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## NORTH ATLANTIC HURRICANES AND TROPICAL DISTURBANCES OF 1943

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[Weather Bureau, Washington, December 1943]

THE hurricane season of 1943, statistically near the average of the past several years, contributed two interesting and significant approaches for investigation. They came in connection with two of the most severe tropical storms of the year, the hurricane of July 25-28 that passed inland over the Houston-Galveston Bay area of Texas, and the intense hurricane of August 20-26 that passed northeast of the Lesser Antilles.

One was the unusual three-pronged pressure fall traced by the barograph pen at the Galveston city office during the passage of the July storm. A copy of the trace sheet is reproduced as figure 1. Many modified examples of these secondary pressure falls have been noticed in connection with the passage of other hurricanes, notably the New England hurricane of 1938, but nothing as clear cut and symmetrical as this trace has been available for study.

The other feature, and one offering greater possibilities for research, involved flights through the two hurricanes by officers of the Army Air Corps. Flights through the earlier storm were made from the Instructor's School at Bryan Field, Tex. On the first flight Col. Joseph P. Duckworth was accompanied by Second Lt. Ralph M. O'Hair, navigator, and on the second trip by First Lt. William H. Jones-Burdick, a pilot weather officer. This is the first time, to our knowledge, that a plane has been intentionally flown through the center of a hurricane. The flights were made at altitudes between 4,000 and 9,000 feet. The following bird's-eye view description of the "eye" of a hurricane is quoted from Colonel Duckworth's report:

As we broke into the "eye" of the storm we were, of course, contact, and could see the sun and the ground. Apparently the "eye" was like a leaning cone as observation of the ground showed a considerable ground wind.

At another point in his report, describing flight conditions, he said:

On the whole, neither flight through the hurricane was as uncomfortable as a good, rough thunderstorm. Rain had been encountered in thunderstorms which was heavier than the rain in the hurricane, to say nothing of much more severe drafts and choppy and bumpy air.

Later in the season observations were reported by Capt. Gordon H. MacDougall, Army Air Corps, during two flights through the hurricane of August 20-26. These flights were made from the island of Antigua, British West Indies, during the morning hours of the 20th and 21st of August. Various meteorological elements were observed and excellent cloud and swell observations were obtained.

Sea conditions observed within the storm area are described in this excerpt from his report:

For those of us who had spent enough time in the Caribbean to be familiar with the magnitude of the waves usually encountered, it was hard to believe what we saw below. The seas were tremen-

dous and the crests were being blown off in long swirls by a wind that must easily have exceeded 70 miles per hour. The long parallel streaks of foam streaming from one wave to another made it evident from which direction the wind was blowing.

Captain MacDougall reported that after pictures were taken an examination of the camera lens showed a salt residue from water droplets deposited at 1,000 feet.

To determine whether the natives possess any understanding of the precursory signs of an approaching hurricane, several natives were queried, with this result:

Our actual findings were that the natives were in all cases completely unaware of imminent danger. Twelve hours before the hurricane was to approach critically near the island we broached the subject with four of the more erudite looking natives of remote Willikies Village. Three of them said honestly, "I cawn't exactly say, mawn." The last one countered with, "No, it's the bloody rain that makes the wind this way."

Below are descriptions of the individual storms taken in the main from station reports.

*Hurricane of July 25-28.*—The hurricane that passed inland over the Bolivar Peninsula, on the upper Texas coast during the early afternoon of July 27, was the most severe storm experienced in the Galveston Bay area since the hurricane of August 16-18, 1915. It was a storm of rather small area but unfortunately passed over the most densely populated and highly developed portion of the Texas coast.

A partial circulation aloft had been noticed over the extreme southeastern portion of the United States and the eastern Gulf of Mexico as early as July 23, but no disturbed surface conditions were observed until the early afternoon of July 25, when wind shifts from southeast to northeast at Burrwood, New Orleans, and Biloxi indicated a disturbance south of Burrwood. Within a few hours heavy seas were reported on Mississippi Sound. The highest wind reported while the storm was moving westward south of the Delta was Beaufort force 7 (32-38 miles per hour), recorded at Burrwood.

During the next 2 days the disturbance increased rapidly in intensity and moving west-northwestward to the Texas coast passed inland over the Galveston Bay region, between noon and 1:00 p. m. (C. S. T.) July 27, as a small intense storm accompanied by full hurricane winds.

Galveston Airport recorded a maximum wind velocity of 74 m. p. h. and Houston Airport 85 m. p. h. while a gust of 104 m. p. h. was recorded on a slack diaphragm anemograph at Texas City. Other maximum wind velocities were: Port Arthur, 54 m. p. h.; Galveston city office, 63 m. p. h., extreme 68 m. p. h.; Ellington Field, 54 m. p. h., and Houston city office, 59 m. p. h.

The calm center of the storm was felt over almost the entire length of the Bolivar Peninsula and reports say its passage required about an hour. Since, at this point, the storm was moving 12 to 14 miles per hour

the calm center or "eye" was about 12 to 14 miles across as it passed inland.

The lowest pressure reported during the passage of this storm was 980 millibars (28.95 inches) recorded at both the Galveston city office and the Houston Airport. Unusually heavy rainfall accompanied the storm. Both Port Arthur and La Porte recorded a fall of over 17 inches during and immediately following its passage.

Damage in connection with this hurricane has been estimated at \$10,000,000 in the Galveston area, \$6,250,000 in the Houston area, and \$300,000 in the Port Arthur area, a total of \$16,550,000. A large amount of the damage was caused by wind-driven rain. Tides were not unusually high and they caused comparatively little damage, although lowlands along Bolivar Peninsula were flooded and several hundred head of cattle were reported lost in this area.

Nineteen persons lost their lives in the storm. The U. S. Engineer's dredge *Galveston*, dragging two anchors, struck the north jetty off the entrance to Galveston Bay and went down in 40 feet of water with the loss of 11 members of the crew. The tug *Titan* foundered at sea en route from Corpus Christi to Port Neches with the loss of 3 lives. Two deaths were reported in Houston, and 1 each in the 3 cities of Galveston, La Porte, and Port Arthur.

Another severe loss, one not easily calculated, comes from work stoppages and slow-downs in all types of industry. These are due not only to flooding, wind damage, and the resultant light and power tie-ups, but also stem from the storm threat itself which keeps many workers away from their places of employment. In the congested area affected by this storm many plants lost 2 full days' production.

*Tropical disturbance of August 13-19.*—A disturbance of moderate intensity was first detected on August 13, near 17° N. and 60° W. Moving northwestward until the evening of the 17th, it then turned north and northeastward, passing about 200 miles east of Cape Hatteras. From this point it decreased rapidly in intensity and lost its identity near 41° N. and 61° W. It did not develop winds of hurricane force.

*Hurricane, August 20-26.*—This large and intense hurricane was first observed on August 20 in the area east of the Lesser Antilles. Moving in a parabolic course, it passed some distance west of Bermuda, joined with a storm that had moved off Labrador at about 51° N. and 42° W., intensified, and moved rapidly northeastward across the Atlantic and north of Scotland. Winds of Beaufort force 12 (over 75 m. p. h.) reported at Bermuda, August 24, while the storm center was estimated to be 100-150 miles west of that island, indicate the large area of hurricane winds that accompanied the storm. At 12 noon, August 24, Bermuda reported a barometer reading of 1,002 millibars (29.59 inches).

*Hurricane of September 1-9.*—No previous charted history is available for the fully developed hurricane that appeared southeast of Bermuda on September 2. On the 3d it passed about 125-150 miles east of Bermuda and then began to curve slowly northeastward. At this point its progress was retarded for several days by a strong high pressure area, after which its course was changed to northwestward, then north, and later to northeastward as it moved into Newfoundland on September 9.

*Disturbance of September 14-16.*—A disturbance developing in the northern end of a trough of low pressure at about latitude 30° N., longitude 72° W. was accompanied by gale winds as it moved northward and northeastward. It passed about 150 miles east of Cape Hatteras on the 14th,

skirted Nova Scotia, and reached Newfoundland on August 16.

*Hurricane of September 15-19.*—From September 12th through the 14th winds aloft showed a partial circulation off the Gulf Coast of Mexico, and by the 15th this circulation was evident in surface observations. During the night of September 16th a high-pressure area, centered over the northern Plains States, blocked the north-northwestward progress of the storm and forced it into a loop which was completed during the 17th. Evidence suggests that this storm was of a violent nature and extended over a wide area during September 16-17. At this period of its existence the disturbance was at its height and while still approximately 80 miles from the coast caused a wind of 62 m. p. h. and a tide of 4.5 feet at Freeport, Tex. Galveston about 120 miles distant from the center reported a wind of 38 m. p. h. (extreme 40), and Port Arthur about 180 miles removed experienced winds ranging as high as 47 m. p. h. (extreme 54).

At Galveston sea swells decreased from a rate of 8 per minute, during the late afternoon of the 15th, to 6 per minute at 6:00 p. m. (C. S. T.) on the 16th.

The level of the water in Lake Ponchartrain exceeded all previous records, rising 0.2 foot higher than the previous record, observed during the passage of the severe New Orleans hurricane of 1915.

The lowest barometer reading along the coast was 1010.5 millibars (29.84 inches) observed on September 16, at Freeport, Tex.

The storm decreased rapidly in intensity during September 18-19, and no winds in line with those that caused damage 2 days earlier were reported as the storm moved inland over the southwestern Louisiana coast.

Heavy rains that accompanied the storm were responsible for most of the damage. At Raceland Prairie, about 2 miles south of Raceland, a combination of heavy rain and backwater inundated an area of approximately 6 square miles to a depth of 3 to 5 feet, and water in Bayou False rose to within several inches of the top of the retaining levee. Although flood conditions required that numerous families be evacuated to higher ground no loss of life has been reported. In Jefferson County damage to property has been estimated at \$15,000 and to crops \$175,000. About 5 percent of the rice crop in this county was lost as a result of the storm. In the Galveston-Freeport area damage, mostly to buildings, amounted to about \$5,000.

*Disturbance, September 28-October 1.*—Forming as a weak wave southwest of Bermuda on the 28th, this storm developed gale winds as it moved northwestward and passed inland over the coasts of Maryland and Virginia during the afternoon and evening of September 30. In the early afternoon, Cape Henry, Va., reported a maximum wind velocity of 56 m. p. h. (extreme 66) from a northwesterly direction. The lowest pressure recorded at that station, 1003.1 millibars (29.62 inches) was registered about 8 p. m. Wind gusts of approximately 60 m. p. h. were experienced during the afternoon at Norfolk Airport.

In the Norfolk and Cape Charles areas gales and heavy downpours of rain caused considerable damage to crops, and high tides with the rain caused flooding of some streets in the downtown portion of Norfolk. One small ship and several small boats were sunk. Property damage was estimated at \$5,000 and crop damage at about \$15,000.

*Disturbance, October 1-3.*—This disturbance was first noticed some distance southeast of Bermuda, and after passing slightly west of that island on October 1-2, curved to the northeastward and lost its identity in the North Atlantic near 45° N. and 55° W. At 7:30 p. m.

(E. S. T.), on October 1, Bermuda reported a wind of force 7 (32–38 m. p. h.).

*Hurricane of October 11–17.*—A moderate disturbance that moved westward through the Windward Islands near Santa Lucia on the 11th, turned northward near longitude 68° W., passed through Mona Passage, accompanied by hurricane winds, and continued on an almost straight northerly course to the Atlantic coast, where it passed inland near the Maine-New Brunswick border with greatly decreased intensity. No gale winds were reported along the Maine coast. Bermuda reported a wind of force 8 (39–46 m. p. h.) as the storm passed about 150 miles west of that island on October 16.

*Disturbance, October 21–22.*—During October 21 and 22 a tropical disturbance, of moderate gale force, moved through the western Caribbean south of Swan Island into the Gulf of Honduras, and dissipated near the east coast of Guatemala.

Three additional tropical disturbances developed during October, one in the Gulf of Mexico on the 1st–2d, and two in the western Caribbean region on the 25th. They were apparently of slight intensity and are not included in the table or chart of tracks.

A tabular listing of the North Atlantic hurricanes and tropical disturbances of 1943 is given at the end of the summary. Their tracks, numbered I through X chronologically, are shown in figure 2.

*Severe hurricane that passed inland, October 9, on the west coast of Mexico, near Mazatlan, Sinaloa.*<sup>1</sup>—Meteorological data contained in the following summary were secured by Arnold P. Eliot of the U. S. Weather Bureau from records supplied by Prof. Vasquez Schiaffino, Chief of the Meteorological Observatory at Mazatlan.

At 9:30 a. m. (90 meridian time) on October 9, 1943, a tropical storm of considerable intensity struck the west coast of Mexico, passing inland a few kilometers south of the Port of Mazatlan, Sinaloa.

The disturbance apparently formed in the area between the Revilla Gigedo Islands and the Marias Islands during the evening of October 8, and moved rapidly northeastward to the coast where it destroyed the small towns of El Roble and Palmillas and partially destroyed Villa Union and the Port of Mazatlan. After passing inland it apparently dissipated upon reaching the mountain range near the coast.

Barometric pressure at the Mazatlan Observatory began to fall at 1:30 a. m. on October 9, reaching a minimum of 958.6 millibars (28.31 inches) about 8 hours later. An extremely rapid fall of 0.827 inch took place in 8 hours.

A maximum wind velocity of 134 m. p. h. was reached about 9:30 a. m. This velocity was recorded for a period of 15 minutes ending when the anemometer was blown loose. Precipitation was light during the actual storm passage but approximately 2 inches fell during the rest of the day.

In the towns previously mentioned about 100 persons lost their lives. Property damage amounted to about \$4,500,000. Several fishing boats and a small Mexican naval vessel were caught in the path of the hurricane, and as no trace has been found, they are presumed lost with all hands. A small coastwise boat arrived in port with 6 of her crew missing.

<sup>1</sup> Included in Summary of North Atlantic Tropical Disturbances as a matter of record.

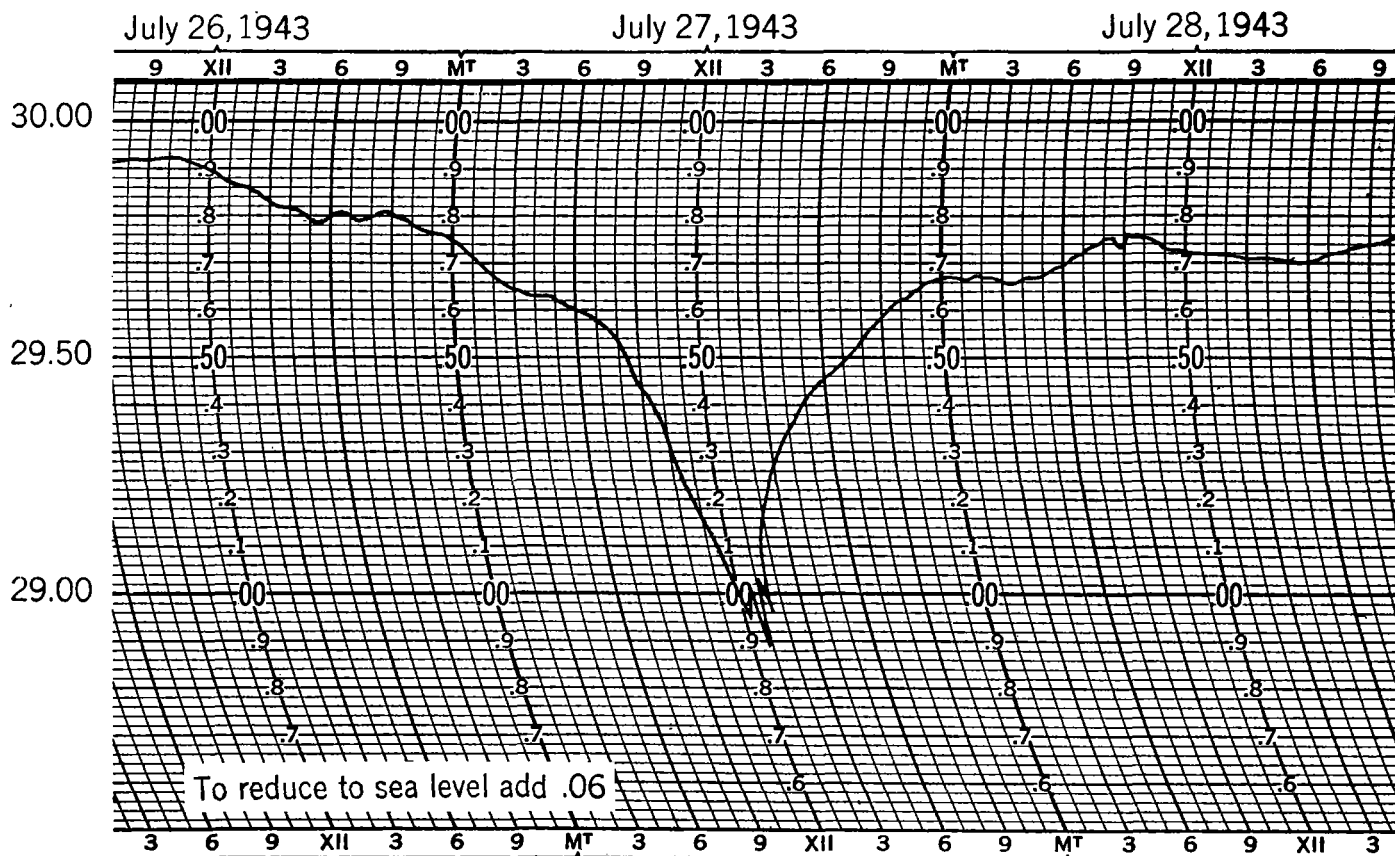


FIGURE 1.—Reproduction of the Galveston City Office barogram of July 26–28, 1943. (90th mer. time.)

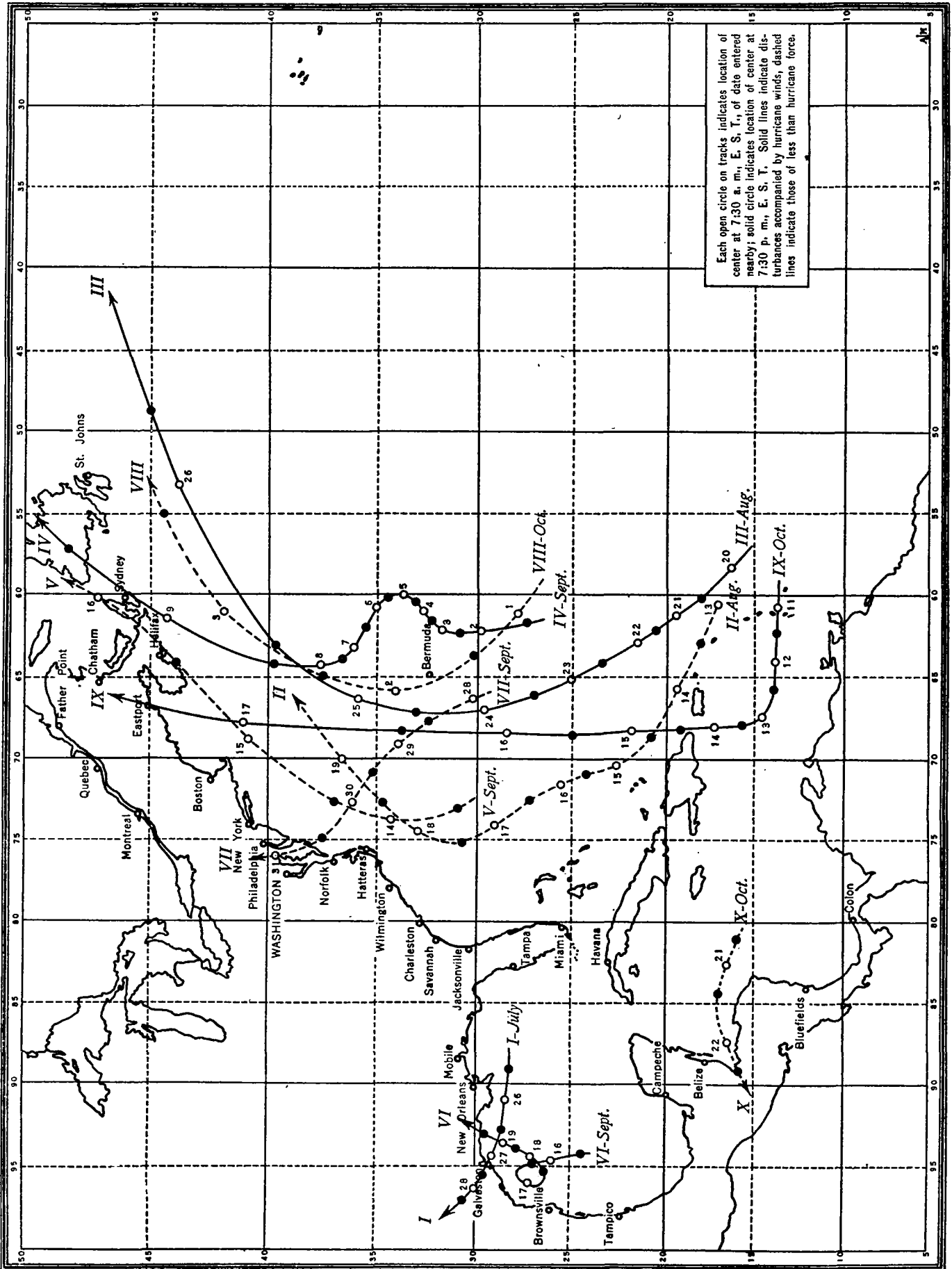


FIGURE 2.—Tracks of North Atlantic Hurricanes and Tropical Disturbances of 1943.

## NORTH ATLANTIC HURRICANES AND TROPICAL DISTURBANCES OF 1943

[Number of storm in table corresponds to number of path on accompanying chart]

Storm	Date	Place where first reported	Coast lines crossed	Maximum wind velocity reported	Lowest barometer reported	Place of dissipation	Intensity	Remarks
I.....	July 26-28.....	North-central Gulf of Mexico.	Texas.....	104 miles per hour at Texas City, Tex.	980 millibars (28.95 inches) at Houston Airport and Galveston city office.	Southern Texas..	Full hurricane.....	Most severe hurricane in Galveston area since 1915. Nineteen lives lost in Texas and at sea off Texas coast. Total estimated damage in southern Texas, \$16,550,000.
II.....	Aug. 13-19.....	Near Virgin Islands.	None.....	40 miles per hour, at sea.	No data <sup>1</sup> .....	North Atlantic Ocean.	Not of hurricane intensity.	Passed considerable distance east of Hatteras on 18th-19th.
III.....	Aug. 20-26.....	East of Lesser Antilles.	do.....	Beaufort force 12 (above 75 m. p. h.) from south at Bermuda on Aug. 24 at 7:30 p. m. (E. S. T.).	1002 millibars (29.59 inches) at Bermuda on Aug. 24-12 noon (E. S. T.).	do.....	Full hurricane.....	No reports of damage have been received.
IV.....	Sept. 11-19.....	Southeast of Bermuda.	Newfoundland.	No data.....	No data.....	Newfoundland..	do.....	Accompanied by a large area of hurricane winds and gales. No damage reported.
V.....	Sept. 14-16.....	North of Bahama Islands.	Skirted Nova Scotia.	do.....	do.....	Near Newfoundland.	Not of hurricane force.	Developed gale intensity near 32° N. 72° W.
VI.....	Sept. 15-19.....	West-central Gulf of Mexico.	Louisiana.....	62 miles per hour NE., Freeport, Tex.	1010.5 millibars (29.84 inches) at Freeport, Tex.	Southwestern Louisiana.	Probably of hurricane intensity at sea.	Large percentage of damage from excessive rains and resultant flooding. No loss of life or serious injury reported.
VII.....	Sept. 28-Oct. 1.	Near Bermuda.....	Maryland and Virginia.	No data.....	No data.....	Maryland.....	Not of hurricane intensity.	Estimated damage Norfolk-Cape Charles area, property \$5,000, crops \$15,000.
VIII.....	Oct. 1-3.....	Southeast of Bermuda.	None.....	do.....	do.....	North Atlantic Ocean.	do.....	Winds of gale force probably developed at sea.
IX.....	Oct. 11-17.....	East of Lesser Antilles.	Northern New England.	Beaufort force 8 (39-46 m. p. h.) from south at Bermuda on Oct. 16 at 7:30 p. m. (E. S. T.). <sup>2</sup>	do.....	New Brunswick, Canada.	Full hurricane.....	No ship losses or damage reported.
X.....	Oct. 21-22.....	Caribbean Sea south of Swan Island.	Guatemala.....	No data.....	do.....	Eastern Guatemala.	Not of hurricane intensity.	Attended by winds of gale force, no reports of damage.

<sup>1</sup> Restriction of radio reports has resulted in a scarcity of data on storms that expended their greatest energy over water surfaces without seriously affecting coastal areas.<sup>2</sup> Higher wind velocities undoubtedly occurred at sea but records are not available.