

Weather 2

UNITED STATES DEPARTMENT OF AGRICULTURE
WEATHER BUREAU ✓
WASHINGTON

OFFICE OF THE CHIEF

October 3, 1938.

FILED

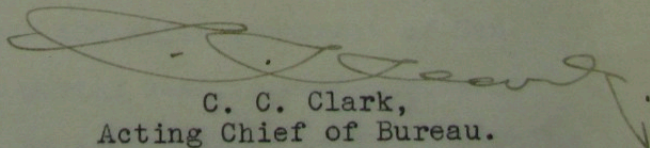
★ OCT 12 38 P MEMORANDUM FOR THE SECRETARY.

Please return to the
Secretary's File Room

Dear Mr. Secretary:

In harmony with your request for a statement regarding the recent hurricane which went inland over Long Island and New England, I am transmitting herewith such report, prepared by the forecaster on duty in Washington, D. C., at that time.

Sincerely yours,


C. C. Clark,
Acting Chief of Bureau.

(Inclosure)

THE TROPICAL STORM OF SEPTEMBER 17-21, 1938.

The tropical storm that caused such serious damage in portions of New England and New York on September 21, 1938 was first located definitely the evening of Sept. 17th ^{when a report} when a vessel about 600 miles east-northeast of Puerto Rico reported a barometer reading of 29.27 inches and a gale blowing from the north-northeast. Our Jacksonville office issued an advisory warning at 9:30 p.m. of that date, giving the usual data and indicating that the storm was moving westward about 15 to 18 miles an hour. On the morning of Sept. 18 the center was located about 400 miles northeast of San Juan, Puerto Rico, apparently moving west or west-northwestward 15 to 20 miles an hour. An intermediate advisory warning was issued at 3:00 p.m., and the regular advisory at 9:30 p.m.

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stated hurricane was centered about 400 miles due east of Miami and that the storm had turned northwestward and would probably recurve north-northwestward or northward within the next 24 hours. An intermediate advisory warning at 2:30 a.m. Sept. 20 indicated a northwestward movement with lessened danger to Florida, and the regular morning advisory at 9:30 a.m. stated that the center was about 300 miles east of Vero Beach moving north-northwestward or northward about 17 miles an hour. Storm warnings were ordered displayed at that time on the North Carolina coast between Wilmington and Cape Hatteras. An intermediate advisory at 3:00 p.m. stated that the storm would gradually turn toward the north and north-northeast and move more rapidly, and the 9:30 p.m. advisory warning from Jacksonville stated that the storm center was about 400 miles east of Jacksonville moving almost due north and that the storm would gradually turn northeastward and

on the Hatteras. An intermediate advisory at 3:00 p.m. stated that the storm would gradually turn toward the north and north-northeast and move more rapidly, and the 9:30 p.m. advisory warning from Jacksonville stated that the storm center was about 400 miles east of Jacksonville moving almost due north and that the storm would gradually turn northeastward and move more rapidly during the next 24 hours with center passing near but east of Cape Hatteras during Wednesday. Storm warnings were ordered displayed by the Washington office at 9:30 p.m. from Cape Hatteras to Atlantic City, New Jersey. The last advisory from Jacksonville was issued at 3:00 a.m. on the 21st at which time the storm center was about 225 miles south of Cape Hatteras moving rapidly north or possibly slightly east of north. Storm warnings on the morning of Sept. 21 were issued from Washington, D.C. It was stated that the storm was apparently central about 75 miles east of

Cape Hatteras moving rapidly north-northeastward attended by shifting gales over a wide area and by winds of hurricane force near the center. At that time northeast storm warnings were ordered along the coast north of Atlantic City to and including Connecticut and southeast storm warnings from Block Island to Eastport, Maine. Small craft were advised to remain in port until the storm passed. At 11:30^{10.00} a.m. the storm was centered about 100 miles east of the Virginia Capes moving rapidly northward or slightly east of north, and storm warnings were changed to whole gale warnings along the Atlantic coast north of the Virginia Capes to Sandy Hook. At 2:00 p.m. the last warning was issued stating that the storm was central at 12:00 noon about 75 miles east-southeast of Atlantic City moving rapidly north-northeastward with no material change in intensity since morning and that the storm center would likely pass over Long Island and Connecticut late in the afternoon or early night.

Accompanying this report are copies of all warnings issued in connection with this ^{storm.} ~~statement.~~

Exhibit A gives the approximate path and location of the

Virginia Capes to Sandy Hook. At 2:00 p.m. the last warning was issued stating that the storm was central at 12:00 noon about 75 miles east-southeast of Atlantic City moving rapidly north-northeastward with no material change in intensity since morning and that the storm center would likely pass over Long Island and Connecticut late in the afternoon or early night.

Accompanying this report are copies of all warnings issued in connection with this ^{storm.} ~~statement.~~

Exhibit *A* gives the approximate path and location of the center of the tropical storm each 12 hours from the evening of September 17 to the evening of September 22 when the disturbance entirely disappeared over eastern Ontario and southwestern Quebec.

The predicted movement of this storm on the 21st was as accurate as could reasonably be expected with no observational data over a wide area to the northeast, east and south of the storm center. On the morning of that day (see exhibit *B*)

and unfortunately there was no way of locating the storm center as accurately as desired on the evening of the 20th (see exhibit C) due to conflicting data from two vessels, both of which were very near the center. There was a difference of approximately one degree of longitude in the location of the center depending upon which vessel report was accepted as being in the correct position. And this difference of 50 miles or more in the location of the storm center at the time the storm was recurving made it impossible to plot with assurance the exact direction of movement during the ensuing 12 hours, and this defect also made the prediction of the future direction of movement more uncertain. However, there is nothing surprising in the uncertain reported positions of the two vessels in question for it is well known that the position of vessels in or near a storm center is computed by dead reckoning and if the sky remains overcast for a day or two, the computed position may be in error by ^aconsiderable distance. Special 10:00 a.m. and 12:00 noon observations were called

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center of such a storm would pass over such a populous area should not be issued until we are quite sure such will be the case. Therefore, as we considered there was still plenty of time for indicating where the storm center would pass inland with such a degree of refinement, we awaited the noon reports and immediately upon completion of the noon map () we issued the warning in which it was stated that the center would pass inland over Long Island and Connecticut "late this afternoon or early tonight."

According to reports on the storm from the coastal stations from New York to Boston, there was considerable delay in delivery of our warnings on the 21st. This, together with the unfortunate fact that one of the powerful New York radio stations upon which so many residents of Long Island, Connecticut and adjacent areas depend for their weather information failed to broadcast the ^{important} ^{probably} ~~very important~~ ^{popular interest in} storm information/due to the war in Europe, resulted in the failure of thousands of residents in the affected area to receive our warnings in time or perhaps

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This delay or failure to receive warnings was serious because of the fact that this storm moved 600 miles in 12 hours after leaving the vicinity of Cape Hatteras, in contrast with the computed normal movement in September of about 200 miles. This rate of movement of 50 miles per hour was unprecedented so far as we know for such a storm of tropical origin. This meant the arrival of the storm center at the Connecticut coast

line before 4:00 p.m. instead of many hours later if the rate of movement had been normal which meant a period of several hours less time for preparation. Notwithstanding these unfortunate and unavoidable delays the warnings undoubtedly resulted in the saving of many lives and much property. Of course, because of the severity of the storm ^{much} ~~part~~ of the property damage could not have been saved. It was one of the most destructive storms of which there is record in the Western Hemisphere.

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It may be asked, "Why did the Weather Bureau not know that the storm would move so rapidly and with such great intensity over Long Island and New England?" There are a number of reasons, the most important of which are (1) lack of upper air data from the northeastern part of the United States, (2) lack of vessel reports, both in number of reporting vessels and in frequency of reports and (3) lack of facilities and personnel to provide continuous service at forecast centers and local Weather Bureau offices which would have enabled better use of the system of weather reports available during the late night and early morning hours. It should be understood that no criticism can be made for failure to receive all-important data from such sources. Up to this time it has been impossible to secure the data, either because of lack of development of instruments or because of lack of funds, or both. Exhibit E herewith shows the wind direction (arrows fly with the wind) and velocity (miles per hour) at about 5:30 a.m. of September 21st, as received from all stations from the Plains States eastward. These charts give data up to

morning hours. It should be understood that no criticism can be made for failure to receive all-important data from such sources. Up to this time it has been impossible to secure the data, either because of lack of development of instruments or because of lack of funds, or both. Exhibit E herewith shows the wind direction (arrows fly with the wind) and velocity (miles per hour) at about 5:30 a.m. of September 21st, as received from all stations from the Plains States eastward. These charts give data up to 14,000 feet. Inasmuch as the tropical cyclones are carried along in the general drift of the air above the system of gyratory wind around the center at lower levels very much as a whirlpool in a creek or river is carried along with the general current (except that the whirl of water is at the top instead of the bottom), the wind data plotted gave no clue to the direction or rate of movement of the air currents aloft over the area affected by the storm. The center of the storm was just far enough off the Carolina coast and the area of cloudiness (low clouds) was such that the pilot balloons released that morning were lost to sight as soon as they entered the clouds at all stations east of those from which reports are entered on the charts of the 21st. The Bureau had to rely

on its experience in dealing with previous storms and on surface data as shown on the daily weather map. However, the development of the radiometeorograph has progressed so rapidly during the past two or three years that we now have a few stations scattered over the United States where daily flights of balloons carrying these instruments are made, and from the data received, isobars are drawn for the levels 5,000, 10,000 and 14,000 feet above sea level, supplementing the sea-level isobars on the regular map and enabling us (if sufficient data are available) to know almost the exact direction of movement of the air at the respective levels and to calculate the approximate rate of air movement. But the program for radiometeorograph soundings is still more or less in the experimental stage, only a few stations are in operation, and none is located east of Michigan and Tennessee, except one operated by the Navy at Anacostia, D. C. If only a few reports from radiometeorographs had been

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We still have to deal with the unprecedented intensity of the storm over portions of New England, even as far north as Vermont, and especially the destructive winds to the east of the center to a distance of over 100 miles. All tropical storms of the past 50 years or more have been studied by the Weather Bureau and from our intensive studies, it has been found that destructive winds seldom, if ever, occur more than 50 to 60 miles away from the storm center when the storm is of wide extent, such as the recent one, or not more than 15 or 20 miles away if the storm is of very small diameter. Furthermore, tropical cyclones upon reaching the cooler waters north of Cape Hatteras, as a rule, lessen in intensity progressively and all tropical storms, whether they move inland in the South or North almost invariably begin to dissipate rapidly and cause destructive winds only a few miles inland, with central pressure in the storm increasing very rapidly. But, in the case of this storm, the barometer fell to 28.10 inches at New Haven, Conn., which is 0.43 inch lower than previously recorded at that place.

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The storm center never approached nearer than 75 miles to land at any point in its path until it reached Long Island, and the wind velocities reported from the nearest land stations and vessels were rather disappointing until about noon of the 21st. Vessels approximately as far east of the center in southern waters as Boston and Providence were from the center when it passed over Connecticut, reported velocities of Beau-

fort force 8 (39-46 m. p. h.) and force 9 (47-56 m. p. h.) and none of them reported the usual exceedingly turbulent sea conditions experienced, as a rule, for a considerable distance from the storm center. These considerations, together with the total absence of vessel reports the morning of the 21st to the northeast, east, and southeast of the storm center, and the very weak pressure gradient to the northward over New York, western New England and Canada, resulted in our being totally unprepared to anticipate its experienced violence near and for a considerable distance east of the storm center as it moved inland and on to the North. On the other hand the wind velocities experienced at our coastal station from Cape Hatteras to New York City were rather less than expected, although the storm center was much nearer to Cape Hatteras, Atlantic City, Sandy Hook and New York City than it was to Boston and Providence, and the wind experienced on the coast of Maine was about as expected.

ADVISORIES ISSUED IN CONNECTION WITH THE TROPICAL HURRICANE OF
SEPTEMBER 17-21, 1938.

From Jacksonville, Fla.

September 17, 1938

Advisory nine thirty p.m. A well developed tropical disturbance probably of full hurricane intensity has appeared some five hundred miles northeast of the Leeward Islands and was centered at seven p.m. EST in approximately latitude twenty two degrees north fifty seven degrees thirty minutes west apparently moving westward about fifteen to eighteen miles per hour. Caution advised all vessels in path of this dangerous storm.

September 18, 1938.

Preliminary advisory nine thirty a.m. Tropical disturbance probably of full hurricane intensity centered at seven a.m. EST in approximately latitude twenty two degrees thirty minutes north longitude sixty two degrees west apparently moving west or west-northwestward fifteen to twenty miles per hour. Caution advised all vessels in the path of this dangerous storm.

Advisory ten thirty a.m. Same as 9:30 a.m. preliminary advisory.

Advisory three p.m. Hurricane central at one p.m. EST in approximately latitude twenty two degrees forty five minutes north and longitude sixty three degrees west which is approximately twelve hundred miles due east of Havana Cuba moving west-northwestward sixteen to twenty miles per hour attended by strong shifting gales and squalls over an increasing area and by hurricane winds near center. Caution advised vessels in path against dangerous conditions. Storm continues to move rather rapidly at present with no material change

in the path of this dangerous storm.

Advisory ten thirty a.m. Same as 9:30 a.m. preliminary advisory.

Advisory three p.m. Hurricane central at one p.m. EST in approximately latitude twenty two degrees forty five minutes north and longitude sixty three degrees west which is approximately twelve hundred miles due east of Havana Cuba moving west-northwestward sixteen to twenty miles per hour attended by strong shifting gales and squalls over an increasing area and by hurricane winds near center. Caution advised vessels in path against dangerous conditions. Storm continues to move rather rapidly at present with no material change in direction likely next twenty four hours. All small craft Cape Hatteras to Florida Straits should navigate with extreme caution until storm danger passes.

Advisory nine thirty p.m. Hurricane centered at seven p.m. EST in approximately latitude twenty three degrees north and longitude sixty six degrees west which is about nine hundred miles east-southeast of Miami moving west-northwestward about twenty miles per hour attended by strong shifting gales and squalls over large area and by hurricane winds near center. Caution advised all vessels in path and all small craft Hatteras to Florida Straits should remain in port until storm danger passes. Storm will begin to affect extreme eastern Bahamas by midday Monday and central Bahamas by Monday night. Interests on east Florida coast should keep closely in touch with further advices. If present direction and rate of movement is maintained winds will begin to increase on east Florida coast early Tuesday.

September 19, 1938

Advisory three a.m. The hurricane continues to move west-northwest-

ward about twenty miles per hour and was central at one a.m. near latitude twenty three degrees thirty minutes north and longitude sixty eight degrees thirty minutes west. Present direction and rate of movement will bring storm over Bahama Islands late Monday and to Florida coast by early Tuesday morning. All interests in path of this severe storm should exercise extreme caution. Florida is in the danger zone of this storm and all persons are urged to stand by for later announcements today.

Advisory nine thirty a.m. Northeast storm warnings ordered Jacksonville to Key West Florida. Hurricane centered at seven a.m. EST in approximately latitude twenty three degrees forty five minutes north and longitude seventy degrees thirty minutes west which is about six hundred fifty miles east-southeast of Miami apparently still moving west-northwestward at least twenty miles per hour. Winds will increase in Bahamas throughout day reaching hurricane force during afternoon in outlying islands and if present direction and rate of movement is maintained storm will reach southeast Florida coast Tuesday morning with winds commencing to increase tonight. Florida east coast is in the danger zone of this storm and all interests are urged to stand by for possible hurricane warnings during the day.

Advisory three p.m. Hurricane centered at one p.m. EST in approximately latitude twenty four degrees north longitude seventy two degrees west which is about five hundred and thirty miles east-southeast of Miami apparently still moving west-northwestward nearly twenty miles per hour attended by gales and squalls over a large area and hurricane winds near center. If present direction and rate of movement is maintained center of storm will pass through Bahamas tonight and reach southeast Florida coast in twenty four to thirty hours with winds beginning to increase on coast late tonight. All interests in southern Florida should immediately make all possible preparations to withstand this severe storm and then

Florida coast Tuesday morning with winds commencing to increase tonight. Florida east coast is in the danger zone of this storm and all interests are urged to stand by for possible hurricane warnings during the day.

Advisory three p.m. Hurricane centered at one p.m. EST in approximately latitude twenty four degrees north longitude seventy two degrees west which is about five hundred and thirty miles east-south-east of Miami apparently still moving west-northwestward nearly twenty miles per hour attended by gales and squalls over a large area and hurricane winds near center. If present direction and rate of movement is maintained center of storm will pass through Bahamas tonight and reach southeast Florida coast in twenty four to thirty hours with winds beginning to increase on coast late tonight. All interests in southern Florida should immediately make all possible preliminary preparations to withstand this severe storm and then stand by for later advices. Hurricane warnings probably will be issued tonight. Northeast storm warnings remain displayed Jacksonville to Key West.

Bulletin six thirty p.m. Barometer readings in Bahamas since one p.m. have shown only gradual fall in pressure with lowest pressure reported twenty nine sixty inches on Cat Island. At five p.m. EST slow fall in pressure this region indicates storm may be turning towards the northwest. However, interests on southeast Florida coast urged not relax vigilance until recurving tendency is definitely established.

Advisory nine p.m. Hurricane centered at seven p.m. EST in approximately latitude twenty five degrees thirty minutes north longitude seventy three degrees thirty minutes west which is about four hundred twenty miles due east of Miami attended by gales and squalls over large area and by hurricane winds near center. Storm has turned northwestward and will probably recurve north-northwestward or northward next twenty four hours. Storm threat to Florida east coast

has greatly diminished although interests this area should follow advices carefully next twelve hours. Vessels in path of this severe storm should exercise extreme caution.

September 20, 1938.

Advisory two thirty a.m. Severe hurricane with central pressure about 28.00 inches was centered at one a.m. EST near latitude twenty six degrees thirty minutes north longitude seventy five degrees west moving northwestward about seventeen miles per hour. This position is about three hundred fifty miles east of Palm Beach. Caution advised all ships in the Atlantic south of Cape Hatteras from the coast outward three hundred to four hundred miles. The northwestward movement lessens the danger to Florida but vigilance should be continued for another twelve hours. Storm warnings remain displayed Jacksonville to Key West Florida.

Advisory nine thirty a.m. Northeast storm warnings ordered nine thirty a.m. EST North Carolina coast between Wilmington and Cape Hatteras. Hurricane of great intensity central seven a.m. EST near latitude twenty eight degrees north longitude seventy five degrees west which is about three hundred miles east of Vero Beach Florida now moving north-northwestward or northward about seventeen miles per hour. Storm will gradually turn toward the north-northeast with center passing some distance east of Cape Hatteras tonight and will cause increasing northerly winds on the North Carolina coast becoming fresh to strong and probably reaching gale force at exposed places on the Cape with hurricane winds some distance off shore. Caution advised all vessels in path and all small craft from Virginia Capes to Charleston should remain in harbor until storm passes. Lowest pressure reported during night twenty seven ninety inches.

Advisory three p.m. Severe hurricane centered one p.m. EST approximately latitude twenty nine degrees north longitude seventy five degrees west which is about three hundred fifty miles east of Daytona Beach Florida moving between north-northwestward and north-

northeast with center passing some distance east of Cape Hatteras tonight and will cause increasing northerly winds on the North Carolina coast becoming fresh to strong and probably reaching gale force at exposed places on the Cape with hurricane winds some distance off shore. Caution advised all vessels in path and all small craft from Virginia Capes to Charleston should remain in harbor until storm passes. Lowest pressure reported during night twenty seven ninety inches.

Advisory three p.m. Severe hurricane centered one p.m. EST approximately latitude twenty nine degrees north longitude seventy five degrees west which is about three hundred fifty miles east of Daytona Beach Florida moving between north-northwestward and northward about seventeen miles per hour attended by gales and squalls over large area and hurricane winds near center. Storm will gradually turn toward the north and north-northeast and move more rapidly during next thirty six hours with center passing some distance east of Cape Hatteras late tonight or Wednesday morning. Caution advised vessels in path and all small craft Virginia Capes to Charleston should remain in port until storm passes. Storm warnings remain displayed between Cape Hatteras and Wilmington.

Advisory nine thirty p.m. Severe hurricane with central pressure still close to 28.00 inches was centered at seven p.m. EST in approximately latitude thirty degrees north longitude seventy five degrees thirty minutes west which is about four hundred miles east of Jacksonville now moving almost due north attended by gales over large area and hurricane winds near center. Storm will gradually turn northeastward and move rapidly during next twenty four hours with center passing near but east of Cape Hatteras during Wednesday and will cause strong winds on North Carolina coast reaching gale force on the Cape with high tides north of Beaufort North Carolina. Caution advised vessels in path and all small craft Virginia Capes to Charleston should remain in port until storm passes. Storm warn-

ings remain displayed Atlantic City New Jersey to north of Wilmington.

September 21, 1938

Advisory three a.m. Hurricane central one a.m. EST about two hundred and twenty five miles south of Cape Hatteras moving rapidly north or possibly slightly east of north. Indications are that center will pass near but slightly off the Carolina Capes within the next twelve hours attended by dangerous gales and high tides on the coast and by hurricane winds short distance off shore. Storm warnings are displayed north of Wilmington North Carolina to Atlantic City, New Jersey. Caution advised ships in path of this severe storm.

From Washington, D.C.

September 20, 1938

Advisory one p.m. Northeast storm warnings ordered south of Virginia Capes to Cape Hatteras. Wind will become north or northeast this afternoon and probably increase to gale force late tonight or Wednesday forenoon.

Advisory nine thirty p.m. Northeast storm warnings ordered Atlantic coast Virginia Capes to Atlantic City New Jersey including lower Chesapeake Bay. Tropical storm will be attended by northeast winds becoming strong and reaching gale force Virginia Capes Section Wednesday and southern New Jersey coast late Wednesday afternoon or Wednesday night.

September 21, 1938.

Advisory nine a.m. Northeast storm warnings ordered upper Chesapeake Bay. Increasing northerly winds becoming strong and possibly reaching gale force at times this afternoon. Further information regard-

afternoon and probably increase to gale force late tonight-
Wednesday forenoon.

Advisory nine thirty p.m. Northeast storm warnings ordered Atlantic coast Virginia Capes to Atlantic City New Jersey including lower Chesapeake Bay. Tropical storm will be attended by northeast winds becoming strong and reaching gale force Virginia Capes Section Wednesday and southern New Jersey coast late Wednesday afternoon or Wednesday night.

September 21, 1938.

Advisory nine a.m. Northeast storm warnings ordered upper Chesapeake Bay. Increasing northerly winds becoming strong and possibly reaching gale force at times this afternoon. Further information regarding tropical storm later.

Advisory nine a.m. Northeast storm warnings ordered north of Atlantic City and south of Block Island and southeast storm warnings ordered Block Island to Eastport Maine. Tropical storm apparently central about seventy five miles east of Cape Hatteras moving rapidly north-northeastward attended by shifting gales over a wide area and by winds of hurricane force near its center. Northeast or north gales backing to northwest south of Block Island to Hatteras today and southeast or east gales Block Island to Eastport becoming northwest tonight or Thursday morning. Small craft should remain in port until storm passes.

Advisory nine thirty a.m. Warnings changed to northwest south of the Virginia Capes to Cape Hatteras.

Advisory eleven thirty a.m. Warnings changed to whole gale Atlantic coast north of Virginia Capes to Sandy Hook New Jersey. Tropical storm central ten a.m. about one hundred miles east of the Virginia Capes moving rapidly northward or slightly east of north. It is

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attended by shifting gales over a wide area and by winds of whole gale force over a considerable area around center. Northerly winds along the New Jersey, Maryland and southern Delaware coast will likely increase to whole gale force this afternoon and back to northwest and diminish tonight.

Advisory two p.m. Warnings changed to northwest Virginia Capes to Sandy Hook New Jersey. Tropical storm central twelve noon about seventy five miles east-southeast of Atlantic City moving rapidly north-northeastward with no material change in intensity since morning. Storm center will likely pass over Long Island and Connecticut late this afternoon or early tonight attended by shifting gales.