

THE NASSAU HURRICANE, JULY 25-26, 1926

Not since many a day has there been written a more vivid account by an eye witness of a West India hurricane than that printed below. It is taken from a copy of the *Nassau Guardian* of July 28, received by the Weather Bureau from the State Department.

The hurricane which the Bahamas has just experienced is more fearful and devastating than any most people can remember. Nassau is ravaged; from every district come stories of ruin and havoc, and the tale is not yet fully told, for there are the reports from the out islands still to come.

The radio messages on Friday and Saturday morning found most people optimistic. * * * Saturday afternoon brought more serious news. The indication was that the storm was headed straight for these islands; still people talked of sudden curves to the gulf. There seemed nothing abnormal in the weather, only fresh breezes, and the glass was steady. On Sunday morning came worse news, a direct warning of the hurricane's approach. The wind rose higher. People looked to see that their shutters were in good order, and nailed and battened down windows. Still the glass was steady; ships of all sizes began to make for a safer anchorage in the waterfront near Potter's Cay and at the Eastern Creek. All the time the wind rose; the sky was heavy with clouds, and the sea began to lash angrily. As evening came on all the storm signs grew more intense. The barometer made a sudden drop, and weather-wise people shook their heads. As the sparse congregations came out of the churches after evening service it was plain that the storm was near. The wind rushed along Bay Street, swirling leaves and scraps of paper and stray sponges into doorways. The shopkeepers had almost without exception taken the precaution to board up their windows and Bay Street looked ready for a barricade, as indeed it needed to be. The sea came dashing up Rawson Square, throwing spray far over, and the harbor at this part was strangely dark any deserted. Here and there electric lights began to fuse, and street after street was plunged into darkness. Hardly anyone was to be seen, save unfamiliar policemen in long dark coats and storm helmets. People were all at home trying to make their houses additionally secure.

The wind was now blowing a heavy gale, dashing through the trees, and shaking the houses, growing steadily more terrible. Everything that could be shaken loose it began tearing down—shutters, signboards, gates. There was little sleep that night for anyone on the island, just listening to this merciless crashing and

tearing and roaring, and wondering what would be the outcome. The gale brought storms of rain, not ordinary rain, but sweeping storms of water like spray, traveling too swiftly to fall downward. Soon roofs of houses began to tear away, and water was swept in. Some roofs were torn off entirely, and people had to leave everything, stumbling pitifully through the wreckage for shelter elsewhere. Few trees could withstand this tremendous force, and down they came. Worst of all was the turmoil in the harbor. No anchorage was safe for ships on such a night. Bigger vessels kept on full speed ahead, and perilously rode the storm; others dragged their anchors and were seen drifting down the harbor and away to sea; some, it could be discerned, with people on board gesticulating in terror, but few could attempt to aid them. A true estimate can not yet be made, but it is said that over 40 vessels went helplessly adrift in this way. Men swam ashore in a desperate attempt when they felt their ships giving way. The sea boiled and raged, the harbor was no refuge. The tide swept over Bay Street, carrying boats with it, and plowing up everything in its way. When light came the storm was raging at its height and though everyone welcomed the end of that fearful night, it was seen that the worst was not yet over. The coming of dawn revealed a town lashed unceasingly by a pitiless wind intent on demolishing everything in its track, and driving rain as fine as smoke. The hurricane was now approaching its height, and large trees of every description which had withstood the battering of a night went down like ninepins before the awful crescendo which raged during the early morning. The water-logged branches of many trees were their ruin, the shallow roots of palms proved a cause of their speedy destruction; but then, what could be expected to stand when concrete telegraph poles with iron cores were bent and broken off by the dozen?

* * * Trees, telegraph wires, corrugated iron, shutters, and debris of every description lay sprinkled in the roadway; in fact, much of the debris was moving about on the ground, for the gale did not deign to leave alone what it had so scornfully torn down. For a quarter of a mile East Bay Street below Murphy's warehouse was a foot deep in water lashed by the hurricane into waves larger than those normally seen in the harbor itself. At the Eastern Parade, Bay Street was totally blocked by trees, and the field was a vast lake. Shirley Street was as impassable as if the bush had been given a hundred years to sprout through the asphalt, while the harbor was a milk-white inferno of turbulent water, running westward with the speed of a millrace. * * * Roofs were being stripped of their shingles as one peels the skin from an orange; the shuttered houses streaming with water gave no sign of the anxious life within, and save for a few hardy wayfarers Nassau seemed a town of the dead.

THE AFTERMATH

Yesterday came calm and sunny, and everyone was out early to see what damage had been done. Nowhere was the force of the storm better illustrated than at Fort Montagu. What had been trim lawns and shrubberies and neat paths is now as ravaged as if it had been the scene of modern warfare, with tanks in action. The ground is all torn up; trees are uprooted; there are ruts and sand drifts and the scene is desolate. The Fort Montagu Hotel stands in a lake. A little further east it is even worse with the road itself torn up, littered with trees, and boats cast ashore. The western end of the island is the same. Fox Hill suffered terribly, many of the small dwellings having fallen like playing cards. In Grant's Town there is great distress. The scene has entirely changed, there are so many houses down and trees thrown across the roads, while to add to the hardship there are floods in the streets. A great many people are homeless. Other of the poor people are mourning the loss of their boats, their sole means of livelihood, while others are in fear for safety of their relatives out in sponging vessels or at sea on trips to the out islands. All over the island there is distress and loss, beside which the destruction of many of our beautiful vistas is a small matter. * * * Some of the finest trees in the city have been lost and among them, sad to say, the two tall Caicos palms in the Deanery garden which 50 years ago were reputed to be the oldest palms in the island. * * * The *Firebird* had her engines giving full speed ahead for four hours, and lost two shackles while the hurricane was at its height. One of her officers who has seen typhoons in the China Sea and has also had experience in West Indian hurricanes, said he has seen nothing to equal this. * * * A conglomeration of 65 boats, mostly pleasure craft, is to be seen on the beach near Mathew Avenue. Of 49 boats in the back channel, 42 are said to have been blown out of the harbor. * * * We have heard of many courageous acts performed during the storm, but one of the most outstanding was that of Captain Richardson, of the dredger *Lucayan*. He, it is said, saved over a dozen lives. People who were being swept past on sloops clung to the forestructure of the dredger, and the captain rushed to save them as they came, unheeding of the peril to himself.

* * * A great many automobiles were damaged, the covers being shred to ribbons and the enamel "burnt" off by the velocity of the wind; exposed paint work generally seemed to have undergone the fire of blow lamps. * * * It is generally agreed that the best roofing to resist hurricane onslaughts is that of cypress and cedar shingles, though few houses remained entirely dry throughout the storm. In some houses umbrellas were used when going from one room to another.

THE TROPICAL STORM OF AUGUST 25-26, 1926, IN SOUTHERN LOUISIANA

By R. A. DYKE

[Weather Bureau Office, New Orleans, La.]

This paper, supplementary to the regular report on warnings, New Orleans forecast district, for August, 1926, considers some aspects of the hurricane which have been brought out through further study.

Advance indications of tropical storms are usually provided by the tides and the clouds. As this storm, while in the southern part of the Gulf of Mexico, was apparently small and of moderate intensity, the advance tides were not alarmingly high on the coast. At Burwood the tide was 0.5 foot above the predicted tide on the 23d and rose slowly during the ensuing 48 hours to a maximum 1 foot above the predicted tide at 11 a. m. of the 25th. Along the coast of Terrebonne Parish slightly higher advance tides were reported, but there are no gage readings for this section.

At Galveston the tide was 2 feet above the predicted tide in the afternoon of the 25th, or 1 foot above the highest reading of the preceding day. This was a local effect, due to the 20 to 30 mile north wind, which favored a moderate accumulation of water in the southern end of Galveston Bay, the escape of water into the Gulf being retarded somewhat by the narrowness of the passes separating the Bay from the Gulf. The moderate southeast swells also tended to increase the tide slightly.

The clouds at middle altitudes, alto-stratus and occasionally alto-cumulus, came from the south at New Orleans nearly all day on the 24th and until 1 p. m. of the 25th, when they became obscured by lower clouds from the southeast and east. During this time the direction of the middle clouds was more changeable at Pensacola and Mobile; both upper and middle clouds were occasionally observed moving from the south and also from southwest, west, and northwest. At Galveston cirrus and cirro-stratus clouds from the south and southeast prevailed during the morning of the 24th, but from westerly directions in the afternoon of the 24th, in agreement with the highest clouds over New Orleans and farther east. In the afternoon of the 25th, when the storm front was advancing to the Louisiana coast, alto-cumulus clouds at Galveston were moving from the north, directly opposite to the movement of middle clouds at New Orleans, as observed up to 1 p. m.

The movement of alto-stratus over eastern Louisiana, considerably in advance of the storm, shows an air current from the south. The northward movement of cirrus clouds over Galveston during the morning of the 24th, and over Port Arthur in the afternoon, appears to have come from the region of the storm, although east of Galveston not many observations of cirrus from the

direction of the storm were obtained, the directions indicating a prevailing eastward movement at the cirrus level. The movement of cirrus from southerly directions possibly took place at a lower level than the prevailing cirrus movement from the west. Before the sky became completely overcast with lower clouds, alto-cumuli from the south were noted at Mobile in the early morning of the 25th and alto-stratus clouds from the south at Pensacola in the early afternoon. The width of the northward-moving current was not great and its thickness is unknown; but apparently there was sufficient movement to guide this relatively small hurricane in its advance to southeastern Louisiana.

In approaching the coast the storm was evidently moving north-northeast. Ship Shoal Lighthouse, latitude $28^{\circ} 54' 52''$ N., longitude $91^{\circ} 4' 15''$ W., was in the western part of the central calm area at 4 to 5 p. m. of the 25th, with lowest barometer reading (uncorrected) of 28.30 inches, the wind changing through north to west and increasing to hurricane force after the passage of the storm center. Soon after the center passed inland the storm curved to the northwest. The path of the center lay west of the Mississippi River, approaching it rather closely at Donaldsonville and Plaquemine (pressure of 29.16 inches at Plaquemine) and crossing the Atchafalaya River in northwestern Iberville Parish.

Among the influences tending to cause the storm to turn westward in Louisiana we may mention a rise in pressure over Tennessee and northern Alabama and Georgia in the afternoon of the 25th, which, with the relatively high pressure on the west, formed a barometric ridge extending east and west and favored a circulation of air which would tend to drag the storm westward. In an eastward-moving extratropical storm a rise in pressure in front of it has a blocking or retarding effect; in a northward-moving storm the effect appears to be as stated in the present instance, although exceptions may occur when the dominant circulation is not indicated by the surface observations.

The remarkable intensity of the storm, as indicated by the low barometer readings at Houma, compared to those at other stations, was referred to in the preliminary report. The aneroid barometers used at Houma and Morgan City have been tested at New Orleans for readings as low as 28 inches, enabling us to make necessary corrections. The pressure at Houma fell 1.32 inches in 11 hours, at an average rate of 0.12 inch an hour. From 5 p. m. to 9.30 p. m., the rate of fall was 0.32 inch an hour, about the same as that registered at New Orleans in the

larger storm of September 29, 1915. Compared to the average gradient in the 50 miles between Bay St. Louis and New Orleans, in the 1915 storm 0.02 inch per mile, the average gradient between New Orleans and Houma, a distance of 48 miles, in the storm of August, 1926, was 0.023 inch per mile. On August 25, 1926, at 9.30 p. m., there was a difference of 0.66 inch between the barometer readings at Morgan City and Houma, 30 miles apart. As the storm center was slightly west of Houma, we have here a difference of at least 0.66 inch in a distance of less than 30 miles.

After passing Houma the storm decreased in intensity but retained considerable energy until it passed into St. Landry and Evangeline Parishes, where it damaged only crops. Heavy rainfall ceased with the passage of the storm center.

The previous report referred to the lack of high tides west of the center. At some points on the Louisiana coast, notably in the vicinity of Morgan City, the northeast gales on the storm front produced an unusually low tide; the lowest reading of the river gauge at Morgan City was 2.5 feet below zero at 6.45 p. m. of the 25th, about 6 feet below mean low tide. This is very remarkable, for the lowest previous river gauge reading at Morgan City was 0.2 foot above zero.

The Atchafalaya River connects with Grand Lake, a considerable body of water immediately northwest of Morgan City, and with the Gulf to the south, of which the nearest coast line is at right angles to a northeast

offshore wind. This wind, blowing with hurricane force, lowered the water along the coast, particularly on the north side of Atchafalaya Bay, where the river empties into the Gulf, and may also have checked the rate of flow from Grand Lake into the river. When the wind backed to northwest, between midnight and 1 a. m. of the 26th, the water in the Gulf, relieved of the unusual strain, began to return to the north and east sides of Atchafalaya Bay, increasing the height of water in the river. A small peninsula, Point au Fer, extends westward from the Terrebonne coast and with westerly gales favors some accumulation of water at the mouth of the Atchafalaya. Simultaneously the northwest gale on Grand Lake increased the flow from that source. The resulting rise of 7.3 feet brought the river back to slightly more than the usual stage in about six hours.

Radiophone broadcasting and reception made possible a better distribution of warnings than in previous storms. In view of the intensity of the hurricane, the large number of people engaged in fishing and other coast industries, and the very slight elevation of the swampy areas in southern Terrebonne Parish, where the storm was most violent, the loss of life, 25 persons, is considered small. Reports of property loss and damage due to the storm are not all in; but trustworthy information indicates that property damage of all kinds, exclusive of crops in the field, was between \$3,000,000 and \$4,000,000 and that damage to crops will reach an equal or somewhat higher figure.

MONTHLY WEATHER REVIEW

Editor, ALFRED J. HENRY

Assistant Editor, BURTON M. VARNEY

Vol. 54, No. 10
W. B. No. 909

OCTOBER, 1926

CLOSED DECEMBER 3, 1926
ISSUED JANUARY 3, 1927

THE WEST INDIAN HURRICANE OF SEPTEMBER 14-22, 1926

By CHARLES L. MITCHELL

[With the collaboration of the Editor]

The tropical cyclone of September 14-22 was first observed on the morning of the 14th northeast of St. Kitts. On this date two other tropical cyclones were centered over the southern part of the North Atlantic, the first and more intense of the two being about 300 miles southwest of Bermuda, and the second, of little intensity, was slowly moving northeastward between Cuba and the Bahamas. This last-named soon lost whatever intensity it possessed at the time and could not be charted after the 17th.

The geographic position of these 3 disturbances at 8 a. m. 75th meridian time is shown in Figure 1 which also presents the 8 a. m. positions of the respective disturbances on the 15th, 16th, 17th and 18th; the 8 p. m. chart of the 17th is inserted in the series, as showing the barometric conditions immediately before the storm struck the Florida coast.

The third storm of the series with which this article is chiefly concerned was one of the most severe tropical cyclones or hurricanes that ever reached coastal United States, entailing a loss of life of 242 souls and an estimated property loss, in round numbers, of one hundred million dollars.

The course of this storm, on the average, was about 30 to 35° north of west; it passed almost directly over Grand Turk Island, very close to Nassau and struck the Florida coast at Miami after crossing the Gulf Stream at about its narrowest point. See Chart 14a, Figure 1. Its speed of movement varied somewhat. In the first 3 days subsequent to its appearance northeast of St. Kitts its center moved about 1,000 miles, or at the rate of about 14 m. p. h.; during the 24 hours previous to its arrival at the Florida coast it covered 450 miles at the rate of 18.75 m. p. h., an unusually rapid speed. During the next 2 days, when it was crossing southern Florida and northeastern Gulf of Mexico, a distance of about 550 miles, it traveled at the rate of only 11.5 m. p. h., while between 8 a. m. of the 20th and 8 a. m. of the 21st the center advanced only about 150 miles or at the rate of 6.25 m. p. h. These figures may be in error to a slight degree because of lack of meteorological reports from oceanic areas and the resulting uncertainty of the location of the center of the storm.

I present in the table below the data of the storm within a radius of 500 miles of its center as received from land and sea stations by radio and cable and available to the forecaster in predicting the future movement of this storm. The notable feature of this table is the small number of reports from oceanic areas and this is strikingly manifest for the 17th—the critical date. It may be that the advance notice of the presence of the storm deterred vessel masters from entering the storm area; in any event the absence of reports from oceanic areas at critical times must be a serious handicap to any organization that attempts to forecast the coming of these destructive storms.

TABLE 1.—Synoptic data for the West Indian hurricane of September 14-22, 1926

Date	Stations	Sea-level pressure	Temperature	Wind		State of weather
				Direction	Force (Beaufort)	
Sept. 14, 8 a. m.	St. Kitts.....	29.78	74	NW...	1	Cloudy.
	St. Thomas.....	29.82	82	N.....	4	Partly cloudy.
14, 8 p. m.	St. Kitts.....	29.70	80	W.....	2	Rain.
	St. Thomas.....	29.74	74	N.....	5	Cloudy.
15, 8 a. m.	St. Kitts.....	29.84	74	SW...	5	Cloudy.
	St. Martins.....	29.76	74	S.....	7	Rain.
15, 8 p. m.	St. Thomas.....	29.66	74	SW...	8	Rain.
	San Juan.....	29.74	82	W.....	5	Cloudy.
16, 8 a. m.	St. Thomas.....	29.80	82	SW...	7	Cloudy.
	San Juan.....	29.72	78	S.....	3	Rain.
16, 8 a. m.	Santo Domingo.....	29.76	92	NW...	1	Cloudy.
	Turks Island.....	29.90	-90	NE...	3	Clear.
11.20 a. m.	St. Thomas.....	29.92	72	SE...	4	Cloudy.
	Santo Domingo.....	29.76	72	SW...	3	Cloudy.
1 p. m.	Puerto Plata.....	29.72	74	W.....	3	Rain.
	Turks Island.....	29.74	70	NW...	4	Cloudy.
16, 8 p. m.	Turks Island.....	29.62	72	NW...	7	Cloudy.
	Turks Island.....	29.26	68	NW...	12	Cloudy.
16, 8 p. m.	Santo Domingo.....	29.78	92	S.....	3	Cloudy.
	Puerto Plata.....	29.62	82	S.....	3	Cloudy.
17, 8 a. m.	Inagua.....	29.64	82	NW...	7	Cloudy.
	U. S. S. Kittery (20° 1' N. 72° 3' W.)	29.64	88	SW...	6	Cloudy.
17, 8 a. m.	S. S. Gulf Trade (24° 3' N. 74° 3' W.)	29.82	82	NE...	5	Rain.
	Puerto Plata.....	29.78	76	SE...	4	Partly cloudy.
10 a. m.	Baracoa.....	29.72	80	S.....	2	Cloudy.
	Gibara.....	29.76	76	SW...	2	Rain.
12 noon.	Camaguey.....	29.74	76	NW...	2	Clear.
	Nassau.....	29.72	84	NE...	5	Partly cloudy.
1 p. m.	S. S. Scantic (26° 3' N. 74° 2' W.)	29.90	84	E.....	7	Partly cloudy.
	Nassau.....	29.64	86	NE...	7	Partly cloudy.
17, 8 p. m.	Gibara.....	29.68	86	SSW...	3	Cloudy.
	Nassau.....	29.56	86	N.....	9	Cloudy.
17, 8 p. m.	Gibara.....	29.76	86	S.....	2	Cloudy.
	Camaguey.....	29.68	84	SW...	4	Rain.
12 noon.	Tunas.....	29.70	70	W.....	6	Cloudy.
	Cienfuegos.....	29.66	90	W.....	3	Rain.
4 p. m.	Havana.....	29.72	90	NW...	4	Partly cloudy.
	Key West.....	29.68	84	NE...	3	Cloudy.
18, 8 a. m.	Miami.....	29.68	82	NE...	4	Cloudy.
	S. S. La Playa (26° 4' N. 79° 7' W.)	29.74	82	NE...	6	Cloudy.
12 noon.	Key West.....	29.50	82	NW...	7	Cloudy.
	Fort Myers.....	29.46	82	NE...	6	Cloudy.
4 p. m.	Havana.....	29.64	80	SW...	4	Cloudy.
	Tampa.....	29.68	80	NE...	5	Cloudy.
12 noon.	S. S. El Oceana (29° 3' N. 79° 5' W.)	29.66	86	NE...	9	Rain.
	S. S. Scantic (25° 7' N. 76° 6' W.)	29.88	82	SE...	7	Cloudy.
4 p. m.	Miami (received next day).	27.94	-----	SE...	9	Rain.
	Fort Myers.....	29.04	76	N.....	9	Rain.
4 p. m.	Tampa.....	29.42	78	NE...	7	Rain.

THE HURRICANE APPROACHES THE FLORIDA COAST

A special observation made at Nassau at 1 p. m. on the 17th was the last and only observation received from the region east of Miami and Key West on that date. At the 8 p. m. observation of the 17th both of these stations reported a barometer reading of 29.68 inches, with northeast wind, 18 m. p. h. at Miami and 12 at Key West; furthermore, both stations reported no material change in pressure within the last 2 hours. The lack of information from the region to the eastward of Florida and the rather disconcerting reports of little pressure

at the two stations named placed the forecaster in a very difficult position. With night already on and no chance of awaiting special reports from Miami, he had to rely on his previous deductions made Friday morning, which placed the hurricane center near Miami at 8 a. m. Saturday morning; therefore, with no indications whatever of a recurve in the path of the hurricane, the storm warnings were changed to hurricane warnings at 11 p. m. of the 17th from Key West to Jupiter Inlet, and northeast storm warnings were ordered north of Jupiter to Titusville and on the west Florida coast from Key West to Punta Gorda.

A chronological list of the most important warnings issued in connection with this storm is given in a later section of this report.

The center of the hurricane reached the Florida coast at Miami about 6 a. m. September 18. That the "eye" of the storm passed directly over the Weather Bureau office in Miami is clearly shown in Figure 2, the latter being a reproduction of the record of wind direction and speed as automatically recorded in that office for the hours 5 to 8 a. m. September 18, within which time the "eye" of the storm passed the station.

It is shown thereon that the strong northeast winds diminished and at 6:10 a. m. became variable, at first shifting to the southeast and for the next 35 minutes momentary winds from all directions were recorded but in the main they were from the southeast at velocities of 10 to 12 miles per hour. At this time the people of Miami, thinking the storm was over, ventured into the streets, as told herein later by Mr. Gray, some of whom doubtless lost their lives by so doing.

After the lull the wind went to the southeast and increased in speed and at 9 a. m. of the 18th it became southwest and continued in that direction until well after the storm had passed.

At the end of this report is given a short account of an extraordinary wind experienced at Jupiter Inlet, about 80 miles north of Miami, as late as 8 p. m. of the 18th.

At the time of the passage of the "eye" of the storm, Miami was doubtless in or near the northern edge thereof since at Homestead 28 miles to the south, the lull was of but 5 minutes duration.

The record of rainfall and temperature during the passage of the "eye" was lost due to the recording instruments being blown away. Below is the narrative of R. W. Gray, the official in charge of the station.

Miami, Fla.—The first information concerning the storm was received from the central office at 11:30 a. m. of the 14th. No vessels bound for the Bahamas left Miami after that date. Advisory messages relative to the intensity and progress of the storm were received at regular intervals from the 15th to the 17th, inclusive, and these advices were given such wide distribution that it can be safely said that the entire population of the lower east coast of Florida was informed of the approach of the storm.

Northeast storm warnings were displayed, by order of the central office, at noon of the 17th. The afternoon newspapers published the warning, and it was otherwise disseminated by telephone and telegraph. From the early afternoon of the 17th until the wires were blown down, telephone calls at the Weather Bureau office were answered at the rate of two to three per minute. In addition to the telephone service from the Weather Bureau, the Miami Daily News kept a special telephone operator on duty to give information to those who did not succeed in getting telephone connection with the Weather Bureau. A representative of the News remained at the Weather Bureau office throughout the night of the 17th-18th and kept his paper informed of all available information until telephone connection was severed.

The message ordering hurricane warnings at 11 p. m. of the 17th was received at 11:16 p. m. The warning was displayed from the roof of the Federal Building at 11:25 p. m., and from the storm warning tower at the city docks, one and one-half miles from the Weather Bureau office, at midnight.

Before leaving for the storm-warning tower, I gave the hurricane warning to the long distance telephone operator, who repeated it to the telephone exchanges at Homestead, Dania, Hollywood, and Fort Lauderdale. The warning was also telephoned to the chief dispatcher of the Florida East Coast Railroad, and several efforts were made to get telephone connection with Fowey Rock Light-house and the Coast Guard base at Fort Lauderdale. Telephone communication had not been interrupted, but the operator reported that repeated calls failed to get any response from Fowey Rock or the Coast Guard station. Shortly after 10 p. m. I began to give out the information that the rapid fall of the barometer and the direction and increasing velocity of the wind indicated that the storm was rapidly approaching this coast, and that, unless it recurved to the east of Miami, winds of hurricane force might be expected. This information continued to be given by telephone until the receipt of the hurricane warnings at 11:16 p. m. After that time all persons calling by telephone or in person were informed of the display of hurricane warnings. Telephone communication with Hollywood and Miami Beach was severed between 1 a. m. and 2 a. m., and in Miami between 2 a. m. and 3 a. m.

The hurricane came with great suddenness. Except for a moderate but steady fall of the barometer after 10 a. m. of the 17th, there were no unusual meteorological conditions to herald the approach of the storm. The wind velocity as late as 8 p. m. of the 17th was only 19 miles per hour, and the usual heavy rain that precedes a tropical storm did not set in until after midnight, by which time the wind was blowing a fresh gale. At 10 p. m. of the 17th the barometer began to fall rapidly, and by midnight it had fallen 0.11 inch. From midnight to 6:45 a. m., at which time the center of the storm passed over Miami, there was a precipitate fall at the rate of 0.28 inch per hour. * * * From about 5:30 to 6:10 a. m. the barometer fell 0.40 inch and then remained stationary for 15 or 20 minutes. This was at the beginning of the lull in the wind that attended the arrival of the center of the storm. After the short stationary period there was another rapid fall of 0.06 inch, and at 6:45 a. m. a reading of the mercurial barometer showed a pressure of 27.61 inches. * * * After the passage of the center of the storm, the barometer rose even more rapidly than it had fallen, and by noon it had reached 29.30 inches.

The center of the storm passed over the central and southern parts of Miami. Over the extreme northern part of the city and over the northern part of Miami Beach the wind shifted from northeast to south, but there was no pronounced lull. At the Weather Bureau office the wind fell to 10 miles per hour at 6:30 a. m. At the same time the velocity at the Allison Hospital, 6¼ miles northeast of the Weather Bureau office in the northern part of Miami Beach, was 80 miles per hour. Ten minutes before, the velocity had been 108 miles.¹

The wind increased steadily from the northeast after 10 p. m. At 1:50 a. m. the anemometer recorded a velocity of 41 miles, indicating a true velocity of about 57 miles per hour. Telephone communication with Miami Beach ceased shortly before this time. By 2:35 a. m. the true velocity had increased to 60 miles per hour, and by 3 a. m. telephone service in Miami had ended. There was a steady increase in wind velocity from that time to 5 a. m. when the anemometer recorded a maximum velocity of 80 miles, indicating a true velocity of at least 115 miles per hour. The top of the rain-gauge blew off at 3:42 a. m., and was recovered and replaced by the assistant at this station. It was again blown off a few minutes later and lost. A part of it was found the next day on the roof of a nearby building. The electric light wires were blown down at 4 a. m., and the observations during the remainder of the night were made with a flashlight, supplied by one of the visitors who spent the night at the Weather Bureau office. Frequent flashes of electricity from fallen wires added to the fearful aspect of the elements. The instrument shelter blew away between 4 a. m. and 5 a. m., landing in the street below and crashing into the automobile of a *Miami Daily News* staff writer who was on duty at the Weather Bureau office. There was an abrupt decrease in the wind velocity between 6:10 a. m. and 6:15 a. m., when the center of the storm reached Miami (see Fig. 2). Many persons who had spent the night in down-town buildings rushed out to

¹ Mr. B. C. Kadel, Chief of the Instrument Division, informs the editor that the anemometer here mentioned was supplied by Friez of Baltimore and that it is one of the new three-cup pattern anemometer developed by J. Patterson of the Canadian Meteorological service in collaboration with U. S. Weather Bureau officials, and, further, that this form of anemometer at the speeds named registers very close to the true velocity and that the maximum of 128 m. p. h. is equivalent to a velocity of 160 m. p. h. as registered by the 4-cup Robinson anemometer.

The disparity between the wind velocities at the two exposures mentioned is therefore greater than the figures would indicate; this is due to the blanketing effect of recently erected high buildings which almost completely surround the three-story Federal office building in which the Weather Bureau office is housed. These buildings rise to 8 and, in one case, 18-stories; one 15-story building stands not more than 100 feet east-northeast of the Weather Bureau exposure. It so happens that plans for a change in location were under consideration at the time the disaster occurred. See Mr. Kadel's analysis of the Allison Hospital wind record following this article.—Ed.

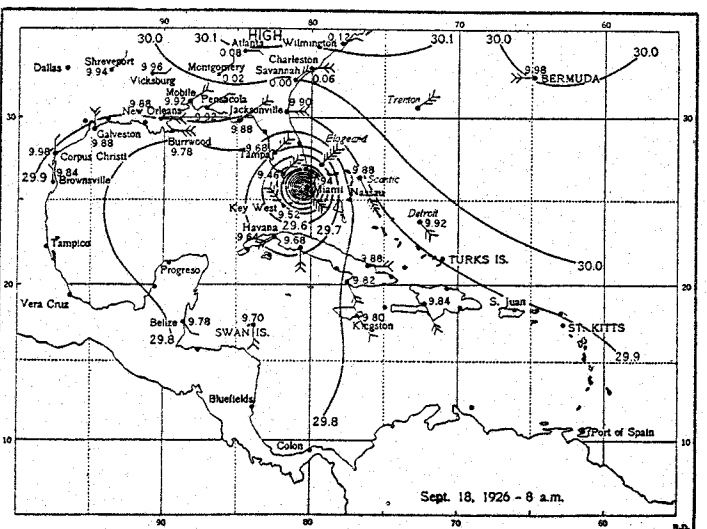
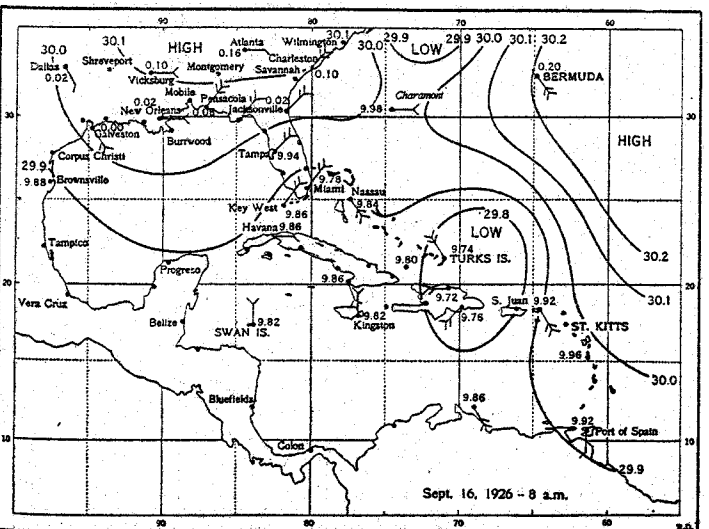
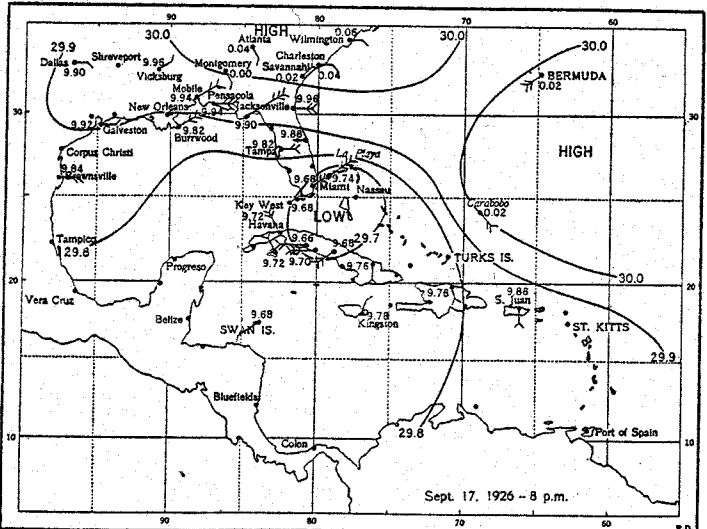
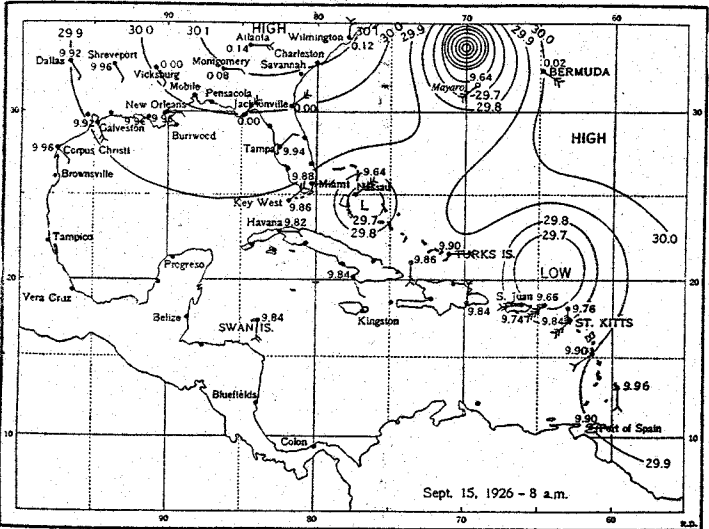
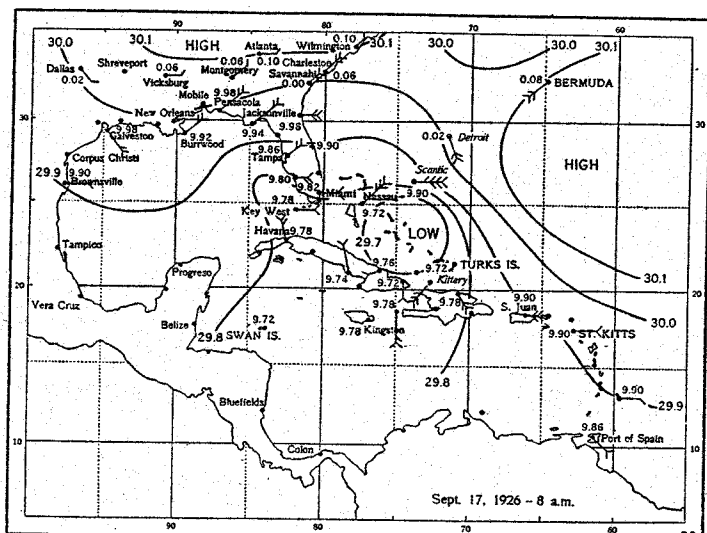
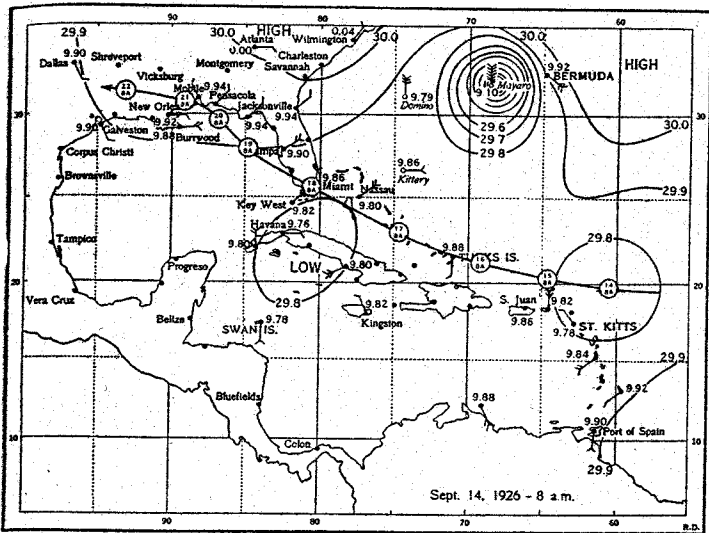


FIG. 1.—Synoptic charts of the Miami hurricane

view the wreckage that filled the streets. I warned those in the vicinity of the Federal Building that the storm was not over and that it would be dangerous to remain in the open. The lull lasted 35 minutes, and during that time the streets of the city became crowded with people. As a result, many lives were lost during the second phase of the storm. With the passage of the center of the storm, the wind shifted to southeast at 6:47 a. m., and immediately increased to gale force. A velocity of 50 miles was recorded at 7:55 a. m. and a velocity of 60 miles at 8:55 a. m. These recorded velocities are nearly 50 per cent less than the actual velocities. The wind shifted to southwest at 9 a. m. and continued from that direction until 6 p. m., with steadily diminishing force.

A Robinson anemometer on the roof of the Allison Hospital,² Miami Beach, connected with a Weather Bureau type triple register, recorded a velocity of 128 miles per hour at 7:30 a. m. The anemometer blew away at 8:12 a. m., at which time it was recording 120 miles per hour.

The storm tide on the Miami side of Biscayne Bay was approximately eight feet, and reports indicate a similar tide at Miami Beach. The water front of Miami was flooded for two to three blocks back from the bay, and low parts of the city near the Miami River were also flooded. After the storm, the entire bay front section of Miami was strewn with boats ranging in size from small pleasure craft to large schooners. Some of the boats had been carried more than two blocks from the bay. Water rose in hotels and residences near the bay to a depth of three to five feet. Miami Beach was entirely inundated, and, at the height of the tide, the ocean extended to Miami, three and one-half miles across Biscayne Bay. All streets near the ocean at Miami Beach were covered

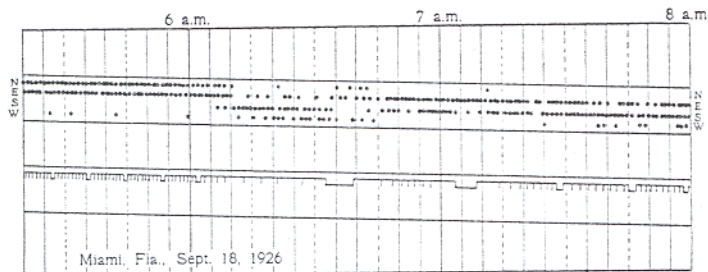


FIG. 2.—Record of wind direction and velocity, Miami hurricane (Weather Bureau Office, Miami, during passage of "eye" of storm. Each space between pairs of vertical marks on velocity graph equals one mile of wind)

with sand to a depth of several feet, and in some places automobiles were entirely covered. The foundations of some buildings were washed out, allowing the buildings to collapse. The storm tide occurred with the shift of the wind to the east and southeast, following the arrival of the center of the storm. In the Miami River, the tide came in the form of a bore that left a mass of wreckage from the boats that had sought safe anchorage.

The intensity of the storm and the wreckage that it left can not be adequately described. The continuous roar of the wind; the crash of falling buildings, flying débris, and plate glass; the shriek of fire apparatus and ambulances that rendered assistance until the streets became impassable; the terrifically driven rain that came in sheets as dense as fog; the electric flashes from live wires have left the memory of a fearful night in the minds of the many thousands that were in the storm area.

The known loss of life in the Miami district is 114. Many more are missing. Several thousand persons were injured, and 25,000 were without shelter after the storm.

The property loss in the greater Miami area has been estimated at \$76,000,000. This does not include damage to house, office, and store furnishings. Approximately 4,725 homes were destroyed and 9,100 damaged in the area extending from Fort Lauderdale to Miami.

THE HURRICANE AFTER PASSING MIAMI

Nearing the west coast of extreme southern Florida, the center passed over Bonita Springs, about 20 miles south of Fort Myers, shortly after noon. It passed into the Gulf of Mexico during the afternoon, the displayman at Punta Rasa, Fla., reporting a calm at 3:15 p. m. and lowest pressure 28.05 inches at 3:30 p. m. After crossing the northeastern portion of the Gulf, the center closely approached, but did not reach Pensacola, September 20,

where the pressure fell to 28.56 inches. Shortly afterward the center was definitely located as passing over Perdido Beach, Baldwin Co., Ala., where a minimum reading of 28.20 inches was observed between 3 and 4 p. m. with a lull in the wind and a shift from northeast to southwest. It moved thence toward the west passing a short distance south of Mobile at 9:30 p. m. when the barometer at that station reached its minimum of 28.76

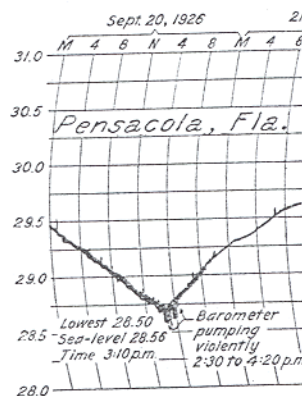
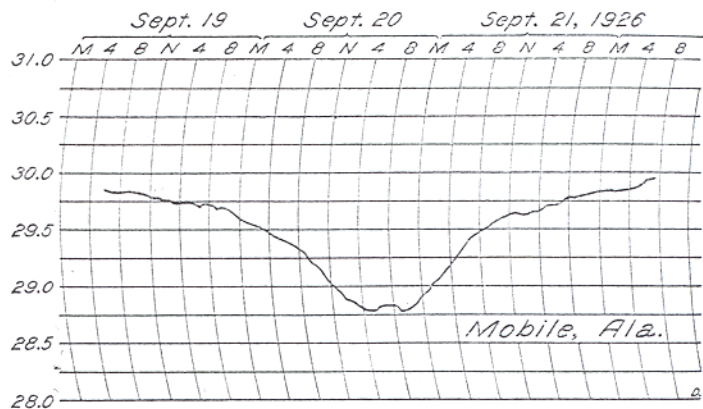
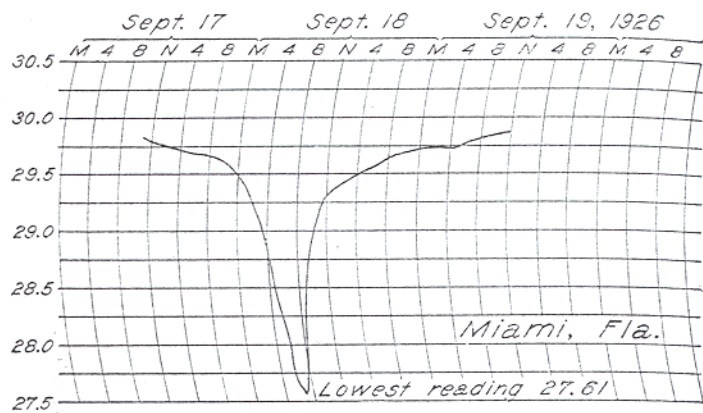


FIG. 3.—Barograms at three cities, Miami hurricane

inches; continuing thence westward the center passed a very short distance south of Pascagoula, Miss., at 5:25 a. m. of the 21st with lowest pressure 28.99 inches. The northern edge of the "eye" of the storm passed over Biloxi about 8 a. m., with a pressure of 29.03 inches at that time; at 9 a. m., the center reached Gulfport and there was a calm of about 10 minutes during which the barometer read 29.08 inches. The center passed over Pass Christian about 9:30 a. m., and there was a calm of about 30 minutes. The lowest pressure was about the

² See footnote 1.

same as at Gulfport. Beginning about 9:30 a. m., there was calm for an hour at Bay St. Louis. The hurricane center moved over land after leaving Pass Christian and Bay St. Louis. By this time it had greatly diminished in intensity. At 8 p. m. the center was some distance northwest of New Orleans and during the ensuing 24 hours it moved more rapidly westward over Louisiana and dissipated in eastern Texas.

As showing the changed character of the pressure distribution in the storm, three barograph curves are reproduced in Figure 3, viz, Miami, and Pensacola, Fla., and Mobile, Ala.

Thus far no evidence has been received as to the place of origin of the storm, but it may be inferred that it developed to the southwest of the Cape Verde Islands 6 or 7 days before its appearance northeast of St. Kitts.

This storm was the sixth tropical cyclone in the last 40 years to pass inland over the southeast Florida coast and cross the peninsula into the Gulf of Mexico. It was also by far the most severe of the six.

Below is given data of lowest sea-level pressure and maximum wind velocity at the various observing stations in or near the path of the storm. These data clearly show that the maximum intensity was reached on the Florida coast when the storm passed from the Gulf Stream to a land surface, that the pressure in or near the center did not thereafter descend to so low a level as where it first impinged on the coast, there being 0.59 inch difference between the low pressure at Miami and at Perdido Beach, Ala., near where the storm made its second entry upon a land surface, see Table 2.

TABLE 2.—Pressure and wind data for stations along the path of the hurricane, stations arranged in accordance with their respective distances from the center

Stations	Date	Lowest pressure	Time	Wind	
				Maximum velocity	Direction
		<i>Inches</i>		<i>M. p. h.</i>	
Miami, Fla.-----	Sept. 18	27.61	6:45 a.---	115	NE.
Miami Beach, Fla.---	do	-----	-----	128	SE. or E.
Punta Rasa, Fla.---	do	28.05	3:30 p.---	-----	-----
Fort Myers, Fla.---	do	28.14	-----	180	-----
Perdido Beach, Ala.---	Sept. 20	28.20	3:30 p.---	116	E.-SE.
Pensacola, Fla.---	do	28.56	3:10 p.---	94	N.
Mobile, Ala.---	do	28.76	9:30 p.---	155	S.-SE.
Gulfport, Miss.---	Sept. 21	29.08	8:30 a.---	50	NE.
Tampa, Fla.---	Sept. 18	29.36	5:30 a.---	64	NE.
Apalachicola, Fla.---	Sept. 19	29.57	5:00 a.---	50	E.
Jacksonville, Fla.---	Sept. 18	29.77	4:00 p.---	27	NW.
New Orleans, La.---	Sept. 21	29.47	2:00 p.---	-----	-----

¹ Estimated.

STORM TIDES

(Excerpts from reports of Weather Bureau officials)

Miami and Miami Beach.—The tide ranged from 7.5 feet along the northern part of the Miami water-front to 11.7 feet along the lower water-front south of Miami River. The highest tide occurred in the lower and wider part of Biscayne Bay. (All heights given are above mean low water.)

At Miami Beach, the tide was highest over the southern part of the city, ranging from 10.6 feet on the ocean side to 6.4 feet on the bay side.

All measurements at Miami and Miami Beach were carefully made, most of them being taken from water marks inside of buildings, where the action of the waves was not shown.

Tampa.—The tide was very low, being driven out of the bay and river by the strong northeast winds, as was the case in 1910. At 3 p. m. of the 18th it was 0.8 feet below mean low water, at 6 p. m., 4.0 feet below, and at 9 p. m. 6 feet below (lowest point). High

tide on September 19 about 2 p. m. reached 4.5 feet above mean low tide, making the extreme range 10.5 feet. It was high again on the 20th, being 3.9 feet above mean low tide. In 1910 the tide went 8 feet below mean low tide, and in 1921 it went 10.5 feet above.

Fort Myers.—High water accompanied the storm, according to newspaper reports, reaching 4 to 6 feet above normal and flooding certain sections of the city.

Apalachicola.—The tide was down to -0.4 foot at 6:30 a. m.; it rose during the day, 20th, reaching 3.4 feet at 6:30 p. m. and continued to rise during the night. On the 21st the tide was estimated at 4.2 feet at 6:30 a. m.; it was then overflowing low ground along the water front with highest waves running possibly to 5.0 feet, portions of Water Street being then from 6 to 8 inches under water.

Pensacola.—Tides were but little above normal until after midnight of the 19th-20th, and at 2 a. m. of the 20th the stage was only 1.3 feet above normal, but thereafter the water rose rapidly and reached its highest stage about noon of the 20th. At 7 a. m. of the 20th the tide was 5 feet above normal, at which time the U. S. Coast and Geodetic tide gage ceased recording. The water remained high until after 2 p. m. when it receded considerably. The water rose steadily in the face of northeast winds of hurricane force, indicating that the storm center was preceded by a moderate tidal wave, as the highest water occurred before the winds became true southeast, or off the Gulf. The high stage of 9.4 feet above mean sea level has been accurately determined since the storm. This stage is 0.6 foot below the high water recorded in 1906, but reliable persons who experienced the 1906 storm assert that the water was higher this year than in 1906, probably by two feet. The United States Coast and Geodetic tide gage was not in operation, of course, in 1906, and probably an inaccurate base level was used in computing the level of the storm tide of that year. Reports indicate that the tide did not reach as high a level at the Naval Air Station as at Pensacola, while proceeding eastward in Pensacola Bay much higher levels were reported. The Bagdad Land and Lumber Company at Bagdad, Fla., reports a tide of 14 feet. Valparaiso reports a tide of about 4 feet above normal; St. Andrews, 6 feet; and Port St. Joe about 4½ feet. Reports from the Gulf Beach, about 20 miles southwest of Pensacola indicate that no high water was experienced there.

Mobile, The tide in Mobile River.—There was a steadily decreasing tide with the northerly winds until an unprecedented low stage occurred at 2 p. m., September 21. The water was 0.5 foot above mean low tide on the harbor-master's gage at 11:30 p. m., September 19. Measurements by the observer of the depths of the water at points of the river bottom reported by different parties as having been above water level indicate a minimum stage of 9.7 feet below mean low tide. This unusual condition became troublesome and caused slight damage to boats that had sought shelter at Twelve Mile Island, upriver from Mobile, as it increased the height of the river bank above water, and the swaying of the trees caused large sections of ground with timber to slide into the river. The tide was reported to be rising at 1 a. m., September 21, and a maximum stage of 5.3 feet was reached at 11 a. m. It fluctuated slightly and remained within a foot of the highest stage until about night-fall.

Gulfport.—* * * At 9:30 a. m., after a lull of 10 minutes, the wind shifted to east-southeast and was about 15 m. p. h. It did not change much until 11:15 a. m., when it began to veer and increase in velocity. It was from the southwest by 6:15 p. m., having reached a velocity of about 55 miles p. h. from the SSE at 2:30 p. m. The tide fell and it was 3.8 feet below mean low tide at 10 a. m. September 20. It rose on September 21 and reached a maximum of 6.0 feet at 1:15 p. m.

Bay St. Louis.—* * * The tide was very low from September 17 to 9:15 a. m. September 21, when it began to rise, and it reached about 3 feet above normal.

New Orleans.—* * * The storm having moved across the Florida Peninsula, the length of fetch over the Gulf needed to develop swells that would produce tides preceding the storm was short. The rise in the tide on the Mississippi coast and at Burrwood up to Sunday morning, the 19th, indicated that the center of the storm was moving toward the mouth of the Mississippi; however, on Sunday afternoon, September 19, reports from along the Mississippi coast and Burrwood, La. showed the tide falling at all points. From these and attendant weather conditions, we concluded that the whole coast eastward to Mobile was in that part of the storm to the left of the line of advance of the center. Our judgment on this matter was therefore embodied in a telegram to the Central Office which was forwarded shortly after 4 p. m. September 19.

DISTRIBUTION OF WARNINGS OF SEVERE STORMS

General distribution.—Hurricane and other warnings of severe storms are telegraphed or cabled from the Central Office of the Weather Bureau in Washington direct to officials in charge of principal and substations of the Bureau in the districts affected; also to the radio broadcast stations at Brownsville, Tex., New Orleans, La., and Key West, Fla., for radio broadcast at those points.

The Navy Department (Communications Office for Arlington) also receives a copy of warnings of all severe storms. The weather bulletin broadcast daily by the Arlington station (NAA) includes in addition to the weather data warnings of severe storms as issued by the Weather Bureau.

Press associations are also supplied with telegraphic advices of storm warnings.

Advices of the coming of the hurricane, in the present case, were perhaps as widely, if not more widely distributed than ever before due to the multiplication of radio broadcasting stations. The radio service at New Orleans, in particular, was especially effective; one station broadcasting hourly bulletins.

Space does not permit mention of the valuable services of individuals and organizations in spreading the warnings and the subsequent advices as issued.

Below is given copies of the more important warnings issued; the arrangement is chronological.

September 15, 10:02 a. m.—Tropical disturbance reported northeast of St. Kitts Tuesday morning has moved directly westward. Now centered short distance north St. Thomas, Virgin Islands. This storm has already attained considerable intensity.

September 16, 3 p. m.—Center of hurricane of great intensity passing near Turks Island which reports wind one hundred miles from northwest. Hurricane center will pass near or slightly north of Crooked Island, Bahama group, Friday forenoon. Greatest caution advised vessels bound for Bahama group and adjacent waters.

September 16, 9:30 p. m.—Third tropical storm has passed Turks Island moving west-northwestward attended by dangerous shifting gales. Caution advised vessels bound for Florida Straits, Bahamas and adjacent waters.

September 17, 10:20 a. m.—Hoist northeast storm warning twelve noon Jupiter Inlet to Key West. Hurricane central about twenty-three north seventy-four west moving west-northwestward attended by winds hurricane force near center. This is a very severe storm. Its center will likely pass near Nassau early to-night. Great caution advised all vessels bound Florida Straits, Bahama Islands, and east Florida coast. Every precaution should be taken for destructive winds Saturday morning especially Jupiter to Miami.

To the Governor General, Nassau, Bahamas, the following message was sent:

September 17, 10:02 a. m.—Please send special observations every two hours to-day. Hurricane central near and north Crooked Island and its center will likely pass near Nassau early to-night. This is a destructive storm.

AN INTERPRETATION OF THE WIND VELOCITY RECORD AT MIAMI BEACH, FLA., SEPTEMBER 17-18, 1926

By BENJAMIN C. KADEL, in charge of Instrument Division

[U. S. Weather Bureau, Washington, D. C.]

Dr. Scott R. Edwards, superintendent of Allison Hospital, Miami Beach, Fla., has kindly furnished to the Weather Bureau, through R. W. Gray of the Miami office of the Weather Bureau, a record of the wind movement at Miami Beach about 4 miles east of the city of Miami during the hurricane of September 17 and 18, 1926. The hospital is three-fourths of a mile north of the northern limit of the center of the hurricane. The anemometer, a 3-cup Robinson anemometer, cups 5 inches in diameter on arms 6.29 inches long, factor 2.50,

September 18, 1:30 p. m.—Hoist northeast storm warning 4 p. m. north of Jacksonville to Charleston and west of Mobile to mouth of Mississippi River. Hurricane center noon over extreme southern Florida, Fort Myers reporting barometer 29.04, wind fifty-two miles north. Hurricane will pass into Gulf of Mexico this afternoon and continue to move west-northwestward for the present. This is a very severe storm. Greatest caution advised vessels in its path.

September 18, 9:45 p. m.—Change to hurricane warning 11 p. m. Apalachicola, Fla., to Burrwood, La. Hurricane central between twenty-six and twenty-seven north and about eighty-three west moving west-northwestward attended by winds of hurricane force. This is a very severe storm. Unless course changes hurricane center will move inland, most likely between Pensacola and mouth of Mississippi River Sunday night. Emergency. Every precaution should be taken against destructive winds.

September 19, 10 a. m.—Advisory 10 a. m. Hurricane apparently central between twenty-seven and twenty-eight north and about eighty-five west moving west-northwestward attended by dangerous shifting gales. Unless course changes hurricane center will move inland late to-night between Pensacola and mouth of Mississippi River, probably nearer the latter. Further advices this afternoon. Meanwhile every precaution should be taken against destructive east and northeast winds beginning to-night all points where hurricane warnings are displayed.

September 19, 2:30 p. m.—At 2:30 p. m. of the 19th the following advisory warning was sent to all stations from Apalachicola to Burrwood, inclusive, and hurricane warnings were ordered continued at 11 p. m. at all display stations within this area:

Noon specials indicate hurricane center near twenty-eight north eighty-six west moving west-northwestward. This is a hurricane of great intensity and magnitude and emphasis should be placed on need of every possible preparation for destructive winds, especially Pensacola to mouth of Mississippi River. Hurricane center will likely pass inland late to-night or Monday morning.

Then the final advisory before the hurricane center approached the coast was as follows:

September 19, 9:30 p. m.—Advisory 9:30 p. m. Hurricane central about twenty-nine north eighty-seven west apparently moving northwestward. Hurricane center will pass inland early Monday morning, probably not far from the Pensacola-Mobile section.

The local distribution.—Each local Weather Bureau station in the storm area distributes the warnings by telephone directly to all persons and organizations that have vital interests to be served. In urgent cases such other means of quick personal distribution as are available are utilized. In the present case the Tampa official enlisted the services of the local Boy Scout organization. Other officials took advantage of such means as were at hand, but in the main chief reliance is placed on the telephone, the radio, and the daily local press.

Special acknowledgement is made to the *Mobile Register* for issuing a special edition on Sunday, September 19, giving the latest information respecting the hurricane. Space does not permit a recital of the details of the local distribution at the various Weather Bureau stations in the storm-stricken area; suffice it to say that each and every employee was faithful to the trust imposed in him, and made the widest distribution humanly possible.

was exposed 19 feet above the roof and 40 feet above the ground, the ground being 5 feet above mean sea level. It was on the eastern or ocean side of the hospital roof, about 1,200 feet from the ocean, and freely exposed to wind from all directions. The anemometer was equipped to close an electrical circuit for each mile of travel of the wind, the 9th and 10th miles being connected together to aid in identification of the record.

The record was made on a standard Weather Bureau pattern meteorograph, variously called triple register or

quadruple register, which is a simple chronographic recorder having a chart speed of $2\frac{1}{2}$ inches per hour. A record sheet that had been used for testing was employed, and while the sheet was not placed on the instrument in exactly the customary manner, the time has been indicated in pencil notation by Dr. F. J. Payton of the hospital staff. Careful examination of the record shows smooth uniform motion of the cylinder throughout the period, except for two slight jogs in the line during the last three-fourths hour, which indicate some slight readjustment. With these two unimportant exceptions the record is entirely automatic. The instruments were recently purchased from Julien P. Friez and Sons, who regularly manufacture such equipment for the Weather Bureau, and who are familiar with all the requirements. There is every reason for full and complete confidence in the record.

The record shows that the wind increased gradually from 29 miles per hour at 9 p. m. of the 17th, reaching 100 by 4.30 a. m. of the 18th, and continuing above 100 to a peak of 114 at 6:10 a. m., after which there was a slight decrease to a minimum rate of 78 at 6:25 a. m.; this comparatively low rate lasted but 5 minutes, the wind increasing again to above 100 and reaching a 5-minute maximum of 128 by 7:30 a. m., after which the rate continued above 120 until the anemometer blew away at 8:12 a. m.

The rates above given are for periods of 5 minutes, and are subject to the following small instrumental corrections: At 40, -2; at 60, -3; at 80, -4; at 100, -5; at 120, -5; at 130, -5; at 140, -6. There are several instances on the record of higher rates maintained for two adjacent miles, the highest being 138 at 7:40 a. m. A still higher rate for one mile at 7:43 a. m. has been discarded because the longer mile just preceding it indicates possible disturbance of the record cylinder. It has been customary for many years to use 5-minute velocities in Weather Bureau records and publications because of recognized difficulty in interpretation due to irregular movement of the cylinder, inequalities in length of contacts, and particularly the inertia of the cup wheel in gusty wind. For comparisons with other 5-minute records it is desired to state that the 5-minute maximum of 128 means a true velocity of 123 after applying the correction for this form of anemometer determined in the wind tunnels of the Bureau of Standards (1). If this wind had been measured by the well-known 4-cup anemometer, the indicated record would have shown 163 as the 5-minute maximum and 183 as the extreme.

The indicated extreme velocity of 138, maintained for two miles at 7.40 a. m., corrected for known anemometer error, becomes 132 miles per hour. Using Eiffel's value, $.0033 \text{ SV}^2$ equals pounds per square foot, we find that the corresponding pressure is 57 pounds per square foot on a flat surface normal to the wind. Individual gusts no doubt exceed the average of two miles. The writer has examined some records from a Dine's pressure-tube anemometer in Washington which show that at extreme (one-mile) velocities between 40 and 50 the gusts were 30 per cent higher, but whether so great an increase occurred in the hurricane is unknown. If gusts exceeding by more than 30 per cent the record of the integrated miles had prevailed, we should expect less uniformity in the time for recording the single miles than the record shows. Few single miles differ greatly in length from adjacent miles.

The following table gives in miles for each hour the total movement, the maximum velocity for 5 minutes,

and the extreme velocity, as indicated on the face of the record, and also the corrected values. The explanation of the use of 2 miles for the extreme at high velocities is found in the difficulty of measuring the record of a single mile.

Hour ending at	Total movement	Recorded		Corrected to true velocity	
		Maximum, 5-minute	Extreme	Maximum, 5-minute	Extreme
10 p. m.	31	36	138	35	137
11 p. m.	36	41	142	40	141
12 midt.	40	46	152	44	150
1 a. m.	44	48	152	46	150
2 a. m.	51	59	160	57	158
3 a. m.	59	65	169	62	166
4 a. m.	77	88	104	84	100
5 a. m.	97	108	116	104	112
6 a. m.	104	108	122	104	117
7 a. m.	100	114	124	109	119
8 a. m.	114	128	138	123	132
8 to 8.12 a. m.	25	124	136	119	130

¹ Extreme from one mile of wind movement.

² Extreme from two adjacent miles.

No automatic record of wind direction was made, but the correspondence states that the direction at time of maximum was either east or southeast.

It seems appropriate to refer here to other records of high winds in the United States. The highest known, 186 miles per hour, was measured with a Robinson 4-cup anemometer on Mount Washington, N. H., at 4 a. m., January 11, 1878 (2). The possible error of the anemometer was even then recognized and mentioned in the published account. We now know that this value represents 140 miles true velocity. Some remarks of the observer on duty are as follows: "10th, 11.22 p. m.; east, 112 miles, heavy sleet (window stove in and storm shutters put up); 11.40 p. m., east, 144 miles, light snow; 12 midnight, east, 144 miles, heavy snow; 11th, 1 a. m., east, 150 miles, heavy snow (the roar of the wind is deafening and the building rocks and trembles); 2 a. m., east, 159 miles, heavy snow (another window stove in); 3 a. m., east, 168 miles, heavy snow; 4 a. m., northeast, 186 miles, heavy snow." The record does not state how long the anemometer was exposed between dial readings, but it is not likely to have been more than 5 minutes (the rule in vogue as shown by other journal entries) and may have been but one minute. There was no automatic record.

The Mount Washington record was made in connection with a storm that moved from Cape Hatteras up the Atlantic Coast, characterized as one of the severest ever known along the coast. "Innumerable wrecks occurred, notwithstanding every precaution had been taken."

At Cape Lookout, N. C., on August 18, 1879, a velocity of 138 was recorded, which corresponds to 105 miles per hour true velocity. Following the collapse of the anemometer the observer estimated the maximum at 165, which corresponds to 125 true velocity (3).

At Mobile, Ala., on October 18, 1916, an indicated 5-minute velocity of 115 was recorded, corresponding to a true velocity of 88 (4).

At Pensacola, Fla., on October 18, 1916, a 5-minute maximum of 114, true velocity 87, was recorded. Following the destruction of the anemometer, the estimated maximum was 120, true value 91 (4).

At North Head, Wash., on January 29, 1921, a maximum of 126, true value 96, was recorded. The fastest for one minute was 150, true value 114. Trees were

broken off where their diameter was as much as 4 feet. From examination of the age of trees destroyed, the observer concluded that this was the most destructive storm within 200 years (5).

The Miami Beach record therefore stands as the highest recorded by automatic instruments in the United States.

Engineers and others seeking to apply these velocities to structural problems will find information concerning the average pressure tending to overturn a model in Scientific Paper of the Bureau of Standards No. 523 (6).

LITERATURE CITED

- (1) FERGUSON, S. P., and COVERT, R. N.
1926. NEW STANDARDS OF ANEMOMETRY. Monthly Weather Review, vol. 52, p. 216.
- (2) 1878. Monthly Weather Review, January, p. 5.
- (3) 1879. Monthly Weather Review, August, p. 5.
- (4) FRANKENFIELD, H. C.
1916. WEST INDIAN STORM OF OCTOBER 9 TO 19, 1916. Monthly Weather Review, vol. 44, p. 584.
- (5) DAY, P. C.
1921. SEVERE STORM OVER COAST DISTRICTS OF OREGON AND WASHINGTON. Monthly Weather Review, vol. 49, p. 37.
- (6) DRYDEN, H. L., and HILL, GEORGE C.
1926. WIND PRESSURES ON STRUCTURES. Scientific Paper of the Bureau of Standards No. 523.

DESTRUCTIVE GUST AT JUPITER, FLA., FOLLOWING THE MIAMI HURRICANE

By H. B. BOYER, Meteorologist, In charge

[Weather Bureau office, Key West, Fla., October 4, 1926]

Attention is called to a freakish gust of wind of hurricane force that was experienced at Jupiter, Fla., on September 18, during the tropical storm of that date. This gust practically demolished the naval radio station at that place.

The gust that caused so much damage to the Jupiter radio station was unique in that its destructive force was confined to a narrow and well-defined path running from south-southeast to north-northwest with a width of about 400 feet.

A remarkable feature of this gust was that it occurred during a recrudescence of the storm and after the center

had crossed the Florida Peninsula and was well off the west Florida coast.

Blowing with hurricane force from the northeast and east throughout most of Friday night, the wind veered to southeast and south on Saturday, gradually diminishing in velocity to a whole gale. This was in the natural order of events in a tropical storm whose center was moving on a westerly track to the southward of a given point. In all tropical hurricanes, within the area of hurricane winds, the most destructive are those that occur after the center has passed the gusts being of greatest violence and force, but diminishing in frequency and strength as the center recedes. At Jupiter there was a renewal of the storm to hurricane force during Saturday afternoon, the terrific gust that put the radio station out of commission occurring between 8 and 9 p. m.

* * * In the area of great destruction one anchor of the 200-foot north tower containing 12 cubic feet of concrete was completely pulled out of the ground. Part of the roof of the dormitory was blown southward and deposited on the pier. This, in all probability, was done by an eddy, as there was no other evidence that the gust partook of the nature of a tornado.

E. C. Seibert, public works officer, communicates the following:

It appears as though the majority of the damage at Jupiter was done in a very short space of time, 20 or 30 seconds, or even less. Shortly after 8 p. m., September 18th, a very sudden and marked increase in the wind velocity was noted by the personnel, and before the operator in the operating building could get out, the roof was off and the towers were down. No one witnessed the actual falling of the towers. From the manner in which brush and trees were knocked down, and from its effect on various structures, it appears that this sudden volume of wind was very narrow in width, perhaps only about 400 feet. It seems to have run just a few degrees west of north, wrecking the boathouse and carrying away the operating house roof, north and northeast towers, garage, etc. An old empty wooden tank on a comparatively light steel tower on the lighthouse reservation (to the east) was uninjured, although the tank, it is understood, is not fastened down to the top of the tower except by the effect of the riser pipe from the pump. This tank is only about 500 feet east of the operating building. In other words, the eastern extremity of this cyclonic gust seems to have been about 250 feet east of the operating house, while its western boundary was probably 150 feet. Also, the quarters on top the hill, to the east, and known as the old Weather Bureau House, was not materially damaged.

THE HURRICANE AT TURKS ISLAND, SEPTEMBER 16, 1926

By GEORGE GOODWIN

[Turks Island, West Indies]

At the 8 a. m. readings the weather had taken a very unfavorable change—barometer tending to fall and wind increasing and dropping every few minutes.

On receipt of advice from the bureau that the storm would pass over or near Turks Island, every available means was used to spread the information, that all necessary precautions might be taken. Since the barometer was falling rapidly a special observation was taken at 10:20 a. m. and all particulars sent to the bureau. Wind was then blowing at 36 m. p. h. from NW, with very heavy sea swell. Rain falling. At 1 p. m. the velocity of the wind had increased to 100 m. p. h. NW., with a very heavy sea swell, the intensity of the storm gradually increasing. A special observation was sent to the bureau. At this hour the office was flooded and the sea breaking over the top, carrying all before it. Huge blocks of cement weighing a ton being washed around as if mere pebbles. At 1:55 the storm had reached such intensity as to indicate that everything would be demolished. Wind then about 150 m. p. h., unroofing the

office buildings, the roof of corrugated iron being carried about one mile inland. The sea swell at times was well above the window sills and before it could recede was caught by the next swell, the sea reaching inland for about three-quarters of a mile. The rain and sand at this time were blinding. The wind was so intense that the prickles from the prickly pear were blowing about like dust, being stripped off as the wind would strip a tree of its leaves.

At 5 p. m. it was deemed advisable to take shelter at the commissioner's residence. It took fully 40 minutes to cover a distance of less than a quarter of a mile; after a fierce fight we managed to reach our destination.

At 9:30 p. m., the storm having abated somewhat, the wind suddenly veered round to SE., still of a velocity of about 80 m. p. h.

The instruments of the bureau suffered badly. Cups of the anemometer were found half a mile away. The shelter with the thermometers was blowing around as if a sheet of paper. When eventually picked up it was

found to have sustained little damage and was easily repaired. I was unable to take readings until the 6th of October, unfortunately the clockwork of the barograph having got wet, and sand having found its way into the works of the anemometer register, the whole thing being wrecked. I was able to construct a makeshift from parts on hand * * *.

To illustrate the force of the water from the swell: A small boat of 14 feet * * * was hauled up in front of my residence situated on Front Street. This boat was carried over the abutment, over a 4 ft. 6 in. gate, round the yard, knocking down an outbuilding and finally coming to anchor by my carriage house. The sea rushed through my residence as if a river, at times being knee

deep. Sand from the beach in the yard was above one's knees. The island even now is a perfect wreck and will take a large amount of money and time to put in any state of order * * *.

Date	Hour	Barometer	Wind	Sky	Sea
Sept. 15.	-----	29.910	NE., 10 m.p.h.	Clear	
Sept. 16.	8 a. m.-----	29.751	NW., 18.-----	Cloudy	
	10:20 a. m.-----	29.630	NW., 36.-----	Cloudy	Heavy swell.
	1:00 p. m.-----	29.265	NW., 100.-----	Cloudy	Very heavy swell and intensity of storm increasing.

Measured precipitation 10 inches and rain still falling. Heavy swell carried rain gage some distance inland.

HURRICANE AT BERMUDA, OCTOBER 22, 1926

W. H. Potter, of Bermuda, has sent the following account, to which we add a table of pressure and wind velocities taken from The Royal Gazette and Colonist Daily, Bermuda, for October 25, 1926.

The tropical disturbance which passed over Bermuda on October 22d, 1926, was unique in that it gave no preliminary warnings of its approach. Usually they do. The storm that passed near here on August 6th heralded its approach on the 2d by a very heavy swell on the south shore which kept increasing as the storm came nearer. If it had not been for the warnings issued by the Weather Bureau, no one would have considered the possibility of a hurricane until the storm broke; even with these warnings, it seemed doubtful.

On October 18th, 19th, and 20th the barometer, while rather low was steady, the weather clear and warm. Wind W., moderate, but light on the 20th, veering through NE. to SW. by the 21st. On the 21st the sky was overcast with alto-stratus, but not the uniform pall that precedes hurricanes, but of different thicknesses which grew heavier and lower as the day went on. The wind was SW., light, and the barometer fell very slowly. The symptoms were exactly those that obtain when an ordinary Low passes to the north of us and the indications were, rain in the night followed by clearing with W. to NW. winds next day. It rained in the night hard.

At 7:30 a. m. of the 22d the barometer had taken a big drop, wind backed to SE. and rain was still falling and the graph seemed to be flattening out. This would indicate that the storm was passing to the north and had reached its climax. Suddenly at 7:45 the wind backed to ENE., increased with heavy gusts, the barometer began its rapid fall and then there was no doubt what we were in for, and from then on was a conventional hurricane.

The calm center was rather large, taking about 40 minutes to pass, the wind backing through NE. to NNW. The wind blew harder and all the damage was done in the second half and its velocity was at least 120 m. p. h. Apart from two houses, unoccupied, destroyed in Hamilton, the damage, while rather large in the aggregate, was for the most part small individually. The roofs of probably 40 per cent of the houses were more or less damaged. No one was killed and one slightly injured, and there was no damage to speak of to the small boats in the harbor. The telephone was hit hard, but the electric lights were on in Hamilton by 7 p. m. the 22d, and here across the harbor by the next evening.

Following is the barometer and wind table, prepared by Sergt. W. R. Green, R. A. M. C., the observer at Prospect.

Barometer		Wind		
Hour	Inches	Hour	Actual m. p. h.	Direction
8 a. m.-----	29.54	7:30- 8:30 a. m.---	28	SE.
		8:30- 9:30 a. m.---	45	Changeable between SE. and NE.
		9:30-10:30 a. m.---	168	Do.
11 a. m.-----	28.58	10:30-11:30 a. m.---	47	Do.
		11:30-12:30 p. m.---	228	Do.
		12:30- 1:30 p. m.---	114	NW.
3 p. m.-----	29.59	1:30- 2:30 p. m.---		

¹ It blew at the rate of 95 miles per hour from 10 a. m. to 10:15 a. m.

² It blew at the rate of 8 miles per hour between 11:45 a. m. and 12 noon.

³ No record taken after 1:30 p. m.

At 12 noon the direction of the wind changed to NW.
Rainfall 4.50 inches.

The original barograph trace made at Paget, Bermuda, and kindly loaned to us by Mr. Potter, shows a finely developed deep V form: An uninterrupted and precipitous fall from (uncorrected) 29.75 inches at 7:45 a. m. to slightly below 28.75 inches shortly after noon, followed by a rise, not quite as rapid as the fall, beginning about 12:30 p. m. and reaching approximately 29.80 at about 6:30 p. m. The trace did not reach 30.00 inches until 7 a. m. the next day. Mr. Potter comments as follows upon this barogram:

"Unfortunately the pen was a bit sluggish. While it registered at 8. a m. the 22d the same as the standard barometer at Prospect, it lacked 8 or 10 points of reaching the minimum at noon."