

DISTURBANCES IN SOUTHERN WATERS DURING THE HURRICANE SEASON OF 1922.

By W. P. DAY.

Air pressure was abnormally high in the region of the subpermanent north Atlantic anticyclone during the forepart of the hurricane season (including August) with a tendency to displace the line of discontinuity between the two trade-wind systems (along which these storms develop) to a more southern latitude. This may possibly account for the fact that only two, or possibly three, typical hurricanes were noted in Atlantic waters, while the unusual number of five were encountered in the Pacific to the south and west of the Mexican coast. The latter have been charted and described by Mr. Willis E. Hurd of the Marine Division in an unpublished manuscript entitled "Tropical Storms of the Eastern North Pacific Ocean." At least two of the storms charted by Hurd can be connected with disturbances moving westward over the extreme southern Caribbean.

On June 12 disturbed conditions were noted over the western Caribbean. Moving northwest across the Yucatan Peninsula, the disturbance gained considerable intensity and the characteristics of a developing hurricane in the southwestern Gulf of Mexico. A further increase in intensity was prevented by its passage inland on the Mexican coast between Tampico and the mouth of the Rio Grande, but not without first causing unusually heavy rains over the lower Rio Grande Valley. (Consult also Chart XII at back of this REVIEW.)

After a long period of relative quiet a series of disturbances had their beginning about August 23. Unsettled conditions were noted in the extreme southern Caribbean just north of Panama, then rains in Central America and southern Mexico, and finally a hurricane was noted by Hurd in the Pacific Ocean on the 27th near lat. 15° N. and long. 100° W. (lowest reported barometer reading 29.31 inches). The next of this series was noted as a disturbance over the western Caribbean on the 26th, and moved slowly across Central America and along the extreme Mexican coast. This was also charted by Hurd on September 1 near lat. 17° N. and long. 103° W., having developed hurricane intensity over the Pacific Ocean (lowest reported barometer reading 29.35 inches). Hurd also describes a very formidable hurricane in the vicinity of the Revillo Gigedo Islands, reported by the S. S. *Bessemer City*, on the 9th and 10th of September (lowest reported barometer reading 27.96 inches).

The next period began with the reporting of a fully developed hurricane to the east of the Windward Islands. Moving northwest, this storm passed near Barbuda of the Leeward group on the morning of the 16th of September (lowest barometer reading 28.58 inches). After recurving the hurricane passed near Bermuda on the morning of the 21st (lowest barometer reading 28.57 inches), continued northeastward into the steamer lanes and was encountered by a large number of vessels before reaching the English coast in a modified form. From a very intense storm of small diameter, which was noted at Barbuda and Bermuda, the storm enlarged its area enormously in the northern latitudes and retained much of its vortical energy. A most unusual condition prevailed while this storm was recurving in the vicinity of Bermuda. A very severe Atlantic coast storm developed in the Gulf of Charleston in connection with an area of high barometric pressure over the Lake region and the New

England States, reached its greatest intensity off Hatteras on the 20th and 21st, and died out with the dissipation of the northern high-pressure area. This storm was not a hurricane, though winds of near hurricane force were reported on its northern quarter, where the isobars were constricted. No barometer readings lower than 29.50 inches were reported, and, in fact, there was no unusual gradient near the center. The astonishing thing is in the coexistence of this large extra-tropical cyclone with the almost minute (comparatively) but extremely intense hurricane on its eastern periphery, the subsequent filling up of the coast storm, and the enormous expansion of the hurricane.

Unsettled weather prevailed over the Gulf of Mexico and the western Caribbean during much of the month of October. Several disturbances were charted within this area, but only one attained hurricane intensity or characteristics. The first of these was noted as a slight disturbance in the northwestern Caribbean on the 12th and moved northwest and north without gaining any great intensity, a sort of abortive hurricane, passing inland on the Gulf coast between Mobile and Pensacola on the 17th. On the 14th, falling barometer, wind shifts, and squally weather were reported by a vessel immediately southwest of Jamaica. In contrast to the preceding disturbance, this storm developed rapidly both in intensity and area, becoming a severe hurricane by the 16th. Moving at first west-northwest it crossed the Yucatan Peninsula, was deflected to the southwest by rising pressure on its northwestern quarter, and was last charted on the 21st, decreased in energy and modified in form after its passage across land areas, in the vicinity of Frontera in the Province of Tabasco, Mexico. Hurd has charted a hurricane near Cape San Lucas in the Pacific on the 15th of the month, which may belong to this last series.

On farm buildings destroyed, many lives lost, aged, live stock killed, and crop damage great.

Rain..... Heavy damage from wind.
 Rain and wind..... Damage to buildings, trees, etc., and loss of several hundred lives.

STORMS AND WEATHER WARNINGS.

By EDWARD H. BOWIE, Supervising Forecaster.

TROPICAL STORM IN THE WEST GULF OF MEXICO.

The morning of the 15th meteorological observations by radio from vessels in the southwestern Gulf of Mexico disclosed the presence of a disturbance of moderate intensity central off the port of Tampico, Mexico. This disturbance seemingly had its inception over the southwestern Caribbean Sea on the 12th, although the indications were that it was of but minor intensity. Nevertheless, it caused torrential rains in the vicinity of the Swan Islands during the 12th and 13th. On the 13th there were indications of an imperfectly organized disturbance in the Gulf of Honduras, and moving westward it appeared, as stated before, off Tampico on the morning of the 15th. During its movement westward through British Honduras and Yucatan, press reports tell of torrential rains and unprecedented floods in Salvador, and it is probable that similar conditions prevailed in the adjoining republics, but confirmation of this statement is lacking. Moving northwest from the vicinity of Tampico, the cyclone passed inland during the morning of the 16th immediately south of the Rio Grande and passed up the valley of that river, attended by excessive rains which resulted in unprecedented floods in the lower Rio Grande valley. Northeast storm warnings were dis-

played at 2 p. m. of the 15th at Brownsville, Tex., and at 10 p. m. at Corpus Christi, Tex., and at the same time advices were issued of heavy rains along the lower Texas coast in the ensuing 24 hours. A report of the floods in the lower Rio Grande Valley will be found elsewhere in this number of the MONTHLY WEATHER REVIEW.

STORMS AND WEATHER WARNINGS.

EDWARD H. BOWIE, Supervising Forecaster.

WASHINGTON FORECAST DISTRICT.

Aside from frost warnings on a number of days for the lowlands of New Jersey and for the more northern and elevated districts of the Atlantic States and the Ohio Valley, the important warnings issued during the month were in connection with two storms of the western Atlantic. The first of these originated in low latitudes east of the Lesser Antilles, the French S. S. *Mont Rose* encountering it about 200 miles east of Martinique. This vessel received slight damage. Moving west-northwestward this disturbance passed the vicinity of St. Martin on the 16th on a northwest course and later recurved and passed over Bermuda during the early morning of the 21st. At Hamilton, Bermuda, the lowest barometer reading reported was 28.72 inches, the wind reaching hurricane velocity. Preliminary advices concerning this disturbance were issued on the 14th and they were continued daily until after the disturbance passed to the northward of Porto Rico, after which time the complete absence of reports made the issue of authen-

tic advices impossible. On its approach to Bermuda, warning of increasing winds and rain were sent by radio to vessels in the vicinity of Bermuda.

While the first of these disturbances was in progress another developed off the east Florida coast, the first evidences of it appearing the morning of the 18th, when northeast warnings were displayed along the coast from Cape Henry, Va., southward to Brunswick, Ga. Later during the same day northwest storm-warnings were displayed at and between Jacksonville and Jupiter Inlet, Fla. This disturbance increased in intensity and moved slowly northwestward during the 18th. On the morning of the 19th its center was near latitude 30° N. and longitude 78° W., and moving more to the northward, but slowly. Warnings were repeated on the 19th and vessels off the South Atlantic coast were again advised to exercise caution. From its position on the 19th this disturbance advanced north and then northeastward and passed off Cape Hatteras in an easterly direction on the 22d. On the early afternoon of the 20th storm-warnings were ordered displayed on the coast northward from the Virginia coast to Delaware Breakwater and the morning of the 21st the display was extended northward on the coast to Boston, Mass. No observations have

been received of the lowest barometer readings in the immediate center of this disturbance, but the fact that winds of hurricane velocity occurred off the North Carolina coast would lead to the supposition that the disturbance was one of major intensity, but not actually of tropical origin. So far as known no American vessels were destroyed in either of these disturbances. It is a fact of importance, however, that the Diamond Shoals Lightship was blown 12 miles from its moored position by the second of these disturbances. Details concerning these two disturbances will be found elsewhere in this number of the REVIEW.—*Edward H. Bowie.*

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STORMS AND WEATHER WARNINGS.

WASHINGTON FORECAST DISTRICT.

Unsettled weather conditions prevailed over the Gulf of Mexico and the northwestern Caribbean during a large portion of the month and several disturbances of importance were charted, in contrast to the lesser activity on the Atlantic seaboard.

At 10 p. m. of the 2d northeast storm warnings were displayed on the east Gulf coast from Bay St. Louis, Miss., to Cedar Keys, Fla., in connection with a disturbance of moderate intensity that developed over the northeastern Gulf of Mexico and moved slowly westward. It gradually lost intensity and apparently dissipated on the 4th. The lowest barometer reading reported was 29.72 inches at Burrwood, La., and the highest wind velocity, 32 miles an hour from the east at Pensacola, Fla.

On the evening of the 7th a disturbance of marked intensity was central over Lake Erie, moving northeastward, and storm warnings were ordered displayed at 10 p. m. from Delaware Breakwater to Eastport, Me. The following morning the storm warnings were changed to small-craft warnings, the storm having decreased in intensity during the night. The highest wind velocity reported was 48 miles an hour from the south at Atlantic City, N. J.

Small-craft warnings were displayed from Delaware Breakwater to Nantucket, Mass., on the 10th; from Baltimore, Md., to Eastport, Me., on the 23d; from Delaware Breakwater at Eastport, Me., on the 25th; and from Cape Hatteras to Nantucket, Mass., on the 26th.

At 9:30 p. m. of the 12th the first advisory warning was issued regarding the disturbance that formed east of Swan Island in the northwestern Caribbean Sea and moved slowly northwestward during the 12th-17th, inclusive. Frequent special observations by radio from the S. S. *Chalmette* on the 15th were of great assistance in locating the center of the disturbance on that date. Storm warnings in connection with this disturbance were displayed as follows: 9 p. m. of the 13th, Punta Gorda to Jupiter, Fla.; 8 a. m. of the 14th, north of Punta Gorda to Tarpon Springs, Fla.; 10 p. m. of the 14th, Cedar Keys, Fla., to Bay St. Louis, Miss. The highest wind velocity at a land station was 32 miles an hour from the east at Key West, Fla., on the 14th; while the S. S. *Ellis* reported 48 miles from the northeast on the 14th in latitude 25° 12' N., longitude 85° 42' W., and the S. S. *Chalmette* reported 48 miles from the west on the 15th in latitude 26° 00' N., longitude 85° 42' W. After its center reached latitude 28° N., this disturbance turned toward the northwest and decreased in intensity, passing inland between Pensacola, Fla., and Mobile, Ala., as a very slight disturbance, on the morning of the 17th.

On the evening of the 15th the first advisory warnings were issued in connection with another tropical disturbance that apparently developed immediately southwest of Jamaica on the 14th and moved slowly west-northwestward to the northern portion of the Yucatan Peninsula, thence southwestward over the extreme eastern portion of the Gulf of Campeche to the Mexican coast in the vicinity of Frontera, where it was apparently central on the morning of the 21st. This storm dissipated after moving inland, but heavy rains continued for a day or two longer over the eastern States of Mexico.

The lowest barometer reading reported during this storm was 29.06 inches, by the S. S. *Ceiba*, in latitude 20° 12' N., longitude 87° 6' W., on the morning of the 18th, at which time the wind was blowing 64 miles an hour from the south. On the 20th the S. S. *Hibueras*, in latitude 20° 10' N., longitude 92° 06' W., reported a wind of force 12 from the northeast. The lowest barometer reading reported by this vessel was 29.42 inches.

The following press dispatch from Mexico City, dated October 22, was published in the morning papers of October 23.

Reports received here from Vera Cruz, Progreso, Tampico, Tuxpan, and other ports indicated that the storm which has swept the Gulf of Mexico in these regions during the past few days has done considerable damage to shipping. Several small vessels were sunk. The Ward liners *Esperanza* and *Morro Castle* are still outside Vera Cruz unable to enter the harbor after having fought the waves for two days.

Later press reports refer to an urgent call for help having been received from the governor of Quintana Roo, eastern Province of Yucatan, who telegraphed that the entire coast had been lashed by a severe storm, destroying property and crops and causing some loss of life. The islands of Mujeres and Cozumel, off the northeastern coast of Yucatan, were reported to have been swept bare. Newspaper dispatches from Yucatan reported the foundering of several small vessels.

The fishing smack *Ida S. Brooks* was caught in the storm north of Cozumel Island, the eye of the storm passing very nearly over her, as indicated by the distinct lull noted between a whole gale to hurricane from the north, shifting to a full hurricane velocity from the southeast. The sloop was carried northward over the reefs, bumping many times, and finally wrecked on Contoy Island, where the crew managed to get ashore. They were taken off three days later by the S. S. *Hibueras*, which had ridden out the storm in the Gulf of Campeche.

The following letter, dated October 27, 1922, from the manager of the Marine Department, Standard Oil Co. of New Jersey, tells of the use made by that corporation of the advices issued by the Weather Bureau in connection with the storm of the 14th-21st.

During the hurricane in the Yucatan Channel and the Gulf of Mexico last week a number of our steamers were in close proximity to the center of this disturbance,

Due largely to the accurate and prompt information which we received daily from your office and Mr. Kimball, of your New York office, we were able to keep the masters of our vessels fully advised of the course this storm was taking, thus enabling them to keep clear of the center of the storm and perhaps preventing the loss of both life and property.

We wish to take this opportunity of expressing to you our thanks for the valued services rendered, which are greatly appreciated.

The highest wind velocities reported from Mexican stations were 60 miles from the northwest at Vera Cruz and 56 miles from the northwest at Puerto Mexico on the 20th. Reports from stations farther east were missing. Advisory warnings in connection with this storm were issued twice daily until the 21st. The radio reports received from ships were invaluable, especially the regular and special reports from the steamers *Zacapa*, *Hibureas*, and *Ceiba*, without which reports it would have been impossible to have reported the course of the storm accurately.

A communication concerning the meteorological conditions in the Canal Zone preceding and during the formation of these two disturbances of the 12th-17th and the 14th-21st, and the uses to which the storm advices were put, has been received from Mr. R. Z. Kirkpatrick, Chief Hydrographer, Canal Zone. The following are extracts from the letter:

Reference is made to the recent predictions on the West Indian hurricanes, which were promptly received by cable and via Swan Island. These messages were broadcast by radio and by notices to mariners, as fast as received here. They were instrumental in causing some of the boats in the New Orleans trade to postpone their sailings for a day or two. So far, not many marine casualties have been reported.

The few days preceding the appearance of the first disturbance in the Caribbean on the 12th were accompanied by an unusually low barometer on the Canal Zone, the average pressure for the 11th being 29.79 inches. By the 14th this average had increased to 29.87 inches. Southerly winds prevailed from October 8 to 17, inclusive. In the early morning of the 13th a strong wind was experienced on the Pacific coast, attaining a maximum velocity of 36 miles per hour shortly after noon of the same date. An unusual total wind movement of 425 miles was recorded at Balboa Heights on this date, but by midnight the velocity had decreased to 3 miles per hour; then local influences caused a short period of north wind, which later changed to south again at daybreak. This southerly blow, although experienced at Balboa Heights and Cape Mala, was not very pronounced at Cristobal.

The canal and shipping interests appreciate the prompt service given by the Weather Bureau and the Swan Island radio.

It will be noted that the wind direction and movement were unusual, being from the south from the 8th to the 17th, inclusive. A similar radical departure from the normal wind régime occurred in October, 1921, preceding the formation over the southwestern Caribbean of the hurricane of that month.

In connection with this, reports have come out of the Magdalena Department of Colombia of a storm which swept that region during the 48 hours between October 10 and 11, with great destruction to the banana plantations. The connection between this storm and the disturbance noted over the western Caribbean on the 12th seems obvious.

From the 26th to the 29th, inclusive, advisory warnings were issued daily in connection with a disturbance that appeared south of the Louisiana coast on the morning of the 26th and moved slowly eastward with diminishing intensity and another that moved northward from the central Gulf during the 28th-30th, passing inland on the Mississippi coast on the latter date. Small-craft warnings were displayed from Mobile, Ala., to Cedar Keys, Fla., on the 29th. The highest wind velocity reported was 40 miles an hour from the east at Pensacola, Fla., on the 29th.

Frost warnings were issued for a considerable area in the Washington forecast district on the following dates: 12th, 13th, 17th, 18th, 19th, 20th, 23d, 24th, and 26th. These warnings were well verified, as a rule. No warnings were issued, however, for sections farther south than central Mississippi, northern Alabama, northern Georgia, and South Carolina.—*Chas. L. Mitchell.*