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NORTH ATLANTIC HURRICANES AND TROPICAL DISTURBANCES OF 1944

By H. C. SUMNER

[Weather Bureau, Washington, D. C., December 1944]

THE intense Atlantic coast hurricane of September 8–16 and the Florida-Cuba storm of October 13–21, each of which wrought damage in excess of $100,000,000, carried the hurricane season of 1944 into second position among the most destructive years of record. The historical New England hurricane of September 17–21, 1938, which from the viewpoint of property damage was probably the greatest natural disaster ever to befall the country, placed the season of 1938 at the top of the list. Other seasons have been more costly in the loss of human life, notably that of 1900 during which the great Galveston hurricane caused the death of about 6,000 persons.

Although the number of tropical disturbances detected during the past season was only slightly above the average of 8.6 storms per year for the last decade, the season of 1944 was notable for the high percentage of storms that developed full hurricane winds along the Atlantic coast north of Florida. No tropical disturbances of any consequence struck the Gulf coast of the United States west of Florida, although two hurricanes moved inland on the Mexican east coast and caused considerable damage.

Aircraft reconnaissance which was inaugurated during the 1943 season was extensively used for securing early fixes on tropical disturbances during the past year, and brought the Hurricane Warning Service an excellent new tool for detecting the presence and probable movement of tropical hurricanes.

Below are reviews of the individual hurricanes and tropical disturbances of 1944 taken in the main from station reports. A synopsis of some of the more important features of these storms is given in the tabular listing at the end of this summary; and their tracks numbered I to X, chronologically, are plotted on the accompanying chart.

I. *Tropical disturbance of July 12–19.*—The first tropical storm of the season developed east of the Bahama Islands on the 14th of July from a wave disturbance that had been traced from the eastern Caribbean Sea, where it was first noted near the Grenada Islands on the 11th. It moved through Mona Passage on the evening of the 12th without showing signs of development. The first evidence of increasing intensity was noted as it neared Turks Island on the 13th, and by the 14th a definite circular wind pattern had been established. At this time the Bahama Islands were reporting fairly high ocean swells moving on the coast at the rate of about six per minute.

Moving north-northwestward and increasing slowly in intensity the center reached a position near latitude 31° to 32° N., longitude 76° W., by the evening of the 15th, at which time a slowing of progressive movement was evident and the subsequent recurve toward the northeast began. Bermuda reported winds of approximately 40 miles per hour as the center passed about 250 miles to the northwest of that station. No strong winds were reported from stations along the east coast of the United States. Although no actual observations of hurricane winds are available over ocean areas, it is believed that this storm was of hurricane force from about the time it curved to the northeastward.

II. *Tropical storm—July 24–26.*—On July 24 a small disturbance was noted east of Martinique and Santa Lucia. About 7 p. m.[1] of that date the center passed between those islands and a maximum wind of 55 miles per hour was reported from Fort de France, a town which had been all but destroyed by the disastrous hurricane of August 1891.

The disturbance moved rather rapidly west-northwestward and was located by aircraft reconnaissance near latitude 16° N., longitude 67° W., at 2:30 p. m. on the 25th. After this fix the center was not again definitely located, but there were positive evidences that it was near the coast of Haiti not far south of Port au Prince on the morning of the 26th. A wind of 70 knots was encountered by an airplane near this point (exact location and elevation unknown), and the Port au Prince upper air soundings showed winds aloft of hurricane force, with squalls of 35 miles per hour at the surface. "Considerable damage" was reported from the town of Jacmel on the coast south of Port au Prince. Indications are that the small center struck the high mountains of the Haitian Peninsula and was broken up. It is not believed that winds of hurricane force accompanied this storm at the surface, but that velocities of about 60 miles per hour marked its entire course.

III. *Hurricane—July 30–August 4.*—The first tropical storm of 1944 to reach the coast line of the United States formed east of the Bahamas during the night of July 30–31 from a wave that, during the previous 2 days, had moved from the region northeast of Puerto Rico. The center was definitely located by reconnaissance about 175 miles northeast of Nassau at about 7 a. m. on the 31st. Moving north-northwestward the storm approached the North Carolina coast with slowly increasing intensity and moved inland south of Southport at about 7 p. m. on August 1. The diameter of the storm was small but reports indicate that winds were of hurricane force.

The Coast Guard station on Oak Island reported a wind of 59 miles per hour before the wind indicator failed at 4:30 p. m. Winds increased thereafter and at about 5:50 p. m. were estimated at 70 to 80 miles per hour. The lowest observed pressure 29.22 inches (989.5 millibars) occurred on Oak Island at 6:30 p. m.

The Wilmington Weather Bureau Office, located about 20 miles inland, reported a maximum velocity (maintained for a 5-minute period) of 46 miles per hour, an extreme

[1] All times referred to in this summary are eastern standard.

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velocity of 52 miles per hour, and a lowest pressure of 29.43 inches (996.6 millibars).

Damage to property and crops in the Wilmington area has been estimated at about $2,000,000. On the beaches, particularly at Carolina and Wrightsville, many houses and cottages were destroyed or had their foundations undermined by high tides and extremely high seas. Substantially built structures not subject to undermining by water action went through the storm without damage. A guest at the Ocean Terrace Hotel, Wrightsville Beach, who had retired early, awoke the morning after the storm and found, after a sound night's sleep, that she was the sole occupant of a hotel from which everyone else had been evacuated. Property losses in the city of Wilmington have been reported as totaling about $60,000, and in Southport the damage figure has been placed at $10,000. Slight storm damage was reported from the beaches north of Wilmington.

Crop damage was heaviest in the counties of New Hanover, Brunswick, Onslow, and Pender. The county agent of New Hanover County has estimated crop losses for the entire area at $1,269,000.

More than 10,000 persons were evacuated from beaches and exposed locations in advance of the storm, and as a result no lives were lost and few serious injuries were reported.

Moving north from the Wilmington area the center began a recurve to the northeastward, passed near Richmond and Washington about noon of the 2d, and moved out to sea near Atlantic City where an extreme wind of 38 miles per hour was recorded during the afternoon of the same day. At Washington, 6.15 inches of rain fell during a 24-hour period as the storm center passed east of that city. This amount, the second heaviest 24-hour fall in 71 years of record at that station, is exceeded only by the 7.31 inches that accompanied passage of an earlier hurricane on August 11–12, 1928. There is no indication that the storm regained intensity over the ocean as it skirted the southern New England coast.

IV. *Hurricane of August 16–23.*—This small intense storm was first noted east of Barbados on the 16th. Passing south of Barbados and over the Grenada Islands during the night, it entered the Caribbean not far from St. Vincent about 8:30 a. m. on the 17th.

On the morning of August 18, a vessel, en route from New Orleans to Buenos Aires, was heavily involved in the storm near 15°10′ N., 66°40′ W. or about 180 miles south of Puerto Rico. The master reported a low barometer reading of 28.74 inches (973.3 millibars) which coincided in time with a 5-to 10-minute calm which accompanied passage of the storm center. A fall in barometric pressure of 40 millibars in 3 hours preceded the low reading and a similar rise in the same space of time followed passage of the center. Winds were estimated at 70 to 90 miles per hour with ceiling and visibility zero. Even with full speed ahead to reduce pounding on the port side it was virtually impossible to keep the vessel of 8,498 gross tons, and a maximum speed of 14 knots, headed into the wind since the ship was swung to-and-fro by the force of the wind and sea.

Following its west-northwest course the hurricane swept inland over the southeast coast of Jamaica, in the Boston Bay area, shortly before noon on the 20th and passed off the western coast near Montego Bay some hours later. The storm lost much of its intensity as it crossed the island, for winds fell from an estimated 100 to 120 miles per hour on the east coast to 80 miles per hour in the vicinity of Montego Bay where damage was not serious. Kingston in the right-hand semicircle of lesser winds reported a maximum of 60 miles per hour from the west-southwest and a low pressure of 29.50 inches (999.0 millibars). Heaviest damage occurred in the main banana and coconut belt, two crops which are among the most important on the Island. Press photos show that on some of the large coconut plantations, in the more seriously affected areas, not a tree was left standing.

The hurricane center passed near Grand Cayman Island on the 21st with winds of 80 to 90 miles per hour, in gusts, and more than 20 gusts over 80 miles per hour reported. No damage reports have been received from Grand Cayman.

On the morning of the 22d the center moved inland on the west coast of Yucatan a short distance south of Cozumel Island, and while it lost force in passing over the Peninsula, it emerged into the Gulf of Mexico intact and moved westward into Mexico a short distance south of Tuxpan. According to press reports at least 12 deaths were caused inland in Mexico as a result of floods that accompanied dissipation of the storm.

A conservative estimate of fatalities resulting from this hurricane, taken from incomplete statistics, places loss of life at 216. Marine casualties include a British sailing vessel which disappeared near the Grenada Islands with 74 persons aboard, all of whom are presumed lost; and the 110-foot motorship *Island Trader*, out of Miami for Belize, which was reported lost off Yucatan without details of loss of life and cargo being given. In addition various degrees of damage have been reported from other ships.

Estimates of property damage are incomplete but will total several million dollars. Extremely heavy crop losses were suffered on Jamaica, where a crippling blow was dealt growers, exporters, and industrialists dependent upon the highly important banana and coconut yields. The most authoritative estimate of the number of coconut trees destroyed on the whole Island is 41 percent, while banana trees which were concentrated in the stricken zone, were about 90 percent destroyed. Damage figures for other areas affected by the hurricane are not available.

V. *Minor tropical disturbance of August 20–22.*—Development of a circulation and an increase in intensity was noted north of the Yucatan Peninsula, in an isallobaric wave that for some time had been moving westward through the Caribbean. The disturbance continued a westward or west-northwestward movement and crossed the Mexican coast south of Brownsville about noon of the 22d. Highest winds observed at coastal stations were 34 miles per hour at Fort Isabel and 32 miles per hour at Brownsville. The disturbance did not develop winds of more than moderate gale force.

VI. *The intense New England hurricane of September 8–16.*—The second most destructive hurricane in the history of the country struck inland over Long Island on September 14, took a toll of 390 lives (including marine casualties), and wrought property damage of over $100,000,000.

A complete report of this hurricane, in which listings of lowest pressures, highest winds, tides, fatalities, and property damage are tabulated and compared with like figures for the great New England hurricane of September 1938, can be found in the MONTHLY WEATHER REVIEW, September 1944; 72: 187–189.

VII. *Tropical disturbance of September 8–10.*— A partial wind circulation, evident early in the afternoon of September 7, developed and within the next 36 hours isobars with cyclonic curvature covered the entire west Gulf, and suggested a complete wind circulation with center near

latitude 23° N., longitude 94° W. First moving northward and turning to the northeastward during the 9th it reached the vicinity of Mobile late on the 10th, accompanied by heavy washing rains that continued for about 18 hours, and moderate to fresh, occasionally gusty, easterly winds.

At Mobile a low pressure of 29.63 inches (1,003.4 millibars) was reached at 2:45 p. m. on the 10th. At approximately the same time, the wind reached a maximum velocity of 18 miles per hour from the south with a few gusts reaching 30 miles per hour. Pensacola Naval Air Station reported a maximum wind velocity of 54 miles per hour.

High tides and heavy rains were responsible for practically all of the damage reported. High tide in the Mobile River, reached shortly before the computed time of low tide, was 3.8 feet above sea level, the highest tide since September 1, 1932. The heaviest 24-hour rainfall since 1937, 7.04 inches, was registered at Mobile. Other excessive 24-hour falls included 9.50 inches at Springhill, 10.15 inches at River Falls, and 11 inches at Bellingrath Gardens about 25 miles south of Mobile.

Streets in Mobile were flooded to depths ranging from 6 to 18 inches, and rain water backed into the lower floors of some homes in the southern section of the city. In this area small boats were used on some streets between 10 a. m. and 3 p. m. on the 10th. The bridge causeway was closed part of the afternoon when water to a depth of 1 foot washed over it. No fatalities or injuries resulting from the storm have been reported.

Reduction of various crops in Mobile and Baldwin counties as a result of flooding have been estimated as follows: corn 15 percent, soy beans 10 percent, hay 40 percent, peanut hay 30 percent, and fall potatoes 40 percent.

VIII. *Hurricane of September 19–21.*—Forming from a wave in the Caribbean Sea near the Yucatan Channel, this storm quickly developed a small center with winds of about hurricane force and moved into northern Yucatan on the 20th. Curving toward the southwest and passing south of Merida, it entered the Gulf of Mexico at Campeche about midnight of the 20th–21st. Traversing a small extent of the Gulf the center reentered Mexico between Coatzacoalcos and Ciudad del Carmen in the late afternoon of the 21st. Reports received from Yucatan and from aircraft indicate a very small center with winds of 75 miles per hour throughout the life of this storm.

Although no figured estimates of total damage in Mexico are available, it is known that floods and resultant landslides did extensive damage to transport and communication systems.

Press reports indicate that 200–300 persons drowned in floods that occurred in the Isthmus of Tehuanepec, and 2 or 3 crew members were lost in the sinking of a Mexican schooner of 150 tons off the coast of Campeche.

IX *Slight tropical disturbance of October 1–2.*—Developing from disturbed and squally conditions that had been noted east of the Lesser Antilles, during the several days previous, this disturbance moved northward near the 60th meridian into a strong trough that existed east of Bermuda. The storm did not develop hurricane winds and no reports of damage to shipping have been received.

X *The severe Florida-Cuba hurricane of October 13–21.*—A detailed report on this storm, which took a toll of over 300 lives and resulted in total property damage exceeding $100,000,000, is contained in the MONTHLY WEATHER REVIEW, November 1944; 72: 221–223.

Storm.—On November 2 at about 5:30 a. m. a vessel, involved in a storm near latitude 11° N., longitude 82° 36′ W., sent a report of a 60 knot wind from the west, pressure 29.60 inches (1,002.4 millibars), seas mountainous, and vessel laboring heavily. Similar conditions were reported for about 3 hours, during which time the vessel called for assistance. The storm dissipated or moved inland a short time later as aircraft reconnaissance early on the following day failed to locate any disturbance. Since it is impossible to trace a movement, from available reports, or to determine whether the ship was involved in a small hurricane or a very severe squall, this storm is carried as a matter of record, and it is not listed as a tropical disturbance of the past season.

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THE NORTH ATLANTIC HURRICANE OF SEPTEMBER 8–16, 1944

By H. C. SUMNER

[Weather Bureau, Washington, D. C.]

DURING September 14 and the morning of the 15th an intense hurricane, similar in many respects to the destructive storm of 1938, lashed 900 miles of the east coast of the United States from Hatteras northward. The tracks of these two storms are reproduced in chart I. As they occurred in an interval of less than 6 years, and were the first intense tropical storms to reach the New England area in over 50 years, they will probably come to be known as the First and Second New England Hurricanes. Earlier storms, apparently of tropical origin, have ravaged the same section, and a listing of these storms is given later in this report. Tracks for those of 1815 and 1821, which by coincidence also occurred within a period of 6 years, are traced in chart II.*

The hurricane of September 17–21, 1938, is recognized not only as the most destructive storm to reach the coasts of this country but also, from the standpoint of damage inflicted, as one of the two greatest disasters in the history of the continent. Reliable estimates have placed property damage in the San Francisco Earthquake and in the Hurricane of 1938 at about the same figure—$350,000,000.

Several hurricanes have resulted in a greater number of fatalities, notably: The South Atlantic Coast storm of late August 1893, with a loss of about 2,000 lives; the Louisiana-Mississippi hurricane of early October 1893, with an estimated 1,800 fatalities; the Palm Beach hurricane of September 1928, which resulted in 1,836 deaths; and the Galveston hurricane and tidal wave, September 8, 1900, which took a toll of about 6,000 lives.

Although the hurricane of 1944 was probably of as great intensity as that of 1938 while it swept over the Atlantic east of Florida, several circumstances combined to militate against the heavy casualties and property damage that occurred in the 1938 storm. First among them was a gradual filling of the depression, and a resultant drop in wind velocity after the center passed Hatteras. This decrease in the pressure gradient, coupled with a slower progressive movement than accompanied the earlier storm, brought the center to the heavily populated coastal regions of New England in a less vigorous form than was evidenced in the hurricane of 1938.

*Track of the 1815 hurricane constructed by Tannehill, from newspaper clippings collected and abstracted by Noyes Darling and published in The American Journal of Science and Arts, Vol. XLII, pp. 243–252 New Haven 1842. Track of the 1821 hurricane, according to Redfield.

HISTORY OF THE HURRICANE

The existence of the 1944 hurricane was first suspected on the 8th of September when a pressure fall, accompanied by erratic winds, was noted moving into the Windward Islands. This disturbed condition later showed a circulation pattern. At 4 p. m. (E. W. T.) on the 8th, the presence of a tropical disturbance was announced in a preliminary advisory radioed from San Juan, P. R.

Since this light circulation did not account for other indications that a strong disturbance existed in the vicinity, a reconnaissance plane was dispatched on the 9th to search for a storm farther north. This flight located an intense storm in the vicinity of latitude 21° N., longitude 60°-W., and later reconnaissance proved it to be a fully developed hurricane moving in a west-northwesterly direction.

From this point to the northeast of the Leeward Islands the hurricane drifted west-northwestward, in the prevailing air stream, until further reconnaissance located the center off the northern Bahama Islands near latitude 27° N., longitude 74° W. on the evening of the 12th. At this stage of its progress the hurricane was so large and violent that the term "Great Atlantic Hurricane" was adopted in advisory messages from Miami in order to convey a proper description.

A weather officer aboard an army reconnaissance plane which became involved in the storm estimated the wind at about 140 miles per hour. He reported turbulence so great that with the pilot and copilot both at the controls the plane could not be kept under control, and several times it was feared it would be torn apart or crash out of control. When they returned to base it was found that 150 rivets had been sheared off on one wing alone.

At about 9 p. m. of the 12th, the storm was centered near the 75th meridian and the expected recurve to the northward became apparent. Moving almost due north, at a rate of 25–30 miles per hour, the center passed just east of Hatteras at about 9:20 a. m. (E. W. T.) on the 14th. Then turning slightly to the northeastward it moved up the coast, at an accelerated speed of about 40 miles per hour, and crossed over eastern Long Island at about 10 p. m. of the same date. Moving inland about an hour later near Point Judith, R. I., the center crossed

the States of Rhode Island and Massachusetts, passing a short distance southeast of Boston, and moved into Massachusetts Bay shortly after 1 a. m.

The center again passed inland, on the Maine coast, and later crossed southeastern New Brunswick near the head of the Bay of Fundy. Late on the 15th it passed over Newfoundland and finally merged with an extra-tropical cyclone southeast of Greenland.

PRESSURE

The lowest pressure so far reported for the 1944 hurricane is 947.2 millibars (27.97 inches) recorded at Hatteras, N. C., about 8:20 a. m. of the 14th. The reading is only 0.12 of an inch higher than the low pressure of 943.1 millibars (27.85 inches) observed aboard the S. S. *Carinthia* during the hurricane of 1938. It is quite possible that, when readings of barometric pressure become available from ships heavily involved in the recent storm, even lower readings than those above will be reported.

The lowest sea-level pressure on record is a reading of 26.185 inches taken on August 18, 1927, aboard the Dutch steamship *Sapoeroea*, while she was involved in a Pacific typhoon 460 miles of the Island of Luzon in the Philippines. The lowest sea-level pressure on record in the Western Hemisphere is 26.35 inches, recorded in the Florida Keys storm of September 2, 1935.

WINDS

The highest wind velocity recorded by instrument was an extreme velocity of 134 miles per hour, observed at approximately 12:20 p. m. on September 14, at Cape Henry, Va. Maximum wind velocities equaled or exceeded all previous records at Hatteras, Cape Henry, Atlantic City, New York, and Block Island.

Stations in table 1, a summary of meteorological conditions accompanying the 1944 hurricane, are arranged in a time sequence corresponding, as nearly as possible, to the order in which they were affected by the storm.

TIDES AND INUNDATION

Fortunately, and in contrast to the hurricane of 1938, the recent storm struck inland over Connecticut, Rhode Island, and southeastern Massachusetts at a time of normally low tide. In addition the latest storm struck the coast obliquely, with coastal points on the left or weaker side of the center. As a result the great storm tide which is created by the stronger winds in the righthand quadrants, expended most of its force at sea. No tide heights were recorded in the recent storm which even remotely approach the 20- to 25-foot levels registered in 1938.

LOSS OF LIFE AND PROPERTY DAMAGE

A total of 390 lives were lost as a result of the 1944 hurricane, a large proportion of them as a result of marine casualties. The 46 deaths listed as occurring along the coastal areas of the United States is less than 10 percent of the 494 fatalities resulting from the storm of 1938. Heavy marine casualties were directly related to intensified patrol work and other exigencies resulting from war conditions. Property damage has been estimated at approximately $100,000,000 or about one-third that estimated for the 1938 hurricane.

A survey of the hurricanes of the past 50 years shows that a constantly-improving hurricane warning service has brought about a progressive reduction in the number of deaths per unit of hurricane damage. A tabular breakdown of casualties and damage, by States, is included in table 4.

WARNINGS AND ADVISORIES

A total of 51 warnings and advisories were issued by the Hurricane Warning Centers at San Juan, Miami, Washington, and Boston. Prompt dissemination of these warnings by news distributing agencies resulted in the evacuation of thousands of persons in threatened areas, and the safeguarding from storm damage, insofar as was possible, of protectable property. In New York City, during the period of storm inquiries from September 12 to 15 inclusive, a total of 289,486 calls were received over the automatic telephone system.

HISTORICAL STORMS OF NEW ENGLAND

Below are descriptions of three of the most severe New England hurricanes. Other storms, probably all of tropical origin, which seriously affected the New England States occurred on August 19, 1788; September 8, 1869; October 23–24, 1878; and August 24, 1893.

August 15, 1635. Probably the earliest tropical storm on record in New England began shortly after midnight with heavy rain and a wind that had shifted from south-southwest to northeast. Later the wind increased in violence and was accompanied by torrential rain. After the gale had continued 5 or 6 hours, the wind changed to northwest and gradually subsided. During that month a hurricane, possibly the same storm in an earlier stage, occurred between Martinique and St. Kitts.

September 22–23, 1815. The "Great September Gale" of 1815 was one of the most destructive hurricanes to reach New England. Heaviest damage occurred in Rhode Island and central Massachusetts. On the coast of Connecticut high tides and hurricane winds destroyed many buildings and numerous vessels were driven ashore. The storm began on September 22 and reached its height shortly before noon on the following day. This storm, which had moved up from the West Indies, had been recorded at St. Bartholomew on the 18th. A survey of the damage caused by this hurricane convinced W. C. Redfield that the storm was a "progressive whirlwind," and as a result he began his study of cyclonology.

September 3, 1821. The center of this destructive hurricane crossed the western part of Long Island and passed northward into Connecticut.

Complete accounts of most of these early New England storms can be found in "Historic Storms of New England" by Sidney Perley, The Salem Press, 1891.

ACKNOWLEDGMENTS

The Weather Bureau wishes to express its sincere appreciation to the many organizations and agencies which performed essential roles in vitalizing the Hurricane Warning Service.

To the Army Air Forces newly organized Weather Unit goes credit for the early detection of the storm, and for securing fixes on the center, direction of movement, and wind intensities, at a time when the hurricane was still some distance east of Antigua in the West Indies, and 5 days before signs indicative of such a circulation could have been picked up on the Atlantic coast. With the absence of radio weather reports from ships, this aircraft reconnaissance service, which is employed by the Army, Navy, and Coast Guard, was the only source of early observational data.

Equally appreciated is the unqualified support given by all news distributing agencies who, through their vast facilities, were charged with getting the warnings to the public. Personnel of the newspapers and the radio networks bent every effort toward the fulfilment of this trust.

TABLE 1.—*Meteorological data for the hurricane of Sept. 8–16, 1944, E. S. T.* [1]

Station	Lowest pressure	Time of lowest pressure	Velocity and direction at time of lowest pressure	Maximum wind velocity and direction for a 5-minute period	Time of maximum velocity	Extreme wind velocity and direction (fastest mile from register)	Time of extreme velocity	Velocity of extreme gust	Duration in hours of winds over 38 miles per hour
Hatteras, N. C.	27.97	8:20 a		90 [2] W [5]	10:00 a	110 [2] W			5
Elizabeth City, N. C.	28.88	10:35 a		70 NNW	10:30 a	75		84 I	6½
Norfolk, Va.	29.11	11:45 a		56 NW	11:50 a	73		90 [2]	4
Cape Henry, Va.	28.86	12:10 p		85 NW [5]	12:22 p	134	1:13 p	150 [3]	7
Atlantic City, N. J.	28.73	5:00 p		82 N [5]	4:30 p	91 NE	4:30 p		7
Trenton, N. J.	29.18	5:40 p		49 N	5:43 p	54		66 I	3
Philadelphia, Pa.	29.31	6:40 p		32 N	5:33 p	34		60 I	
New York, N. Y.	29.08	7:15 p		81 N [5]	7:27 p	99			5
New Haven, Conn.	28.86	8:50 p	26 NNE	33 N	11:38 p	38 NE	8:09 p	65 I	0
Hartford, Conn.	28.94	9:50 p	41 N	50 N	10:03 p	62 N	10:05 p	109 [4] N I	3½
Fishers Island, N. Y.	28.41	9:45 p	17 NE	78				96	
Block Island, R. I.	28.34	10:09 p	38 SW	82 SE [5]	9:30 p	88 SE	9:31 p		7
Providence, R. I.	28.48	11:20 p	20 NW	43 SE	10:04 p	49	10:04 p	90 ESE	2
Nantucket, Mass.	29.04	11:28 p	54 SW	57 SW	11:47 p	79	12:45 a	90 [3] I	
Fall River, Mass.	28.53	10:30 p	— ESE						
Worcester, Mass.	28.92	10:50 p	— NNE						
South Weymouth, Mass.	28.55								
Blue Hill, Mass.	28.62	12:11 a	12 NW	67	10:40 p	77	10:43 p		
Boston, Mass.	28.62	12:25 a	15 NNE	60 NE	10:23 p	72 NE	10:28 p	98 I	5h.–17 m.
Concord, Mass.	28.78	1:10 a	26 N	60	9:45 p	65	9:48 p		
Gloucester, Mass.	28.61	12:40 a	20 NE [2]	70 [2]	10:50 p				
Rockport, Mass.	28.59	1:00 a	15 ENE	70 E	1:35 a			80	
Concord, N. H.	29.16	1:45 a		41 NE	12:05 a	47		55 H R	2
Portland, Maine	29.01	3:10 a	26 N	40 NE	1:08 a	50	1:08 a	60 [2]	1
Bangor, Maine	29.14	6:00 a	15 NNW	40	7:30 a	58	7:00 a	72	
Eastport, Maine	29.01	8:00 a	4 WSW	39 E	3:50 a	40	3:52 a		0.2
Millinocket, Maine	29.37	7:30 a	19 NNE	25	6:30 a				
Houlton, Maine	29.37	7:40 a	18 N	22	6:26 a	33	6:32 a		
Extreme pressure and highest velocities	27.97			90 [2] W		134		150 [2]	7

[1] Data represents observations taken on the 14th and 15th of September.
[2] Estimated.
[3] Indicator failed before highest velocity.
[4] Clocked for 4 seconds (10:07 p).
[5] Equals or exceeds all previous records.
I Wind taken from indicator.
H R Wind taken from hourly record.

TABLE 2.—*Comparative data on the hurricanes of Sept. 17–21, 1938, and Sept. 8–16, 1944*

Storm	1938	1944
Date	Sept. 17–21, 1938	Sept. 8–16, 1944.
Place where first reported	Near 21° N., 52° W	Located by aircraft reconnaissance near 22.5° N., 62.5° W.
Coast lines crossed	New York and Connecticut	New York, Connecticut, Rhode Island, Massachusetts, and Maine.
Lowest barometer reported at sea	943.1 millibars (27.85 inches) S. S. *Carinthia*.	
Lowest barometer reported along coast	946.2 millibars (27.94 inches) at Bellport Coast Guard Station, Long Island, N. Y.	947.2 millibars (27.97 inches) at Hatteras, N. C.
Maximum wind velocity and direction for a 5-minute period	87 miles per hour from the southwest at Providence, R. I., Blue Hill, 121 S. [1]	Estimated 90 miles per hour from the west at Hatteras, N. C.
Extreme wind velocity and direction (fastest mile from register)		134 miles per hour at Cape Henry, Va.
Velocity of extreme gust	186 [1] miles per hour at Blue Hill Observatory, Milton, Mass.	Estimated 150 miles per hour at Cape Henry, Va.
Place of dissipation	Ontario, Canada	Merged with extra-tropical LOW in the north Atlantic ocean southeast of Greenland.
Number of persons killed	494 lives lost in New York and the New England States.	46 lives lost along the east coast. 344 lost at sea.
Estimated damage	$250,000,000 to $350,000,000	Approximately $100,000,000.

[1] The extremely high wind at Blue Hill at some distance from the hurricane center, can partially be attributed to the upslope effect at that station. Winds at the level of the surrounding country were considerably lower.

TABLE 3.—*Storm tides during the hurricanes of Sept. 17–21, 1938, and Sept. 8–16, 1944*

Station	1938		1944	
	Highest tide [1]	Time of highest tide (E. S. T.) [2]	Highest tide [1]	Time of Highest tide (E. S. T.) [2]
	Feet		*Feet*	
Hatteras, N. C.	5.0	8:00 a. m.	7.0	9:30 a. m.
Norfolk, Va.	4.4	1:30 p. m.	5.8	12:30 p. m.
Cape Henry, Va.	4.0	10:15 a. m.	[3] 3.6	12:45 p. m.
New York, N. Y.	6.4	4:30 p. m.	6.4	8:30 p. m.
New Haven, Conn.	9.4	9:00 p. m.	10.5	10–11 p. m.
Providence, R. I.	17.6	6:00 p. m.	12.0	10:45 p. m.
Boston, Mass.	11.3		11.4	10:45 p. m.

[1] Height above mean low tide.
[2] Storm tides for the 1938 hurricane were observed on Sept. 21 and those for 1944 on Sept. 14.
[3] Estimated.

TABLE 4.—*Fatalities, casualties, and property damage in the hurricane of Sept. 8–16, 1944**

State	Killed	Injured	Homes destroyed	Homes damaged	Other buildings destroyed	Other buildings damaged	Boats destroyed	Boats damaged
Connecticut	4	0	60	5,136	500	4,550		
Delaware	0	0	0	1,800		850	0	
Maryland	0	0	0	650	15	300		
Massachusetts	26	9	230	3,898	158	915	110	534
New Jersey	9	320	463	3,066	217	635	21	101
New York	6	1	117	2,427	272	852		
North Carolina	1	4	28	316	80	351		
Rhode Island	0	4	23	5,525	368	7,597		
Virginia	0	0	0	1,350	31	782		
Total	[1] 46	338	921	24,168	1,641	16,832	131	635

[1] A release by the public relations office of the fifth Naval district lists 344 men, dead or missing, from 5 vessels wrecked and sunk during the hurricane of Sept. 8–16, 1944. The casualties were from the destroyer *Warrington*, the Coast Guard cutters *Jackson* and *Bedloe*, the light vessel *Vineyard Sound*, and the minesweeper *YMS-409*. The cutters capsized and sank while protecting a Liberty Ship torpedoed off the North Carolina coast, and the light vessel dragged anchor and sank about 2 miles to the northeastward of her station off Martha's Vineyard, Mass.

*Fatalities, casualties, and property damage in the hurricane of Sept. 17–21, 1938**

State	Killed	Injured	Homes destroyed	Homes damaged	Other buildings destroyed	Other buildings damaged	Boats destroyed	Boats damaged
Connecticut	97	109	101	1,378	1,235	2,301		
Massachusetts	117	331	298	3,021	1,111	2,406		
New Hampshire	12	32	31	1,051	292	1,133		
New Jersey	0	0	0	2	0	0		
New York	60	31	57	405	156	173		
Rhode Island	207	204	441	1,378	677	719		
Vermont	1	1	8	284	93	388		
Total	494	708	936	8,019	3,564	7,120	2,605	3,369

*Condensed from reports released by the American Red Cross.

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THE NORTH ATLANTIC HURRICANE OF OCTOBER 13–21, 1944

By H. C. SUMNER

[Weather Bureau, Washington, D. C., Dec. 1944]

THE hurricane of October 13–21, 1944, was of great intensity, and the most destructive storm to visit Cuba and Florida in recent years. Over 300 lives were lost as a result of the storm, and estimates of property damage run well over $100,000,000.

HISTORY OF THE HURRICANE

First indications that this tropical storm was developing in the Caribbean Sea came when the motorship *Silver Arrow*, en route from Jamaica to Belize, stopped at Swan Island about 6:30 p. m., on October 12, and reported rough seas encountered about 100 miles to the eastward. At this time the seas at Swan Island were already fairly high and conditions became gradually more severe until on the 16th the keeper of the island reported the roughest sea in his 17 years of residence. During the period of squally weather from the 12th to 18th, inclusive, no extremely high winds were recorded on the island, the highest gust failing to reach 60 miles per hour.

Farther to the northeastward at Grand Cayman Island, the first signs of the storm were noted during the forenoon of October 13, when a deck of low nimbostratus moved in obscuring the altostratus overcast that had made its appearance the previous day. Rain was continuous on Grand Cayman throughout the remainder of the day except for a 20-minute interval about 9:30 a. m., during which time it was possible to make a 2,000-foot pilot balloon run, showing upper air winds of 63 miles per hour, from a northeasterly direction. Surface winds averaged under 25 miles per hour, with gusts reaching 45 miles per hour, throughout the afternoon and evening on the 13th.

On the 14th surface winds had increased and the highest gust recorded was 58 miles per hour. On this day, as on all other days during the time that the storm influenced Grand Cayman, there was a definite rise in pressure after the normal diurnal minimum at about 4 a. m. and 4 p. m. At about 5 p. m. on the 14th rapidly changing conditions evidenced the existence of a heavy individual squall within the main storm area At that time the wind changed suddenly without pause from moderate NNE. to strong SE., and the heaviest rainfall of the entire storm period occurred. After about 20 minutes the wind returned to NNE. and lost much of its force. A record 24-hour rainfall for the island, 16.04 inches, fell on the 14th.

On the next day, October 15, shortly after 6:30 p. m., the pressure at Grand Cayman Island reached its lowest point 29.06 inches. The extreme gust for that station, 118 miles per hour from the east, was registered at about the same time. The hurricane center passed westward, south of the island and turned rather abruptly to the north along the 83d meridian. As the storm moved northward, hurricane winds on the right of the center sent a destructive storm tide lashing at docks, piers, and other shore installations on the south coast, reducing many of the wooden structures to kindling. During the late afternoon of the 17th the storm center crossed the Isle of Pines. Communications between Cuba and the smaller island were completely severed, but delayed reports that have filtered in indicate heavy damage on the Isle of Pines. Approaching Cuba from the south, the storm center crossed the island a short distance west of the Mariel-Majana line, the narrowest part of Cuba, and about 10 or 15 miles west of Havana.

On the 18th, at a point about midway between the north coast of Cuba and Dry Tortugas, a vessel heavily involved in the storm reported passing through the eye of the hurricane where calm airs were observed for an hour between 1:40 and 2:40 p. m. Except during passage through the center, hurricane winds (Beaufort force 12) were encountered from noon to about 4 p. m.

The calm center of the hurricane was observed over Dry Tortugas from 3 to 5 p. m. on the 18th. From that group of islands, the storm moved northward with the center passing inland south of Sarasota, near Nokomis, about 3 a. m. eastern standard time on October 19. A pressure of 28.42 inches (962.4 millibars) was recorded at Sarasota. Taking a course north-northeastward across Florida, the storm center skirted the east side of Tampa Bay, moved over Dade City and Ocala, and passed seaward a short distance below Jacksonville. Although the storm was traveling about 20 miles per hour, the "eye" was reported to have lasted from 11:30 a. m. to 5 p. m. This exceptionally long period of time required for conditions characteristic of the "eye" of the hurricane to pass Jacksonville indicates an unusually large central core. This central portion of the storm was apparently an elongated oval with its principal axis along the line of advance. The central core extended at one time almost from Jacksonville to Ocala, a distance of about 70 air line miles.

After traveling over a short expanse of ocean the center moved inland just north of Savannah. Passing some distance inland through South Carolina, North Carolina, and Virginia it again reached the Atlantic off the Eastern Shore of Maryland and moving northeastward with increasing speed, passed between Cape Cod and Nantucket, and reached Nova Scotia late on the 21st. Gale winds of force 8 were observed over Newfoundland on the following day during passage of the depression, which later merged with the Icelandic Low east of Greenland.

PRESSURE

The lowest pressure so far reported for the October hurricane is 28.02 inches (948.9 millibars) recorded by an aneroid barometer (uncorrected) at Dry Tortugas on the 18th of October. Within the continental limits of

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the United States the lowest known pressure was 28.42 inches (962.4 millibars) registered at Sarasota, Fla., during the late afternoon of the 19th. A reading of 28.55 inches (966.8 millibars) taken at Tampa is the lowest recorded at that station in the period of more than 50 years of record. The lowest sea-level pressure on record in the western hemisphere is 26.35 inches, recorded in the Florida Keys storm of September 2, 1935.

A tabular listing of the lowest pressures observed at selected stations during the October hurricane is contained in table 1.

WINDS

Damaging winds accompanied the hurricane from the time the storm took up a position west of Grand Cayman Island, British West Indies, on the 16th, until the center had passed north of Savannah, Ga., and into southern South Carolina, late on the 19th. During passage of the storm over Florida, gale winds were experienced over the entire peninsula and westward over the Gulf Coast nearly to Tallahassee, as well as over the coastal sections of Georgia and South Carolina.

The highest winds recorded during the passage of the hurricane were recorded at Havana (National Observatory), across the bay from the city, where the fastest mile registered 120 miles per hour and the strongest gust 163 miles from the south-southeast at about 10 a. m. on October 18. Gusts of at least 60 miles per hour were recorded for a period of 18 hours, and for 1¼ hours all gusts were above 140 miles per hour.

At Dry Tortugas the wind record on a special airways type of anemometer registered 120 miles per hour for 2 consecutive hours before the instrument was finally blown away.

Tampa, although registering the lowest pressure in the history of the station, did not suffer the damage that might be expected, as the storm center passed a short distance to the right of the city and at the height of the storm the winds were blowing offshore.

Heaviest wind damage occurred over a 30-mile-wide belt, beginning on the right-hand edge of the central core which, over Florida, extended some 20 miles on each side of the storm track. Damaging winds thus cut a wide swath through the great citrus and truck producing areas of the State. Orlando reported a 1-minute maximum velocity of 82 miles per hour and gusts of 108 miles per hour, from the south-southeast, during the morning of the 19th.

Stations in the following tabular summary of meteorological conditions accompanying the 1944 hurricane are arranged in a time sequence corresponding, as nearly as possible, to the order in which they were affected by the storm.

TABLE 1.—*Meteorological data for hurricane of Oct. 13–21, 1944*

[All times eastern standard]

Station	Date of observation	Lowest pressure	Time of lowest pressure	Velocity and direction at time of lowest pressure	Maximum wind velocity and direction for a 5-minute period	Time of maximum velocity	Extreme wind velocity and direction (fastest mile from register)	Time of extreme velocity	Velocity of extreme gust	Duration in hours of winds over 38 miles per hour
Swan Island, West Indies					38 NW		40		58	
Grand Cayman, British West Indies	15	29.06	5:30 p. m.	55 E	95				118 E	
Havana, Cuba:										
National Observatory	18	28.50					140	10:00 a. m.	163 SSE	
Batista Field	18	28.36	7:00 a. m.	80 SSE			85 SE [1]	5:45 a. m.	125	17
Dry Tortugas	18	[3] 28.02	5:00 p. m.		120 E [4]	1–2:00 p. m.	120 E [1]	1–2:00 p. m.		72
Key West, Fla.	18	29.11	2:50 p. m.	38 SE	56 SE	2:37 p. m.	66 SE	2:11 p. m.		13
Sombrero Light	18	29.25	4:00 p. m.	110 SE	115 SE	6–7:00 p. m.				30
Miami, Fla.	19	29.49	1:57 a. m.		65	12:03 a. m.	69	12:04 a. m.		
Sanibel Light	19	28.98	12:30 a. m.	100 S	100 S	12:30 a. m.				13
Fort Myers, Fla.	19	29.05	12:30 a. m.	65 ESE	65	12:30 a. m.				17
Tampa, Fla.	19	[5] 28.55	5:00 a. m.	43 NE	56 NE	4:19 a. m.	68 NE	4:23 a. m.	100 [2]	5
Lakeland, Fla. (WBO)	19	28.68	5:30 a. m.	45 E	49 E	4:35 a. m.	57 E [1]	4:38 a. m.		3
Lakeland, Fla. (WBAS)	19	28.67	5:30 a. m.				57 E [1]	4:30 a. m.	78	
Lakeland, Fla. (Army)	19	28.62					81 E [1]		86	
Orlando, Fla.	19	28.94	7:30 a. m.	62 ESE			82 SSE [1]	9:05 a. m.	108 SSE	
Jacksonville, Fla.	19	28.94	2:44 p. m.	6 SE	41 NE	8:02 a. m.	46 NE	7:45 a. m.	60	1½
Savannah, Ga.	19	29.13	11:55 p. m.	15 NW	42		50 NE [2]	5:05 p. m.	85 [2]	
Charleston, S. C.	20	29.25	2:30 a. m.	40 S [2]	60 NE [2]	7:15 p. m.			70 [2]	4½
Florence, S. C.	20	29.36	6:28 a. m.	25 SE					75	2
Columbia, S. C.	20	29.28	7:00 a. m.	19 NNE	30 NE	7:34 p. m.	34 NE	7:34 p. m.	60 NNE	0
Wilmington, N. C.	20				37 S	10:47 a. m.	40 S	10:52 a. m.	52 [2]	0
Greensboro, N. C.	20	29.53	1:30 p. m.	20 N	35 NE	5:28 a. m.	38 NE	5:30 a. m.	61	0
Raleigh, N. C.	20	29.60	3:00 p. m.	18 SW	29 S	1:42 p. m.	31 S	1:44 p. m.	60	0
Richmond, Va.	20	29.49	7:15 p. m.	10 W	24 NE	9:25 a. m.	25 NE	9:25 a. m.	25 NE	0
Extreme pressure and highest velocities		[3] 28.02			120 E [4]		140		163 SSE	72

[1] Maximum for 1 minute.
[2] Estimated.
[3] Aneroid barometer (uncorrected).
[4] Anemometer blown down by wind registering 120 miles per hour.
[5] Exceeds all previous records.

STORM TIDES

On the continent, damage from high tides was most severe along the Florida west coast, between Sarasota and Everglades, with heaviest losses reported along the beaches near Fort Myers. Along the coast north of Sarasota, including Tampa Bay, offshore winds prevented serious tide damage.

The highest tide reported was 12.28 feet above mean low tide at Jacksonville Beach, in an area which was subjected to a tide built up by gale winds off the ocean.

In Cuba, along the southern coast of Havana Province, a tidal wave caused the death of 20 persons in 1 small village and resulted in a considerable property damage. Its strength can be gaged by a report, received through the State Department, that a Standard Oil barge was carried 10 miles inland.

TABLE 2.—*Storm tides during the hurricane of October 1944*

Station	Highest tide [1]	Date	Time of highest tide (est.)	Normal high tide [2]	Time of normal highest tide (est.) [2]
	Feet				
Key West, Fla.	3.0	18	4:30 p. m.	[3] 0.5	4:02 p. m.
Everglades, Fla.	8.2	19	4:00 a. m.	2.6	1:18 a. m.
Fort Myers, Fla.	4.5	19	3:00 a. m.		
Tampa, Fla.	3.1	19	2:15 p. m.	1.9	4:08 p. m.
Daytona Beach, Fla.	6.9	19	9:00 a. m.	4.8	9:03 a. m.
Jacksonville Beach, Fla.	12.28	19	9–10:00 a. m.		
Jacksonville, Fla.	4.5	19	9–10:00 a. m.		
Fernandina, Fla.	10.6	19	11:18 a. m.	6.6	9:45 a. m.
Mayport, Fla.	7.83	19		5.3	9:33 a. m.
Savannah, Ga.	9.4	19	11:00 a. m.	8.3	9:40 a. m.
Charleston, S. C.	8.5	19	8:24 p. m.	5.1	9:02 p. m.

[1] Height above mean low tide.
[2] Compiled by Coast and Geodetic Survey.
[3] Low tide; high tide 1.6 at 10:44 a. m.

WARNINGS AND ADVISORIES

During the 9 days that the hurricane menaced the islands and the Atlantic Seaboard of the United States, a total of 58 warnings and advisories were issued by the Hurricane Warning Centers at Miami, Washington, and Boston. At Miami on the 18th and 19th, prior to the failure of all wire service, 6 commercial radio stations maintained microphones in the Weather Bureau Office over which broadcasts of all warnings and advices were made at 2- to 3-hour intervals by members of the station force. Thorough and prompt dissemination of warnings by all news distributing agencies resulted in the evacuation of thousands of persons from threatened areas, and safeguarding, insofar as was possible, of all protectable property.

The Red Cross reports sheltering 35,000 persons during the height of the storm, a figure which represents only a small proportion of those evacuated from danger areas in the storm's path.

All Army and Navy planes that were in flying condition were moved from Florida to safe fields, and personnel that was not considered essential was evacuated from threatened sections. At Key West 150 small naval vessels were so effectively secured that no vessels were lost and only 6 grounded or had to be beached. Salvage of these was effected without great expense.

LOSS OF LIFE

The number of deaths resulting from the October hurricane has been placed at 318. This number will probably be increased as additional reports are received from the rural areas of Cuba, and the islands to the south, where most of the fatalities occurred.

Marine casualties include nine persons killed and five injured. The deaths occurred in the capsizing of a boat which was attempting to ride out the storm while at anchor in the mouth of Tampa Bay. The injured were involved in the sinking of a crash boat from Batista air base.

PROPERTY DAMAGE

Property damage incurred in connection with the storm has been placed at over $100,000,000, of which $63,000,000 has been estimated for the State of Florida.

As a result of the hurricane taking a path through the great citrus- and truck-producing area of the State, damage to crops was excessive. A total of about 25,000,000 boxes of fruit was blown from the trees or otherwise damaged. Only a small percentage of this fruit could be salvaged. Damage to fall truck is estimated at 70 to 75 percent of the crop.

Damage summary for Florida

Crops	$50, 000, 000
Buildings (including livestock)	8, 000, 000
Power and communications	800, 000
Highways and bridges	200, 000
Trees, ornamentals and shrubbery	3, 000, 000
Miscellaneous	1, 000, 000
Total damage	63, 000, 000

Damage in North Carolina and South Carolina was largely confined to power and communication lines, and from flooding of low coastal areas by high tides. Similar damage occurred in Georgia, and in addition many small fishing boats were wrecked in Savannah harbor.

In Cuba damage was reported from the Provinces of Havana, Pinar del Rio, and Matanzas, but was most severe in the eastern and northern portions of Pinar del Rio, in the region of Guanajay, Artemisa, and Candelaria. After passage of the hurricane, Havana harbor was so clogged with wrecked and sunken vessels that it was closed to traffic until it could be cleared. Reports of property damage in the island areas are too sporadic, at this time, to warrant statistical summarization.

TABLE 3.—*Data on hurricane of Oct. 13–21, 1944*

Place where first reported	Latitude 17° to 18° N., longitude 81°W., or about 200 miles east of Swan Island.
Coast lines crossed	Cuba, Florida, Georgia, Virginia, Maryland, and Delaware.
Lowest barometer reported at land station.	948.9 millibars (28.02 inches) at Dry Tortugas.
Lowest barometer reported at sea.	963.8 millibars (28.46 inches) at 4:30 p. m. on the 18th, near latitude 23°52′ N., longitude 83°01′N
Maximum wind velocity and direction for a 5-minute period.	120 miles per hour from the East at Dry Tortugas.[1]
Maximum wind velocity and direction for a 1-minute period.	140 miles per hour at Havana, Cuba.
Velocity of extreme gust	163 miles per hour from the South-southwest at Havana, Cuba.
Greatest duration of gale winds.	72 hours of winds over 38 miles per hour at Dry Tortugas.
Heaviest precipitation	31.29 inches of rain fell during the passage of the hurricane at Grand Cayman Island, British West Indies, with a 24-hour maximum of 16.04 inches.
Number of persons killed	18 persons killed in Florida. An estimated 300 lives lost in the Cuba area, about 200 of which were reported on the Isle of Pines and 24 at Havana.
Property damage	Estimated over $100,000,000 in the Florida and Cuba areas, of which about $63,000,000 occurred in Florida.

[1] Anemometer blown down by wind registering 120 miles per hour.