

TROPICAL DISTURBANCE OF AUGUST 18-25, 1935

By W. F. McDONALD

[Weather Bureau, Washington, September 1935]

The first indications of probable origin of this hurricane appeared on August 17, or possibly a little earlier, as a mild general disturbance of the normal trade-wind conditions over the lesser Antilles, attended by a slight but fairly widespread depression of the barometer, that became quite definitely localized during the night of the 17th-18th in the area around the intersection of the twentieth parallel and the sixtieth meridian. (The synoptic situation on the morning of August 18 is shown on chart IX.)

The American tanker *California Standard* made the first definite contact with the developing storm center on the morning of August 18, when a northeast gale was encountered near latitude 22° N., longitude 65° W. During that afternoon the wind rose at maximum to storm force (Beaufort 11) and the barometer fell to 29.55 inches, the lowest point, about 8 p. m., after which the wind shifted through east to southeast by south, holding the force of a whole gale (Beaufort 10) until the morning of the 19th. It would appear from these observations that the *California Standard* crossed the track of the storm not far in advance of the center, which at that time was moving west-northwest.

The next report which clearly identified the location and intensity of the cyclone was obtained from the American steamship *Angelina* which passed very close to the center about 5 a. m. of the 21st. This ship was then near 27° N., $68^{\circ}30'$ W. A barometer reading of 28.2 inches was observed, attended by hurricane winds which shifted from northeast through west to southwest, without a lull. The storm had by that time entered the recurve and was moving almost due northward; the *Angelina* was involved in the left-hand semicircle quite close to the center.

The hurricane moved on northward during the 22d, and on the morning of the 23d was central about 180 miles west of Bermuda. Shipping had been well warned of the

approximate position and course of the disturbance, so that vessels successfully avoided the center, and it was not until the morning of the 24th that another ship was heavily involved.

The storm had by that time turned northeastward, and was moving at a much more rapid rate. The British steamer *York City* encountered the central region about 400 miles northeast of Bermuda, and there for 24 hours the vessel experienced storm conditions culminating about 5 a. m., August 24, in a south-to-west hurricane that lasted for 4 hours and caused considerable damage to the lifeboats and superstructures of the ship. The barometer fell to 28.71 inches (uncorrected) at the lowest point, when the ship was in a position $36^{\circ}30'$ N., $59^{\circ}30'$ W. The wind changes, from south-southeast through southwest to northwest, show that the *York City* passed fairly near and just behind the center of the storm, then moving rapidly northeastward.

The synoptic situation over the Atlantic on the morning of August 24, when the *York City* was in the hurricane, is shown in chart X. This chart also gives the full track of the hurricane center, which again turned northward during the 24th, and on the morning of the 25th was over Newfoundland. The disturbance rapidly diminished in intensity thereafter.

As the storm center passed over the Grand Banks, it caused heavy damage to fishing fleets and took a toll of lives estimated from press reports at upward of 50 in all, some as far northward as the Labrador coast. No life losses have been reported from the earlier movements of this hurricane.

The rate of progression during the first 5 days, while the cyclone moved from its origin within the Tropics to the waters west of Bermuda, averaged only 8 to 10 miles per hour. For the last 2 days, August 23 to 25, the rate of movement tripled and averaged nearly 30 miles per hour.

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THE HURRICANE OF AUGUST 31 TO SEPTEMBER 6, 1935

By W. F. McDONALD

[Weather Bureau, Washington, October 1935]

The full life history of the hurricane that devastated some of the Florida Keys on the afternoon and night of Labor Day, September 2, 1935, covers almost 2 weeks.

The first indications of conditions favorable to the origin of this disturbance were noted during the last 2 or 3 days of August, to the eastward and northward of Turks Islands; but it was not until August 31 that a definite depression appeared, near Long Island in the southeastern Bahamas, and deepened rapidly as it moved westward. The identity of the disturbance can be clearly followed from that region, over a long path around Florida and across the South Atlantic States to the North Atlantic Ocean, where, off southern Greenland, it was lost on September 10 by merging with a cyclone of extratropical origin. This path in its entirety is shown on chart X.

Hurricane intensity was doubtless reached by the developing disturbance near the south end of Andros Island on September 1. Hurricane winds were last reported along the track on September 8 as the storm was moving northeastward over the Atlantic Ocean.

The vortex was at the stage of maximum violence, though still of small diameter, as it crossed the Florida Keys between Key West and Miami, September 2, moving northwestward. (See chart IX.) The central minimum barometer there was probably somewhat below 27 inches, as indicated by readings of three aneroids on the Keys, the values ranging from 26.75 to 26.98. Effort is being made to secure one or more of these instruments for testing, because any authenticated pressure value below 27 inches will constitute a new low record for the Western Hemisphere.

Attendant winds on September 2 were of phenomenal violence as is shown by physical effects almost equivalent to those experienced in tornadoes. One observer reported his house partially demolished by a wind-driven beam, 6 by 8 inches in section and 18 feet long, which was blown 300 yards from another building; this occurred at a time nearly 3 hours in advance of arrival of the calm center. It was this observer's impression that the winds were still more violent afterward. The lenses and $\frac{3}{8}$ -inch protecting glass of Alligator Reef Light-house, 135 feet above sea level, were reported to have been completely destroyed by the hurricane; and it is unlikely that this destruction could have been produced by flying debris.

It seems safe to estimate that winds of 150 to 200 miles per hour occurred near and over the Keys, with gusts probably exceeding 200 miles per hour.

Over a distance of about 30 miles, from the settlement of Tavernier (about 25°01' N., 80°32' W.) to Vaca Keys, the destruction of buildings, roads, viaducts, and bridges was practically complete. Much of this damage was caused by the overwhelming depth and strong washing

flow of the storm tide that piled up on the Keys under the driving power of the storm. The tracks of the Florida East Coast Railroad were completely destroyed where they crossed between islands and were shifted bodily off their roadbed over long stretches on the Keys. An 11-car train, sent to Lower Matecumbe Key in an effort to rescue inhabitants, was washed from the tracks and only the locomotive withstood the force of wind and tide.

The disposition of debris and nature of the erosion of the railroad embankments clearly indicate that the destructive tide flowed with intense effect over the Keys from southeast to northwest, in the direction of advance of the storm center.

As is usually the case, the destructive effects extended considerably farther to the right than to the left of the path of the center. Had there been no accompanying tide, the damage undoubtedly would have been severe but by no means so complete as that resulting from the tidal inundation. The track and crossties of the railroad were in one stretch washed off a concrete viaduct 30 feet above ordinary water level, but wave action superimposed on the tide no doubt play tides part in this destruction. Reports agreed in the description of the great rapidity with which the rise of the sea came in from the southern side of the Keys as a "wall of water" or a "high wave."

The Danish motorship *Leise Maersk* was carried over Alligator Reef and grounded nearly 4 miles beyond, after being totally disabled by the wind and sea, with engine room flooded. Captain Richard Morthensen described the grounding as follows: "Ship struck outer edge of Alligator Reef 9 o'clock (p. m.) and was carried over the reef by a wall of water inland $3\frac{3}{4}$ miles through the northward force of the wind, which was terrible." None of the crew was lost, though all superstructures were wrecked. The ship was salvaged September 20.

The American steamship *Dixie* was also carried aground somewhat farther north, on French Reef, without loss of life; this ship was refloated on September 19 and towed to New York. The American tanker *Pueblo* drifted helplessly in the storm from 2 to 10 p. m. of September 2; she went out of control near 24°40' N., 80°25' W., and was carried completely around the storm center, finding herself in 8 hours about 25 miles northeastward of her original position, and just barely able to claw off Molasses Reef as the force of the storm began to abate. The lowest barometer reading on the *Dixie* was 27.28 inches (corrected), and on the *Pueblo*, 27.18 inches (uncorrected).

The passage of the hurricane is graphically described in a report submitted by J. E. Duane, cooperative observer for the Weather Bureau and in charge of a fishing camp on Long Key, over which the center passed. Extracts

from his report follow, in the chronological order of his observations:

September 2: 2 p. m.—Barometer falling; heavy sea swell and a high tide; heavy rain squalls continued. Wind from N. or NNE., force 6.

3 p. m.—Ocean swells had changed; this change noted was that large waves were rolling in from SE., somewhat against winds which were still in N. or NE.

4 p. m.—Wind still N., increasing to force 9. Barometer dropping 0.01 every 5 minutes. Rain continued.

5 p. m.—Wind N., hurricane force. Swells from SE.

6 p. m.—Barometer 28.04; still falling. Heavy rains. Wind still N., hurricane force and increasing. Water rising on north side of island.

6:45 p. m.—Barometer 27.90. Wind backing to NW., increasing; plenty of flying timbers and heavy timber, too—seemed it made no difference as to weight and size. A beam 6 by 8 inches, about 18 feet long, was blown from north side of camp, about 300 yards, through observer's house, wrecking it and nearly striking 3 persons. Water 3 feet from top of railroad grade, or about 16 feet.

7 p. m.—We were now located in main lodge building of camp; flying timbers had begun to wreck this lodge, and it was shaking on every blast. Water had now reached level of railway on north side of camp. (Ed. NOTE.—This was water rapidly piled up from the shallow expanse of Florida Bay, under the drive of northerly hurricane winds.)

9 p. m.—No signs of storm letting up. Barometer still falling very fast.

9:20 p. m.—Barometer 27.22 inches; wind abated. We now heard other noises than the wind and knew center of storm was over us. We now head for the last and only cottage that I think can or will stand the blow due to arrive shortly. All hands, 20 in number, gather in this cottage. During this lull the sky is clear to northward, stars shining brightly and a very light breeze continued; no flat calm. About the middle of the lull, which lasted a timed 55 minutes, the sea began to lift up, it seemed, and rise very fast; this from ocean side of camp. I put my flashlight out on sea and could see walls of water which seemed many feet high. I had to race fast to regain entrance of cottage, but water caught me waist deep, although writer was only about 60 feet from doorway of cottage. Water lifted cottage from its foundations, and it floated.

10:10 p. m.—Barometer now 27.02 inches; wind beginning to blow from SSW.

10:15 p. m.—The first blast from SSW., full force. House now breaking up—wind seemed stronger than any time during storm. I glanced at barometer which read 26.98 inches, dropped it in water and was blown outside into sea; got hung up in broken fronds of cocoanut tree and hung on for dear life. I was then struck by some object and knocked unconscious.

September 3: 2:25 a. m.—I became conscious in tree and found I was lodged about 20 feet above ground. All water had disappeared from island; the cottage had been blown back on the island, from whence the sea receded and left it with all people safe.

Hurricane winds continued till 5 a. m. and during this period terrific lightning flashes were seen. After 5 a. m. strong gales continued throughout day with very heavy rain.

The wind lulled briefly between 8 and 9 p. m. at Alligator Reef, with direction shifting sharply from northeast to southeast; this point was just at the northern edge of the calm center. A calm of 40 minutes' duration was experienced on Lower Matecumbe Key; and, as reported above, there was 55 minutes' respite at Long Key fishing camp, but the wind changes at the latter point indicate that the geometric center passed slightly to northward. It is somewhat difficult to reconcile these reports with the general storm path. The rate of progression over this section of the track was about 10 miles per hour, however, and from this it is estimated that the calm center was perhaps 8 miles in diameter.

The loss of life on the Keys was very heavy. Three populous relief work camps inhabited by war veterans were destroyed. The best estimate of mortalities, furnished by the American Red Cross, places the total at 409, of which number 244 are known dead and 165 missing.

The rescue of survivors was greatly hampered by lack of all means of communication and transport; but the Coast Guard promptly threw into the work 18 cutters,

tugs, and patrol boats, 5 amphibian planes, and other facilities. The Red Cross and other public and private agencies of rescue were also promptly at work, so that the aftermath of mortalities from injuries and lack of supplies was held to a minimum.

After passing the Keys, the hurricane moved slowly into a broad recurve northward, closely parallel to the west coast of the Florida Peninsula, to pass inland, on the afternoon of September 4, over the Gulf coast between Apalachicola and Cedar Keys. The times of lowest barometer at various places along the coast northward from Key West give a good indication of the rate of progress. At Everglade (on the west coast about opposite Miami) the lowest barometer reading was 29.69 inches 6 a. m., September 3; at Egmont Key (entrance to Tampa Bay), 28.94, 11 p. m. of the 3d; and at Cedar Keys, 29.08, 1:50 p. m. of the 4th.

A slow increase in hurricane area took place along this part of the path, coincident with a decrease in central intensity, although the storm was still of hurricane force when it passed inland. Considerable damage to buildings, docks, and fishing craft occurred on the west coast, especially at Cedar Keys, and three lives were lost.

Northward along the west coast of the peninsula the tides shifted from abnormally low stages produced by the high offshore winds of the front quarter, to a heavy but not disastrous rise as the onshore winds in the rear of the storm came into play. Tides at many places on that coast rose 5 feet or more above normal, after the passage of the trough line; and the town of Cedar Keys experienced the highest tide and worst flooding since 1896.

During September 5 the storm moved from Georgia across the Carolinas, attended by high winds and heavy rains that caused some damage to property and crops, especially in southern Georgia. On the morning of September 6 the center of disturbance passed again into the Atlantic near Cape Henry, Va., where the lowest barometer was only 29.31 inches, showing that there had been a great decrease in intensity of the storm during progress over the Atlantic coastal plain.

The cyclone deepened again on moving out to sea; and on the morning of September 7 the American steamer *Excelsior* recorded a barometer reading of 28.46 with a whole gale from the south, shifting suddenly to storm force from the north, near 42° N., 54° W. The central minimum continued below 29 inches for two days longer. The American steamer *Black Condor* recorded 28.02 inches on the evening of the 8th, near 51° N., 31° W.; and on the 9th the Danish ship *Frederick VIII* recorded a reading of 28.73 inches near 55° N., 35° W., a considerable distance from the center. The cyclone was at that time diminishing in intensity and merging with another, so that by the 10th it could no longer be distinguished from the cyclonic condition commonly present at high latitudes in the North Atlantic Ocean.

Winds of hurricane strength were reported by a number of vessels along the track of this storm in the North Atlantic, the first such report coming from the American steamship *Quirigua*, which encountered the rapidly deepening cyclone on the 6th when less than 100 miles off the Delaware coast. The last reports of hurricane winds came from ships near mid-ocean, on the 8th.

Total property losses entailed by this hurricane are very difficult to estimate, but doubtless exceed \$6,000,000; practically all the loss was suffered in Florida, and most of it over the Florida Keys.

Warning service began on August 30, when the first strong indications of an incipient cyclone were noted

northward of Turks Islands. Warnings and advices followed at frequent intervals thereafter, outlining the development and forecasting the progress of the storm area, until the night of September 6, when the disturbance was moving rapidly northeastward, well out in the Atlantic Ocean.

During the developing stage of the hurricane, as it was moving over remote islands and shoals of the southern Bahamas where there were no ships or island stations to report the passage of the small vortex, the problems of accurately locating the center and its line of advance and of forecasting its probable movement were extremely difficult. Nevertheless, timely and generally accurate advices were issued by the forecast center at Jacksonville, Fla., during this period. Two examples from this series of frequent advisory bulletins will illustrate their character:

WEST INDIAN HURRICANE, SEPTEMBER 23 TO OCTOBER 2, 1935

By W. F. McDONALD

[Weather Bureau, Washington, October 1935]

While the history of this disturbance is continuous from the afternoon of September 23 until October 2, there is a period of 36 hours, September 26 and 27, during which the characteristics and movement of the storm are obscure and apparently abnormal.

The first positive indication of a disturbance of sufficient vigor to be classed as a definite tropical cyclone was an observation of southwest wind, force 4, with rain and a confused sea, reported by the American S. S. *San Gil*, 7 p. m. of the 23d, when near 14° N., 75° W. A closed isobar of 29.8 inches also appeared on the synoptic chart over the general area northwestward from this position.

A broad but relatively weak cyclonic circulation persisted during the 24th and most of the 25th, and the evidence indicates that a developing center was probably moving westward on these dates, near the fifteenth parallel. At 11 p. m. of the 25th, the American tanker *A. C. Bedford* experienced a minimum barometer of 29.13 inches attended by west-northwest hurricane winds, her position being then very near 15° N., 80° W. This is the lowest barometer reading, and the only ship to report hurricane winds over the Caribbean Sea in connection with this hurricane. (See chart XI for the synoptic situation on the morning of Sept. 26.)

The disturbance appears to have progressed at a very slow rate during the 26th, and to have taken a recurving path toward the western end of Jamaica. Data from ships' reports and island stations are too meager to permit reconstruction of the full history of storm activities during the 27th. It is certain, however, that the center of action shifted rapidly during that day, with the result that there were high winds and excessive rains in Jamaica, causing heavy damage to the banana crop.

There seems little doubt that a minor disturbance, which moved during October 23 to 26 from its origin near St. Lucia toward Jamaica, joined the major cyclone on the 27th and contributed to the excessive rainfall and gale conditions that caused so much damage to the banana crop in Jamaica on the 27th. The progress of this minor disturbance westward was marked by heavy rainfall and local gales, first in Puerto Rico on the 24th, and the next day in southern Santo Domingo.

However, only one cyclonic center passed northward near Cayman Brac on the afternoon of the 27th. This was of hurricane violence, and caused great damage to

Jacksonville, Fla., September 1, 1935.—Advisory 9:30 a. m. Tropical disturbance central a short distance south of Andros Island moving westward about 8 miles per hour attended by shifting gales and probably winds of hurricane force over a small area near the center. Indications that storm will pass through Florida Straits late tonight or Monday. Caution is advised vessels in path. Northeast storm warnings displayed, Fort Pierce to Fort Myers.

Jacksonville, Fla., September 2, 1935.—Advisory 3:30 a. m. Tropical disturbance still of small diameter but considerable intensity is moving slowly westward off the coast of north-central Cuba, attended by shifting gales and probable winds of hurricane force over a small area. It will probably pass through the Florida Straits Monday. Caution is advised against high tides and gales on the Florida Keys and for ships in its path.

The progress of the hurricane northward and north-eastward beyond the Florida Straits was fully covered by forecasts and timely warnings issued in turn from the Jacksonville and the Washington forecasting centers, as the storm moved from the one district into the other.

buildings and crops on the island, although no lives were lost there inasmuch as the inhabitants had taken warning from radio advices and found shelter in available caves.

Early on the 28th, the city of Cienfuegos, Cuba, was seriously affected by passage of the hurricane center, with lowest barometer unofficially reported at 719 mm (28.31 inches). There was heavy property damage in Cienfuegos, Cumanay Agua, and other Cuban localities, as the hurricane crossed the island, and the casualties in Cuba were estimated at 35 deaths and possibly 500 injured. Much damage was due to the floods that attended the passage of the storm.

During the 28th the hurricane moved from the north coast of Cuba into a broad recurve that carried the center over the island of Bimini, where at 12:20 a. m. of the 29th, the wind shifted from southeast to northwest. The last barometer reading to be received from Bimini was 27.90 inches, at 11 p. m., more than an hour in advance of passage of the center which was doubtless marked by considerably lower minimum pressure. Highest wind was estimated at 120 miles per hour.

The tide is reported to have risen 15 feet at Bimini. More than half of the dwellings on the island were damaged and 14 persons killed.

At Miami, Fla., the lowest barometer was 29.35 inches, at 9:45 p. m. of the 28th, and the maximum wind was from northeast, 40 miles per hour. Fowey-Rock Lighthouse, 12 miles southeast of Miami, experienced hurricane winds from the north, estimated at maximum to have been about 85 miles per hour, with a barometer reading of 29.24 inches.

Passage of the hurricane northward from the Cuban coast was completely covered in Weather Bureau warnings and advices issued from the forecast center at Jacksonville. At 8 a. m. of the 28th, warnings of "possibly hurricane winds" were issued for the southeast Florida coast, West Palm Beach to Key West. As the recurve became evident during the afternoon, announcement of this development was made at 5 p. m.; and at 7 p. m. the Miami area was notified that winds would not reach hurricane force at that place.

After passing Bimini, the hurricane moved steadily northeastward through the 29th and 30th; on October 1 the center took a course northward across the 60th meridian, and on the 2d merged with another depression over

Newfoundland. Chart XII shows the cyclone on September 30, and its entire track.

The American steamer *La Perlawas* near the hurricane center at 1 p. m. of September 29, at 27°14' N., 76°28' W., with barometer reading 28.08. Later in the day (9 p. m.) the Japanese steamer *Tokai Maru*, near 28°30' N., 74°

W., met the hurricane with winds veering from east-southeast to west-southwest, and barometer 28.24 inches.

Several ships reported squalls of hurricane force on October 1, as the disturbance crossed the main trans-Atlantic shipping routes, but the cyclone appears to have diminished considerably in intensity after September 29.

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THE CARIBBEAN HURRICANE OF OCTOBER 19-26, 1935

By W. F. McDONALD

[Weather Bureau, Washington, November 1935]

A tropical cyclone formed between October 17 and 19, 1935, in the western Caribbean Sea, and moved over an unprecedented track which carried the center first north-eastward past Jamaica, then in a reverse curve westward near the south coast of Cuba, and finally southwestward to pass inland as a destructive storm over Honduras.

This hurricane was unusual also in another respect; it produced one of the major disasters of West Indian history, causing life losses estimated at perhaps as many as 2,000, without at any time giving evidence of exceptional violence insofar as available wind and barometer observations from ships or land stations along its course are concerned. The losses and damage occurred almost entirely on land areas where the storm winds, impinging on mountainous elevations, produced torrential rains and devastating floods.

As early as the morning of October 17 there was some evidence of a wide-spread but weak cyclonic wind system in the southwestern Caribbean Sea, between Jamaica and Panama. At the same time, a strong anticyclone was centered over the Middle Atlantic States and extended as far eastward as Bermuda and southward to the Florida Straits. Moderate to fresh northerly to easterly gales were reported from October 16 to 19 by ships in several localities northward from the West Indies.

The persistent southward drift of cooler air of continental origin, as high-pressure systems continued to dominate the western Atlantic from October 17 to 22, seems to have been a contributing influence in the further development of the weak cyclone over the western Caribbean, and almost certainly determined the unusual loop backward from the normal course when the center reached the southeast coast of Cuba. The synoptic situation over the North Atlantic on October 18 is shown on chart IX.

The development of this storm first became quite evident on the afternoon of October 19, when the Ameri-

can steamer *Forbes Hauptmann* experienced a south-southwest gale of force 9, with barometer 29.64 inches, near 13° N., 79° W. This report was received by mail and not by radio, and it was not until the next day that ships' radio reports revealed the increased intensity of the storm. The first of these observations was received from the U. S. S. *Chaumont*, on the morning of the 20th, then near 15° N., 77° W., whence she reported south-southeast wind of force 7, and barometer reading 29.68 inches. Twelve hours later the northeastward direction of progression of the disturbance had been determined, and the first advisory warnings of the developing hurricane were issued by the forecast center at Jacksonville, Fla.

The storm moved northeastward as forecast, and the center passed close to Navassa Island during the afternoon of October 21; but the path was even then beginning to deviate northward, and soon thereafter took a more northwesterly direction that brought the center to the coast of Cuba near Santiago, on the early morning of October 22.

Torrential rains over extreme southwestern Haiti attended the storm's passage, and press reports indicated a disastrous total of deaths, the actual number being uncertain but more than 1,000 and possibly as many as 2,000. There was much damage to crops and property in Jamaica, the estimates of monetary losses exceeding \$2,000,000. An unidentified schooner and its entire crew were lost off Port Antonio, on the northeast coast, but no other report of deaths from this hurricane has been received from Jamaica.

There was considerable damage in the vicinity of Santiago, Cuba, as the cyclone moved into that region, and press reports indicate that four lives were lost there. The wind exceeded 70 miles per hour at Santiago, as measured by an anemometer on a Pan-American Airways hangar which was blown down after that velocity

had been recorded. Whole gale and storm winds occurred on the opposite coast of Cuba near Nipe Bay (due north of Santiago), and also eastward from Santiago as far as Guantanamo Bay where there was minor storm damage.

The hurricane center was undoubtedly deflected and much weakened in intensity by the Sierra Maestra Mountains, which front the coast westward from Santiago. During October 22 and 23 the disturbance moved westward and then southwestward, and it started back again across the western Caribbean Sea, to increase in intensity and resume full hurricane force before entering Honduras near Cape Gracias, on October 25.

The only ship to report a close contact with the storm during its southwestward movement over the open sea was the American steamer *Afel*, which on the morning of October 24 had the lowest barometer so far reported in connection with this hurricane, 29.18 inches, as the central calm passed over the vessel in $17^{\circ}44' N.$, $80^{\circ}26' W.$ The highest wind experienced there was only a strong gale (Beaufort 9) which came up from the southeast after passage of the calm center. The vortex was evidently deepening again at this time, after being very weak during the preceding day, but it had not attained hurricane force.

Next reports from the immediate vicinity of the storm center came on the morning of the 25th from the Honduran steamers *Contessa* and *Sinaloa*, and from the meteorological station at Cape Gracias a Dios, the latter

reporting hurricane winds as the center passed nearby on the morning of October 25. The evidence at hand indicates that the storm weakened slowly after passing inland over Honduras, and curved westward along the fifteenth parallel of latitude, dying out in the interior after the 26th.

Much damage to property and banana plantations occurred in northeastern Honduras, with some lesser damage in extreme northeastern Nicaragua, mostly due to floods. About 150 lives were lost here, mainly in Honduras.

This hurricane adds another unprecedented track to the history of West Indian hurricanes. The center moved over a path about 1,400 miles in length, practically encircling the island of Jamaica in the loop along which its normal northeastward movement was reversed into an abnormal southwestward course; and it passed inland over Honduras only about 250 miles from the place, where, a week before, it had its origin.

Charts IX to XII show the synoptic situation at intervals of about 2 days during the course of this disturbance; and the complete track appears on chart XII.

A succession of comprehensive and accurate timely warnings was issued and broadcast from the hurricane forecasting center at Jacksonville to cover the progress of the disturbance from the evening of October 20 until it passed inland over Honduras, 5 days later.

THE ATLANTIC-GULF OF MEXICO HURRICANE OF OCTOBER 30 TO NOVEMBER 8, 1935

By WILLIS E. HURD

[Weather Bureau, Washington, December 1935]

Following closely upon the Caribbean hurricane of October 19-26, 1935, described in the preceding issue of the REVIEW as moving over a peculiar and unprecedented track, the hurricane of early November 1935 will likewise pass into history as a tropical storm of erratic movement, and the first of record to develop hurricane intensity at so late a date over the southern part of the Florida Peninsula.

This storm seemingly was of extratropical origin, since it first appeared as a small and weak depression central about 32° N., some distance east of Bermuda, early on October 30. It progressed west-by-north, passed close north of Bermuda, and, continuing in a general west-by-north to west-northwesterly course with increasing intensity, became a distinct threat to the entire Carolina coast by the morning of November 1. During the night of November 1, however, it unexpectedly turned south-westward, and by the 2d proceeded almost due south, crossed the northern extremity of the Bahamas on the 3d, and then passed southwesterly across the lower Florida Peninsula into the Gulf of Mexico on the 4th. In the east Gulf it formed an incomplete loop by first moving westward, then northward toward the Alabama coast, and finally eastward nearly to the central west coast of Florida. It did not reach this coast, but entirely disintegrated before 8 p. m. on November 8.

This storm throughout its history was of comparatively small diameter, and its hurricane winds covered only a narrow band.

During October 30, anticyclonic conditions prevailed to the west, north, and northeast of Bermuda, with little signs of breaking, yet at the 8 a. m. observation Bermuda's pressure had fallen decidedly since the previous night to 30.04, with wind from the north, force 7. At 8 p. m. of the 30th, pressure at Bermuda had fallen further to 29.86, with wind from the northwest, force 4. A short distance to the northwest of the island, the British steamship *Monarch of Bermuda* had a northwest wind of force 7, barometer 29.80. A definite Low was thus indicated to be advancing close to the northward of the island.

On the 31st the center of the disturbance moved west-by-north and showed definite signs of developing hurricane intensity. Near midnight on October 31, the American steamship *W. H. Libby* at latitude 34°43' N. and longitude 69°16' W. entered the zone of gale winds, reporting southeast, force 8. The gale winds continued until the afternoon of November 1, changing only slightly to an east-southeast direction and attaining force 9. The lowest barometer reading on this vessel was at 2 a. m. on November 1, when a corrected value of 29.58 inches was indicated. A few hours later the American steamship *Altair*, on the west side of the disturbance at 33°54' N., 74°56' W., reported northwest gales with a barometer reading of about the same value as that on the *W. H. Libby*.

The weather chart prepared at 8 a. m., eastern standard time, November 1, is reproduced in chart IX, at the end of this REVIEW. This places the center of the disturbance at about 34° N., 70½° W. The lowest barometer at this time probably was 29.20 inches or less. At 10 a. m. of this date the American steamship *W. C. Teagle* encountered a southeast gale of force 10, in 35°00' N., 68°50' W., with, however, only a moderate depression of the barometer. At 2 p. m. of the 1st the American steamship

Boringuen, in 35°20' N., 72°05' W., reported a barometer reading of 29.26 inches, wind east, force 11, as the ship came closest to the north side of the intensifying storm center. At 4 p. m., as the storm moved westward, she was in the northeast quadrant, with wind southeast, force 10, and pressure risen to 29.46. Eight hours later, at midnight, the American steamship *W. S. Farish* experienced a northeast gale of force 11, barometer 29.42, in 34°30' N., 75°00' W. These observations indicate how closely the gale winds on the western side of the hurricane approached to the North Carolina coast during November 1. The maximum wind velocity observed at Hatteras on this day was 40 miles per hour from the north.

Between the mornings of November 1 and 2, and particularly during the night of the 1st, the storm center took a peculiar turn toward a more southerly course. By 8 p. m. eastern standard time, the hurricane had already shown a tendency to move southward by changing its course from west-by-north, to west-southwest. On the morning of November 2 it was headed toward the south-southwest and moving somewhat more rapidly than before, but still at the moderately slow rate of about 13 miles per hour.

This abnormal change in direction was accompanied by a further increase in intensity. The American steamship *Iowan* passed through the central calm area at about 2 a. m. on November 2, in 33°30' N., 74°42' W. The barometer at that time stood at 28.94 inches. Just before the passage through the calm, the wind had attained force 12 from the north-northeast. Force 12 from southwest shortly thereafter indicated that the ship had passed from the calm center into the other side of the hurricane. The highest wind intensity, force 12, however, was only momentary according to the reports of Capt. L. Laverge, for the vessel soon ran into a wind of force 10 from north-northeast. By 6 a. m., the ship, which was heading toward Norfolk, passed out of the zone of gales as the wind, which was then east-northeast, diminished to less than force 8.

The position of the center on the morning of November 2 is shown by chart X. (The full track of the storm with its various positions, is shown in connection with chart XII.)

The center on November 2 was nearly 200 miles south of Cape Hatteras. During the next 24 hours the storm moved south-southwest to south at about 13 miles per hour to a position at 7 a. m., November 3, about 100 to 110 miles north-northeast of Great Abaco Island, Bahamas. At 9:30 a. m. the British steamship *Queen of Bermuda*, about 75 miles north-northeast of Hopetown, Great Abaco Island, in 27°41' N., 76°32' W., was in the hurricane center, with a barometer reading of 28.46 inches, the lowest reported for this storm. The vessel hove to for an hour during the passage of the central area, in which only a moderate easterly breeze was experienced, surrounded by a narrow band of hurricane winds.

The following description of the subsequent action of the storm is taken from the report of Gordon E. Dunn, forecaster of the Weather Bureau at Jacksonville, Fla.

At 7 p. m. November 3 the center was a short distance north of Hopetown, Great Abaco Island. The rate of movement between 10 a. m. and 7 p. m. this date was between 6 and 7 miles per hour,

just about half that of the previous day. Thus it would seem that the change in direction of movement (see below) took place in the afternoon and early night of the 3d when the rate of translation was the slowest. Hurricane winds lasted on Great Abaco from 1 to 3 hours. According to press reports 14 lives, including that of the Commissioner, were lost on this island, notwithstanding very definite and adequate warnings as well as the fact that the storm was barely of hurricane intensity and was of short duration.

It may be added that Commissioner John Eldridge Russell lost his life, through the sudden swing of a ship's boom which threw him into the sea, while engaged in distributing relief supplies from a sailboat to islanders who suffered in the hurricane of the previous September 28. Five vessels of the island sponge fleet were reported lost.

"After passing over Great Abaco Island between Hopetown and Green Turtle Cay", continues Mr. Dunn's report, "the storm pursued a straight course west-southwest to Miami."

A report from the American steamship *Arizpa*, Mobile toward London, caught in the hurricane off the southeast coast of Florida, states that the barometer stood at 28.72 inches (corrected) from 11 a. m. until noon of the 4th, at and close to 25° 55' N., 79° 55' W., while hurricane velocities from north and northeast were experienced between 10 a. m. and 1 p. m.

As the storm struck the lower southeast coast of Florida on the 4th, winds of gale force extended northward to West Palm Beach, while winds of hurricane force of short duration were confined to the Fort Lauderdale-Miami neighborhood.

To quote from the report by the Weather Bureau at Miami:

Winds of force 12 from the east, with lowest barometer of 28.86 inches, were reported by Coast Guard base 6 at Fort Lauderdale, Fla., while winds of hurricane force, with heavy seas, and lowest barometer of 29.10 inches at 1:45 p. m., were reported from Fowey Rock Lighthouse. The time of occurrence of the lowest barometer at Fort Lauderdale was 1 p. m. In Miami, which was directly in the path of the center of the disturbance, the lowest barometer was 28.73 inches at 1:45 p. m., and the maximum wind velocity 75 miles per hour from the southeast at 2:07 p. m. The extreme velocity (fastest mile) was 94 miles per hour at 2:17 p. m., at which time exceptionally strong gusts and considerable pumping of the barometer were noted. The duration of the lull at the downtown office and the airport station was practically the same, being 1 hour and 5 minutes, the exact center of the storm passing between the two points as the wind backed from west-northwest to southeast at the airport station, and veered from west-northwest to southeast at the downtown office. A lull of 1 hour was reported from Sunny Isle, which is a short distance north of Miami Beach, while a lull of 15 minutes was noted at Hallandale, Fla.

The report goes on to say that, from the information at hand, the width of the eye of the storm is estimated at 15 miles. The sky did not clear, at least materially, although the rain stopped and some persons reported seeing the sun for a short time.

Damage to buildings in the Miami area, including that done by water to interiors after roofs were demolished or torn, was estimated at \$4,500,000; public utility losses, \$750,000; small craft in harbor, \$120,000. The loss to vessels was confined mostly to two yachts which broke from their moorings and drifted into the causeway, as other small craft secured safe anchorage in the Miami River. Damage estimated at \$150,000 was inflicted on trees and tropical shrubbery in the city and surrounding territory. The total property loss in Miami and vicinity is estimated at \$5,500,000. Although 115 persons are known to have been injured in the area extending from Fort Lauderdale southward to Miami, and southwestward across the lower end of the peninsula, fortunately

only 5 deaths have been reported. The total loss of life in Florida and Great Abaco Island is thus placed at 19.

The position of the storm, together with pressure and wind distribution over surrounding areas, is shown for the morning of November 4 in chart XI, only a few hours before the center reached Miami.

From the Florida east coast, the hurricane center crossed the Everglades and entered the Gulf of Mexico near to or just north of Cape Sable on the evening of the 4th. On the morning of the 5th, the storm was central near 25° N., 83° W. During this day the British motorship *Horn Shell* reported winds of hurricane force at two different observations in the southeastern Gulf. This ship was the last to report similarly intense winds, as the storm moved forward subsequently to the 5th with rapidly decreasing energy, recurving gradually to the right.

Shortly after midnight on the early morning of the 6th the American steamship *Mariana* encountered a northerly gale of force 9, which continued for several hours during the ship's progress northward toward Mobile. The lowest barometer reported by the *Mariana* was 29.77, in 25°49' N., 85°42' W., at 5 a. m. At about 8 a. m. of the 6th the American steamship *Hanover*, in 27°00' N., 86°12' W., encountered the last reported gale, a wind of force 8 from the south, in connection with the storm. This ship, in a voyage from Baltimore toward New Orleans, had previously encountered whole gales (force 10) along the storm track—the first experienced on November 2, in 33°53' N., 75°38' W., and the second on the 4th, in 25°22' N., 80°06' W.

On the evening of the 6th the center of the disturbance, moving northward, had attained its westernmost location at about 87° W., in about 27° N., and was showing a small tendency to recurve into north-northeast. Thereafter, on the 7th and 8th, the narrowing depression moved northeast, and then east until its complete dissipation. During the last 3 days of its existence in the Gulf, while it affected the direction of the coastal winds to the northward and eastward, it caused no fall from normal barometer at coast stations from New Orleans to Tampa.

In discussing the winds, clouds, precipitation, and tidal effects observed in connection with the storm, G. E. Dunn, of the Jacksonville Weather Bureau Office, says:

Many peculiarities attended this storm aside from its most unusual path. About 0.24 inch of rain fell at Miami before the arrival of the lull and about 3.80 inches after passage of the center. I have no recollection of any such rainfall distribution at any place over which the center of a tropical storm passed. Indeed, the heaviest rainfall usually occurs in the front quadrants and least in the rear. Reports from cooperative stations indicated that decidedly heavier precipitation occurred in the left-hand quadrant than in the right, also unusual. Winds prevailed in greater conformity to precedent and near hurricane winds prevailed for about twice the distance to the right of the center than to the left. The wind circulation in the Bahamas and on the southeast Florida coast did not conform exactly to the type case for a circular low. After the center had passed to the south, northwest winds continued for several hours after one would have expected north or northeast winds. The hurricane was apparently not wholly circular and had several extratropical characteristics. No cirrus clouds outran the storm to any extent. Miami reported that the first clouds appeared as a solid alto-stratus cloud sheet moving rapidly in from the northeast about 9 hours before the arrival of the lull. Although the center of the storm passed about 300 miles east of Jacksonville and the visibility was very good, no clouds at all were visible on the eastern horizon.

No report of any extremely high tide in connection with this storm has been received. At Miami a tide of 5 feet, 2.2 above normal, was reported at 2 p. m., a few minutes after passage of the calm center. At Pigeon Key in Biscayne Bay, an estimated reading of almost 6 feet was made. A high tide was reported at Fort Lauderdale following passage of the axis of the storm center and wind shift from northwest to easterly, but details are lacking.

R. A. Dyke, of the Weather Bureau forecast center at New Orleans, in reporting on the tidal conditions in that district during the final stages of the storm, said that "tides were highest on the 6th and 7th, but did not exceed 1.5 feet above normal from Pensacola to Apalachicola, and were lower than that elsewhere."

Warnings issued by the Weather Bureau in connection with the hurricane were ample and timely. On the morning of October 31, when the storm was a short distance to west-northwestward of Bermuda, the Bureau issued an advisory warning, and followed it by a second advisory message after receipt of the evening observations of the same date. On November 1 storm warnings were ordered up on the North Carolina coast, and on the 2d, extended to Charleston, S. C., with cautionary warnings covering the whole east coast to the southward. Full information of the movements of the storm on the 3d, accompanied by cautionary advices, were broadcast to all vessels and interests from the Bahamas to the Florida coast. The first order to hoist hurricane warnings was issued by the Jacksonville office on November 4, 1935, as follows:

Hoist 7:30 a. m. hurricane warnings Miami to Stuart and northeast storm warnings north of Stuart to Titusville. Tropical storm of small diameter but accompanied by hurricane winds has changed its course during the night and now seems to be moving in a westward direction over Bahama Island which is about 100 miles east of West Palm Beach moving about 7 to 10 miles per hour. While storm conditions continue to change direction, all interests on the southeast Florida coast between Miami and Stuart should take extreme precautions against high tides and hurricane winds. Further bulletins today will be issued at about hourly intervals. Caution advised all vessels off Florida coast.

The Jacksonville office thereafter issued such frequent advisory and other warning messages as were necessary, up to and including the 5th of the month, following which, during the presence of the storm in the Gulf, several daily advisories were issued from the office at New Orleans.

The new hurricane warning service gave widest possible distribution of all storm information throughout the Miami and other districts by radio, telephone, telegraph, press agencies, and posted bulletins. In addition, all other interested agencies gave the fullest possible cooperation throughout the life of the storm.

ON THE METEOROLOGICAL HISTORY OF THE HURRICANE OF NOVEMBER 1935

By H. R. BYERS

[Weather Bureau, Washington, December 1935]

The tropical hurricane during the first week of November 1935, described by Mr. Hurd in this issue of the REVIEW, had several outstanding abnormalities. Principal among these were the high latitude and late season of its origin, the singular distribution of the meteorological elements around it, its unusual path, and its odd dissipation in the Gulf of Mexico. An explanation of these phenomena, if at all possible, would be highly desirable; the observational data, particularly from the upper air, are insufficient for the type of detailed study necessary for a complete explanation, but a few features of the storm are here discussed which may partially account for the observed facts.

Formation.—The hurricane center developed on October 30 about 300 miles east of Bermuda. At that time, and indeed for 2 or 3 days previously, there was a trough of low pressure extending northeastward from the Lesser Antilles toward Iceland and toward a large, nearly stationary low-pressure center between Iceland and the Faroe Islands. From a first glance at the synoptic charts it would appear that the center developed from this trough, but closer observation and physical reasoning indicate that it did not do so. Observations show that the storm was to the west of the trough when first noted, and that at that time the entity of the trough was still preserved. It hardly is conceivable that the trough could have formed into the hurricane center without the resultant circulation destroying the trough character.

The air transport over the North Atlantic had been dominated during the preceding days by an abnormally large and stationary Icelandic cyclone. This brought behind it a strong outflow of polar air which settled in a large belt of high pressure to the north of Bermuda. This pressure distribution was accompanied to the south of the high-pressure center by easterly winds which, being originally of polar origin, had had a long fetch over the warm waters of this section of the Atlantic before they reached the vicinity of Bermuda. The wind and pressure structure, in fact, looked very much like the picture of the northeast trade winds, only displaced far to the north. This air must also have been unstable vertically, at least with respect to saturated air, since it was polar

air being strongly heated from below incident to its passage over the warm water.

One of the most generally accepted views as to the origin of tropical cyclones is that they result from large-scale convection with its resultant converging winds which, under the effects of the deflecting influence due to the rotation of the earth, quickly develop a cyclonic circulation. It appears that the unusual conditions of the atmosphere, at the time and place of origin of this storm, were favorable for its genesis according to the above-mentioned hypothesis. That is, the presence of moist, unstable air caused convection over a wide area, with converging winds under the strong deflecting influence at that latitude.

The extra-tropical characteristics.—At the latitudes where this storm was located during its earlier history, the interaction of polar and tropical air currents dominates the circulation, particularly in the fall, winter, and spring. These air masses are integral parts of extra-tropical cyclones. At the latitude and season of development of this storm, it would almost inevitably involve in its circulation these various air currents. This should give the asymmetrical distribution of meteorological elements, such as precipitation, that is associated with the peculiar distribution of the air masses in an extra-tropical cyclone. The observational data of November 1, as shown by the weather map and vertical cross sections through the atmosphere along the coast of the United States, clearly indicate that this extra-tropical influence on the storm was present.

The map in figure 1 shows approximately how the air masses were distributed over the Eastern States and about the storm center on that date. On this chart, as on the others in this paper, cold fronts are indicated by heavy solid lines, and warm fronts by heavy dotted lines. The air masses are designated according to the classification of Willett. The positions of the fronts over the ocean are very uncertain. However, as will be seen from examination of the upper air data, these fronts must have been present somewhere off the coast, and even if they are placed 200 miles from their true position the present discussion will not be affected.

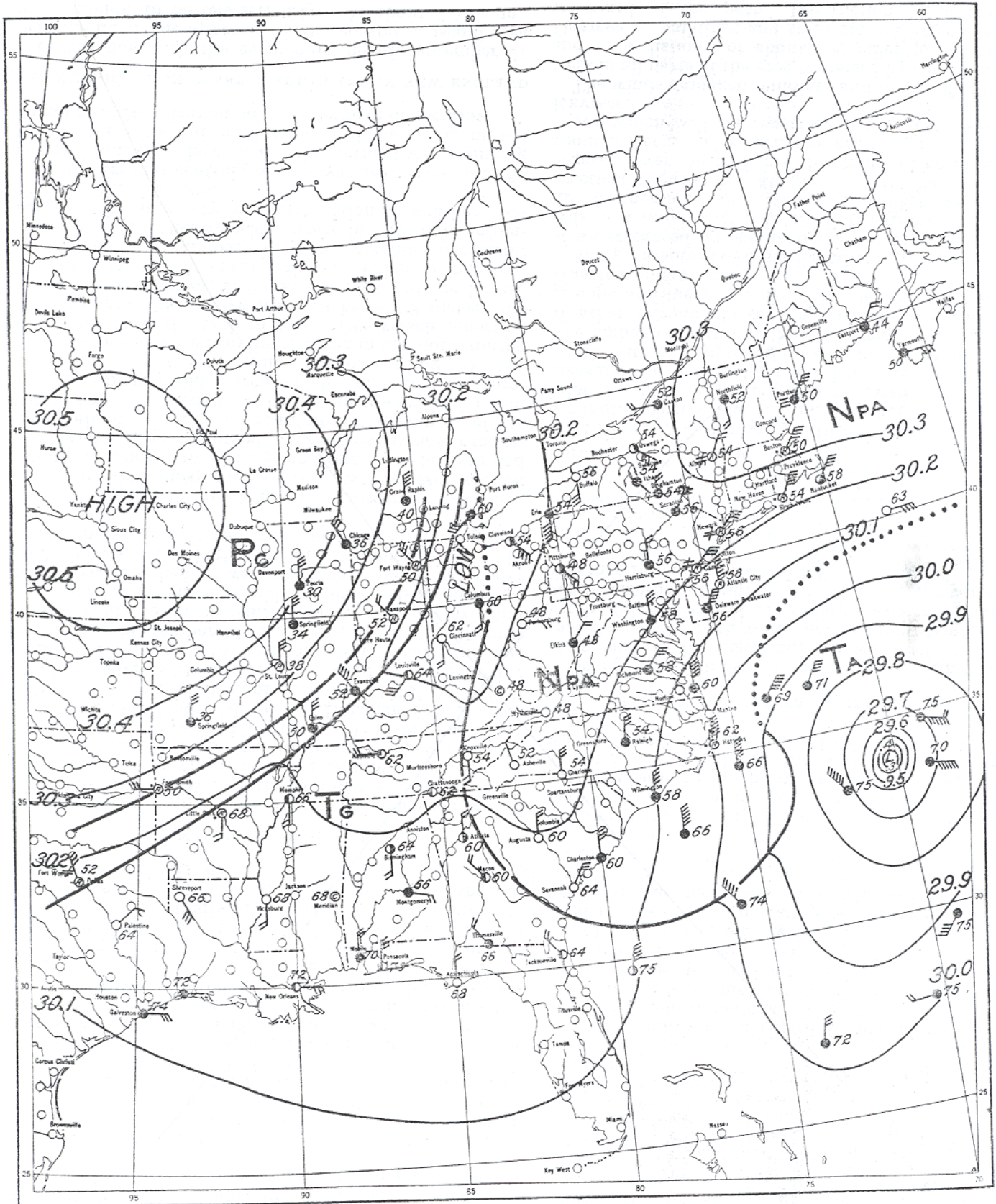


FIGURE 1.—Surface weather map, November 1, 1935, 8 a. m.

It is to be noted that N_{PA} (transitional polar Atlantic) air is flowing around the low center from the northeast and north, with the warm tropical Atlantic (T_A) air occupying most of the hurricane.

The vertical cross section through the atmosphere from Omaha eastward through several aerological stations (given in fig. 2) shows that along the Atlantic coast the two very distinct air masses, N_{PA} and T_A , were present. The airplane observation at Washington on that date indicated a relatively cold, moist current from the north which is identified as of polar Atlantic origin, and an un-

been moving downslope. This would then account for the absence of rain at Washington. Upward movement of the T_A probably was to be found only along the immediate coast and at sea.

With this air-mass structure in mind, a possible explanation can be seen for the peculiar rain distribution at Miami when the storm reached there; the absence of rain in appreciable amounts on the forward or western side of the center was particularly noted. It seems reasonable that the current of air of polar origin, which at Washington and New York was 1 to 2 kilometers in depth and

CROSS SECTION THROUGH THE ATMOSPHERE

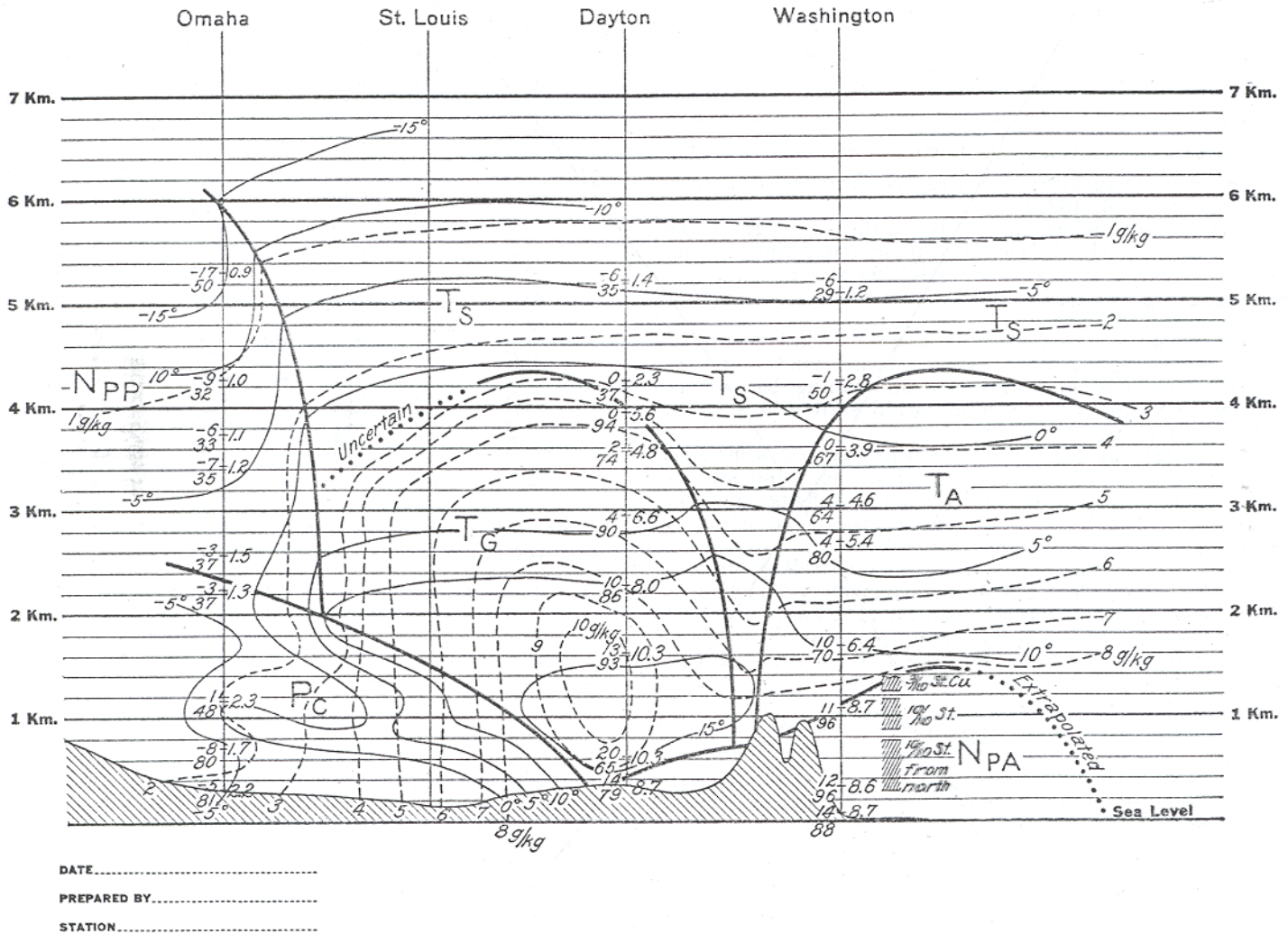


FIGURE 2.—Cross section of the atmosphere, Omaha to Washington, November 1, 1935. Figures to left of vertical lines are temperature and relative humidity (in that order) at the significant levels; figures to right are specific humidity.

usually warm and moist air mass above which fits almost perfectly the qualitative and quantitative definitions of tropical Atlantic air. A pilot balloon observation at Washington earlier in the night further verified this analysis by showing that the latter current was coming from the east out of the region of tropical air designated on the surface chart, figure 1. The conditions indicated on the cross section to the east of Washington are extrapolated from the data of Mitchel Field, near New York, which is to the east but slightly to the north of the line of aerological stations chosen. If this extrapolation be correct, then Washington was to the west of the crest of the N_{PA} air, and therefore the T_A air above must have

probably deepening, played an important part, and that the hurricane, even when it reached Miami, did not consist entirely of tropical air. It also is reasonable to assume that the air of polar origin would occupy the zone of northerly winds on the westward and forward side of the center as it approached Miami. The inherent low moisture content of this air as compared with the normal hurricane air probably accounts in some measure for the peculiar rain distribution noted at that station.

The effect of the very dry tropical superior (T_S) air which was occupying much of the upper atmosphere over the eastern United States may also account for the relative lack of precipitation. This air was moving from

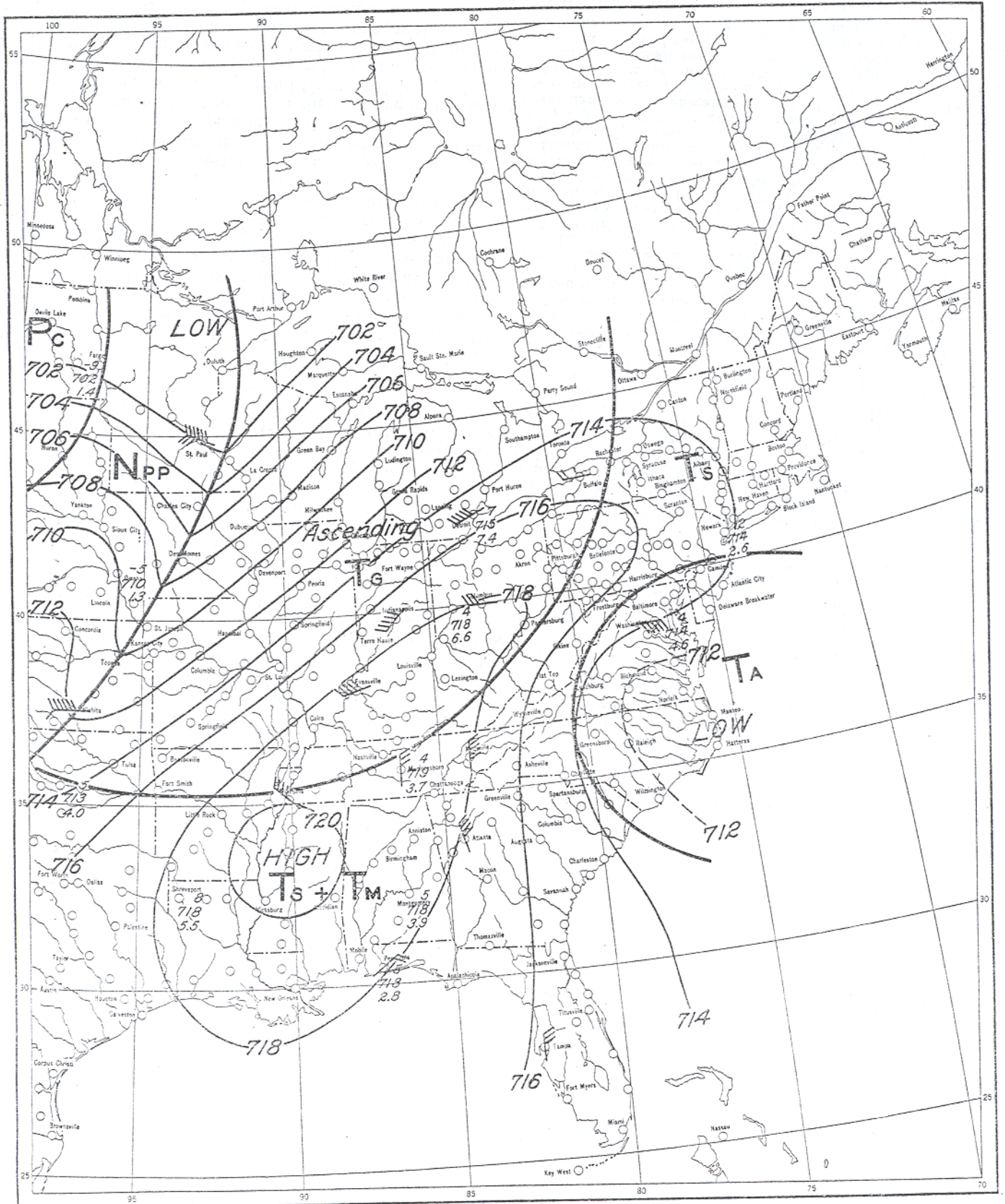


FIGURE 3.—Weather map, 3,000-meter level, November 1, 1935.

the north toward Miami during most of the time. When the storm was many miles at sea on November 1, an easterly current of moist air cut into the T_s over Washington, but at Miami it appears that even when the storm was about to strike, no easterly current aloft was noted. Speaking of the storm during its movement from the Bahamas to Miami, G. E. Dunn, of the Weather Bureau Office at Jacksonville, Fla., writes: "The upper air currents over Florida strengthened somewhat and veered from north-northwest or north to north or north-northeast. At 7 a. m. on November 4, 7 hours before the center reached Miami, the cirrus were still from the north at that place. At 1 p. m. when the center was close to Miami, cirrus still were moving from the north at Key West, but at 2 p. m. had shifted to northeast."

It seems, then, from the observational evidence, that the extra-tropical characteristics of the storm were caused by the importation of other than tropical maritime air masses into the circulation, which is a peculiarity usually found only in extratropical cyclones.

The change in path.—In order to explain in some measure the conditions associated with and perhaps causing the change in direction of movement between the 1st and 2d, it is necessary to examine more closely the air mass and upper air data in figures 1 and 2. Carrying the study a step farther, the observations at all aerological stations in the eastern half of the United States, together with pilot balloon observations, were used to construct a weather map for the 3,000-meter level on November 1. This map is shown in figure 3. The most striking feature of the map is the high pressure centered over the eastern part of the country, with associated northerly winds. Except for the easterly current of tropical Atlantic air over Washington, northerly winds prevailed also at levels below this height, a fact substantiated by pilot balloon observations from a large number of stations which did not reach the 3,000-meter level. A study of pressures at other altitudes shows that the strength of this upper-air anticyclone increased with height.

By considering the temperatures at upper levels, and applying the laws for the static pressure, it is evident that the increasing relatively high pressure with increased height can be definitely associated with the abnormal warmth of the free air. This warm air, as indicated in the analysis, was of tropical Gulf (T_o) origin, and was rising vertically and spreading out over the relatively shallow cold polar masses which occupied most of the surface area. Above this warm, moist current was an even warmer, yet much drier tropical superior (T_s) air mass. This further accentuated the high temperature

condition with its resultant slowly decreasing pressure with height. (At New York the T_s air appears colder than the T_o air at Washington, but this has been discounted in view of an error in the recording at the former station which during that period showed temperatures in some cases as much as 5° too low.)

It has already been pointed out that the surface air along the Atlantic coast was moving from the north. A study of the upper-air weather map shows that aloft an even greater north-to-south movement was present. To what extent this prevailed over the sea cannot be determined. However, the indications are that as the hurricane advanced near the continent it gradually came under the influence of this great north-to-south transport which caused the curvature to the left beginning on November 1. Such a conclusion, of course, presupposes that the path of the tropical hurricane is determined by the mean direction of the wind up to 3 to 5 kilometers. By application of this upper-air weather map it might have been possible to forecast earlier the curvature of path.

The second change in course, that from south-southwest to west-southwest, is more difficult to explain. Insufficient data from the upper air preclude a definite discussion of the conditions accompanying this shift. In his report, Dunn states: "However, the slight veering of the winds in the 24 hours prior to the arrival of the storm center [at Miami] may be considered as slightly permissive but not especially indicative of the change in direction which took place."

The weakening in the Gulf of Mexico.—When the center passed into the Gulf of Mexico it began to come in contact with some very dry air which, as shown by the airplane sounding at Pensacola, Fla., on the 5th, was present from 1,500 meters upward. This air came from the west, probably having slowly settled, accompanied by dynamic heating and drying, in the stationary anticyclonic area over the Pacific. R. A. Dyke, meteorologist of the Weather Bureau at New Orleans, has investigated winds aloft in the vicinity of the Gulf of Mexico during this period. He found at high levels a definite current from the west. This was undoubtedly the dry air just mentioned. He remarks: "* * * the westerly winds prevailing at high levels became successively lower in elevation of their lowest limit until an eastward drift prevailed at all elevations recorded on the evening of the 7th." Since the tropical hurricane depends for its energy on the release of the heat carried latent in the water vapor of the air circulating around it, the mixing with this drier air from the west apparently robbed it of its main source of energy.