The copious rains attending the disturbance were very beneficial to citrus and other late crops, and winds were not strong enough to cause any injury to fruit after reaching inland to the citrus regions.

The remnants of the disturbance persisted and crossed the northern part of the State and were in the vicinity of Apalachicola at 8 a. m. of August 22, but no strong winds occurred on the west coast of this district.

Frequent and ample advisory messages and cautionary warnings to small craft in connection with this disturbance were issued from the Jacksonville forecast center. Northeast storm warnings at 9:30 a. m. (e. s. t.) of the 21st were ordered hoisted from Fort Pierce, Fla., to Charleston, S. C.

*Disturbance of August 28-30.*—At the morning observation of August 28, conditions over the Yucatan Peninsula pointed toward the formation of a slight depression, with lowest barometer, 29.74, at Payo Obispo. At 7 p. m. of that date the suspicion was strengthened that a tropical disturbance was originating in the vicinity. Pressure at Merida had fallen to 29.68 inches, which indicated a northwestward movement of the depression.

On the morning of the 29th, reports from ship and Mexican coast stations indicated the formation of a circulatory wind system with center in the Gulf of Campeche. The S. S. *Ceiba*, near 20° N., 92° W., at 7 a. m. reported the lowest barometer, 29.70, with south wind of force 6. At 7 p. m. (e. s. t.) of the 29th four ships in the southwestern Gulf, within the region 20°-23° N., 92°-95° W., clearly showed the existence of a moderate depression with center a little north of the 20th parallel and close to the 95th meridian. Three of the ships, at some distance from the center reported wind forces of 5-6, while the S. S. *Amapala* in 19.8° N., 94.8° W., had a moderate west gale (force 7), pressure 29.53 inches. The extreme wind reported by the *Amapala* was of force 8, south, at 8 p. m., local time, of the 29th. During the morning of the 30th the disturbance became locally of much increased energy, as indicated by a report received by mail from the S. S. *Cayo Mambi*. This ship, in 21°40' N., 97°00' W., had a barometer reading of 29.52 inches, accompanied by a southeast gale of force 9. The maximum wind reported by the ship was from the east, force 11. The disturbance passed inland near Tuxpam on the morning of the 30th.

Advisories and cautionary warnings were issued from New Orleans during the 29th and on the morning of the 30th.

## TROPICAL DISTURBANCES, SEPTEMBER 1936

By I. R. TANNEHILL

[Marine Division, Weather Bureau, Washington, October 1936]

Six tropical disturbances were charted during September in the North Atlantic Ocean and Gulf of Mexico, and three in the southeastern North Pacific Ocean near the coast of Mexico. Three of the six disturbances on the Atlantic side were of full hurricane intensity; one was of only moderate force; the other two were of minor character. Accounts of the Pacific disturbances are contained in this REVIEW under the heading "North Pacific Ocean."

*August 28-September 5.*—The first indications of this disturbance were contained in radio reports from ships in the vicinity of 15° N., 45° W. on August 28. According to a report received by mail, the S. S. *Van Rensselaer* at about 9 a. m. (ship's time) on that date at 16°14' N., 43°14' W., had wind WSW., 5, with barometer reading 29.67 inches (corrected); at 4 p. m. the highest wind, SSE. 10, was experienced on this ship at about 17½° N., 42° W.

After August 28, observations were lacking in the vicinity of the disturbance until the evening of August 31, when ship reports definitely placed the center of a vigorous cyclone near 25° N., 56° W. It is not possible with available reports to locate the center of the disturbance prior to August 31. However, observations at 7 a. m. (eastern standard time) on the 28th were received by radio from the S. S. *Robin Gray* at 10.3° N., 44.7° W., and from the S. S. *Western Queen* at 12.5° N., 46° W., also at 7 p. m. (eastern standard time) from the S. S. *Van Rensselaer*, which was then at 17.5° N., 41.3° W., wind SE. 5, with indications that a tropical storm had formed. This is the farthest area to the eastward in the Atlantic in which the existence of a tropical disturbance has been revealed by radio reports to the Weather Bureau. The previous record was the location of a disturbance on the morning

of September 10, 1928, by a radio report from the S. S. *Commack* in 17° N., 48°15' W.<sup>1</sup>

By September 1 the disturbance had attained full hurricane intensity. The S. S. *Pan America* reported its lowest barometer reading, 29.01, at 1 p. m., ship's time, at 27°14' N., 58°08' W., with wind NW., force 11, increasing to NW. 12 at 2 p. m.

On September 2, the hurricane recurved to the eastward of Bermuda with center in longitude 58° W. Between 2 and 3 a. m., ship's time, on September 3, the S. S. *West Lashaway* at 35°22' N., 54°14' W., had full hurricane winds, ESE., barometer 28.71. Reports indicate that full hurricane intensity was maintained until the morning of the 5th near 42° N., 39° W., where the S. S. *Nike* experienced wind WSW., force 10, barometer 28.32.

September 7-8.—At 7 a. m. eastern standard time, September 7, the S. S. *Chesapeake* at 20°17' N., 58°56' W., with wind SW. by S., barometer 29.77 (uncorrected) reported that there were indications of a tropical disturbance forming to the northward. Other observations from the vicinity at that hour placed the center at about 21° N., 59° W. Twelve hours later there was a mild cyclonic wind circulation over the Leeward Islands and the ocean to the northward, with center near 21° N., 62° W. By the morning of the 8th, the disturbance, which continued to be of minor intensity, appeared to have advanced toward the west-northwestward, but later observations failed to reveal any definite wind circulation.

September 8-26.—While the preceding disturbance was dissipating near the Leeward Islands on the 8th, there were signs of another disturbance to the eastward with center in the vicinity of 13° N., 50° W., at 7 p. m., eastern standard time, of the 8th. At that time the S. S. *West Selene* was at 13.3° N., 52.1° W., and a long swell from the northeast was observed. The swell became heavier late on the 9th and on the 10th, with slowly falling barometer, when the vessel was about 250 miles east of the Leeward Islands. The observing officers estimated the distance to the disturbance to be about 100 miles.

Reports from other vessels on the 10th indicated the presence of a well-developed cyclone centered at approximately 18° N., 55° W. During the following week, it moved steadily northwestward and approached the North Carolina coast on the 17th. Its progressive movement was very slow at first but increased to about 10 miles an hour as it approached Hatteras.

By the morning of September 15 the hurricane was of wide extent and marked intensity. On the 16th the area of winds of force 6 and higher (Beaufort scale) was about 1,000 miles in diameter. By that criterion it was one of the largest tropical cyclones of record.

As the hurricane center approached Hatteras it began recurving to northward and, after passing a short distance east of the Virginia Capes on the 18th, it turned northeastward at an increasing progressive rate. The storm maintained its identity until the 26th at about 45° N., 30° W. The entire track is shown on chart XI.

A considerable number of ships were heavily involved in or very near the hurricane center. A digest of the wind and barometric observations of several of them is contained in the table of "Ocean gales and storms" elsewhere in the REVIEW. One in particular, the S. S. *El Occidente*, in 35°10' N., 74°50' W., at 5 a. m. (ship's time) of the 18th had lowest barometer 28.60 inches, and reported light fog during the lull at the center about 6 a. m.

In the vicinity of Hatteras, the hurricane was one of the most severe of record. The maximum wind velocity

was 80 miles an hour from the northwest (corrected). A report from the official in charge of the Weather Bureau office at Hatteras includes the following:

There was no loss of life on the entire island, but considerable damage to property: Homes, fishing equipment, wharves, fish houses, ice houses, and many other small buildings all along the water front on the sound shore. From the island of Ocracoke, 20 miles south of Hatteras, where damage was only light, on up the North Carolina coast to the Virginia line, it is estimated that approximately \$20,000 damage was done. This damage could not be avoided, because timely warning was given to all. Everyone took extra precaution to safeguard their property so far as possible, but there was nothing else that could be done. It is simply impossible to even imagine just what would have been the results, even in the loss of life, had it not been for the timely warnings given the entire public.

The Section Director of the Weather Bureau at Raleigh estimated the storm damage in North Carolina to roads and bridges, \$25,000; to homes, fishing equipment wharves, and fish houses, \$30,000.

At Cape Henry the full force of the hurricane winds was not recorded; the anemometer cups and spindle were carried away by the wind at 11:37 a. m. (eastern standard time) of the 18th; one cup had previously been blown away. The wind was estimated at 75 miles an hour.

Conditions in the Virginia coastal area are summarized in the following excerpt from the report of the official in charge of the Norfolk Weather Bureau office:

The tropical hurricane that visited the Tidewater area on September 17, on its journey up the coast, can be characterized as the worst storm ever experienced in this section, and only the intensive system of warnings by the Weather Bureau, and the splendid cooperation of the general public, as well as municipal, State, and national forces, saved it from being a major catastrophe.

Every available facility and means for warning the public was utilized, the radio, the newspapers, Coast Guard communication circuits, and municipal protective agencies, resulting in preparedness on such a scale as was never before witnessed here.

That the results fully justified the extensive preparations is evidenced by the comparative slight property loss suffered, estimated at not more than \$200,000 in the city proper, and not more than \$500,000 in the Norfolk area, while only two fatalities occurred in this section. Those were caused indirectly by the storm; W. T. Butt, 59 years of age, resident of Princess Anne, dying as the result of injuries suffered when struck on the head by flying debris, and Udell George, Negro, 23 years of age, was drowned in the southern branch of the Elizabeth River in an effort to recover a rowboat blown adrift.

Moving northeastward from the Virginia Capes, the hurricane center continued at sea, but gales were felt along the coast. At Nantucket the lowest barometer reading was 29.27 inches at about 5 a. m. of the 19th with maximum wind velocity 45 miles (extreme 58) at 7:40 a. m., eastern standard time.

Timely advices and warnings were disseminated at frequent intervals from Jacksonville and Washington as conditions justified. Northeast storm warnings were ordered by the Washington forecaster at 10:30 p. m. eastern standard time, on September 16, for the coastal region from Beaufort, N. C., to the Virginia Capes. Northwest storm warnings were ordered by the Jacksonville forecaster for the North Carolina coast south of Beaufort at 2:45 a. m. of September 17. At 10 a. m. of the 17th, hurricane warnings were ordered north of Beaufort to Manteo; and at noon from Beaufort southward to Wilmington. At 3:30 p. m. northeast storm warnings were extended to Atlantic City. At 9:30 a. m. of the 18th, displays were changed to whole gale warnings north of Virginia Capes to Sandy Hook. Whole gale warnings were ordered at 4 p. m. from New Haven to Provincetown, and northeast storm warnings were displayed elsewhere north of Sandy Hook.

<sup>1</sup>MONTHLY WEATHER REVIEW, 1928, p. 347.



*September 11-13.*—Of only moderate intensity, this disturbance was first located by radio reports from the S. S. *Turpam* in 22° N., 93° W., at 1 p. m., eastern standard time, on the 11th, wind ESE., force 7, barometer 29.80, and indications that a tropical storm had formed. The S. S. *Nemaha*, at 26° N., 95° W., reported that the highest wind experienced was southeast, force 8, with lowest barometer 29.77 at 3 a. m. eastern standard time, September 13. Without evidence of increase in intensity, the disturbance moved in a general northwest direction and crossed the Texas coast near Brownsville on the 13th.

The report of Forecaster Dyke at New Orleans included the following:

The disturbance moved slowly northwestward until the evening of the 12th, when it turned to the right and moved rapidly north-northwestward, passing very close to and east of Brownsville, Tex., on the morning of the 13th, moving at the average rate of approximately 16 miles an hour from 7 a. m. of the 12th to 8 a. m. of the 13th. There was apparently little variation in intensity, as reported wind velocity and barometric pressure while the disturbance was over water and when it reached shore were about the same. Thereafter it passed inland to the west of Corpus Christi, Tex. Easterly winds of force 7 prevailed on Padre Island at Brazos Santiago Pass, 23 miles northeast of Brownsville; and westerly wind of 27 miles an hour was recorded at Brownsville at 7:48 a. m., eastern standard time, showing that the center of the disturbance, probably without a calm or lull, passed between Brownsville and Brazos Santiago Pass. A maximum wind velocity of 35 miles an hour was recorded at Corpus Christi at 12:30 p. m., eastern standard time. A wind of 30 miles an hour from the southeast occurred at Galveston before 8 a. m. The lowest pressure reported was 29.54 at Brownsville at 7 a. m., eastern standard time. Tide-gage readings on the Texas coast were not much above normal.

On indications of the 8 p. m. map of the 12th, northeast storm warnings were ordered from Brownsville to Corpus Christi. Previously in the afternoon a bulletin was sent to Galveston, Corpus Christi, and Brownsville, advising that persons on exposed islands and in boats off Texas coast from Matagorda Bay to Port Isabel should return to the mainland for the week end, due to possibility of storm increasing in intensity and curving so as to move farther north. Fortunately an increase in intensity did not occur and it became unnecessary to use United States Coast Guard planes which were sent to the Texas coast during the night but were not used

for warning purposes. Persons who evacuated the islands and found shelter escaped the driving rains attending the storm.

Storm warnings were extended at night and morning of the 13th over the remainder of the Texas coast.

*September 19-24.*—Reports from the Leeward Islands and vessels to the northward gave some evidence of cyclone formation at about 21° N., 63½° W., at 7 a. m. of September 19. Somewhat more definite cyclonic circulation was apparently centered at about 24° N., 67½° W., at 7 a. m. of the 20th, with northwestward movement. During the 21st, very rapid development took place with recurve to the north-northeastward. As a fully developed hurricane of small diameter, it was centered close to 29° N., 70° W., at noon on the 22d.

The S. S. *Saramacca* passed through the center of the disturbance on the 22d at 28°55' N., 69°45' W., with lowest barometer 28.86 at noon, ship's time, and wind SSW., 12.

Near the point of recurve the hurricane moved slowly but its progressive speed increased on the 23d; and by 7 p. m. of the 24th it was approaching Nova Scotia. During the night it merged with another disturbance approaching from the westward.

*September 25-October 1.*—This disturbance appears to have been of minor character at all stages. Its beginnings are not clearly shown in the observations at hand. As a weak depression it moved west-northwestward across Florida on the 27th and early on the 28th, then north-westward across the extreme northeastern Gulf, and inland at Apalachicola. From the report of Forecaster Dunn at Jacksonville:

A maximum wind velocity of 26 miles from the south occurred at Tampa. \* \* \* Tarpon Springs reported an estimated velocity of 35 miles. This storm did not give any strong winds at Apalachicola although a barometer reading of about 29.70 inches occurred early on the 29th. Except for notice of squalls in the East Gulf marine forecast, no warnings were issued in connection with this disturbance.

## TROPICAL DISTURBANCE, OCTOBER 9-10, 1936

By I. R. TANNHILL

[Marine Division, Weather Bureau, Washington, November 1936]

Only one tropical disturbance was reported during October from the North Atlantic Ocean (including the Gulf of Mexico and Caribbean Sea); this disturbance was of slight intensity; it was in evidence on October 9 and 10 on the west coast of Yucatan and in the Bay of Campeche.

The initial stages of the disturbance are described in the report of W. R. Stevens, forecaster on duty at New Orleans, as follows:

For a few days previous to October 9, conditions had been unsettled over the northwest Caribbean Sea, attended by slowly falling pressure over the Yucatan Peninsula. Heavy rains were reported on the morning of October 9 at Payo Obispo and Cozumel Island. The 8 p. m. map of October 9 showed a definite circulation over the Gulf of Campeche and the pressure at Merida had fallen to 29.70 inches, representing a 24-hour pressure fall of 0.08 inch, while pressure had risen slightly on the east coast of the Yucatan

Peninsula. The reports at hand indicated that the disturbance was just forming and was probably central near Campeche.

Observations from the vicinity of the disturbance are inadequate to determine the exact course of the center; it appears to have moved south-southwestward across the Bay of Campeche and inland a short distance east of Frontera on October 10. The situation on the morning of the 11th, when the disturbance was centered north of Tapachula, is shown on chart IX.

Advisory information regarding the disturbance was disseminated on the 9th and 10th from the New Orleans forecast center.

An account of tropical disturbances which occurred during October in the Pacific Ocean near Mexico will be found on page 343.