

AN ANALYSIS OF THE MOVEMENT OF A HURRICANE OFF THE EAST COAST OF THE UNITED STATES, OCTOBER 12-14, 1947

CONRAD P. MOOK,¹ EUGENE W. HOOVER, AND ROBERT A. HOOVER

U. S. Weather Bureau Forecast Center, Washington National Airport, Washington, D. C.
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1. INTRODUCTION

During the night of October 11-12, 1947, a tropical hurricane moved northeastward across southern Florida and out to sea in the vicinity of Miami on a course which seemed to offer no further threat to the North Atlantic coast of the United States. However, on October 13 the hurricane turned rather sharply to the left, and on October 15 it moved inland near Savannah, Ga.

The course taken by this hurricane as it made its historic turn has been in doubt due to the scarcity of reports received at the time from ships sailing near the storm center. Several reconnaissance aircraft were in the vicinity of the storm on the 13th, but even their reports did not give a complete enough picture, so that in the annals of

meteorology and storms, including the monumental work by Tannehill [1], the path of the storm is shown as being unknown during the period of the turn. The purpose of this report is to show what appears to be the reliable picture of the track of the storm during the period when it made its turn.

2. ADDITIONAL PUBLISHED EVIDENCE OF THE STORM TRACK

Of particular interest is the fact that three of the aircraft which flew in the vicinity of the storm on October 13, 1947, were a part of a cloud seeding expedition. The

¹ Present affiliation: Diamond Ordnance Fuze Laboratories, Ordnance Corps, Department of the Army, Washington 25, D. C.

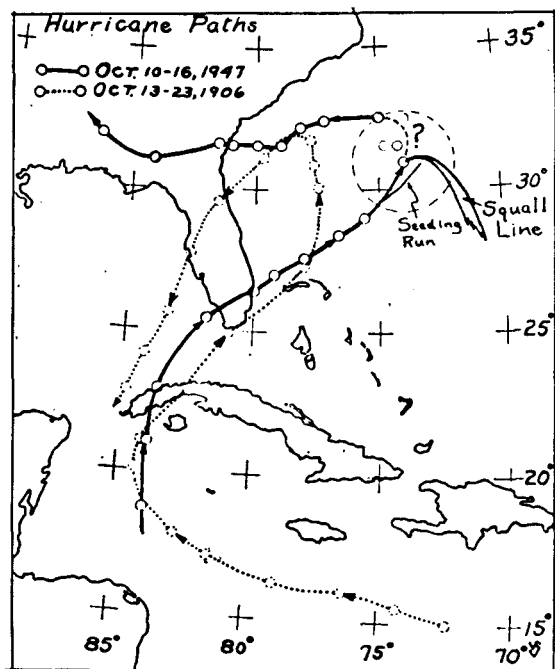


FIGURE 1.—Solid track is the path of the hurricane of October 10-16, 1947, as presented by Langmuir [1]. Note the dashed circle outlining the "approximate area of the clouds of the hurricane" at the time of seeding (1138-1208 EST). (This figure is reproduced, by permission, from the *Proceedings of the American Philosophical Society*.)

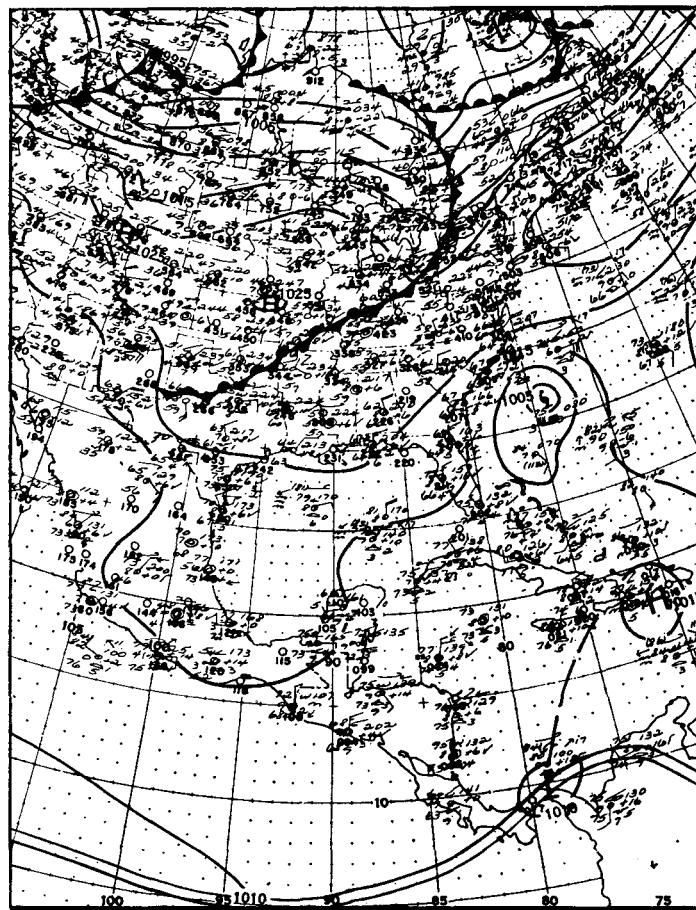


FIGURE 2.—Sea level chart showing the position of the hurricane at 1230 GMT October 13, 1947. (From *Northern Hemisphere Historical Weather Maps*.)

TABLE I

SS. " LISIEUX " - Voyage GALVESTON/LE HAVRE.-

II - RENSEIGNEMENTS DIVERS :

I - POSITIONS :

- Le 11 Octobre à 12h.00 : (L = 25°58' N.
)G = 79°50' W.

- Le 11 -" à 20h.00 : (L = 27°27' N.
)G = 79°39' W.

- Le 12 -" à 14h.00 : (L = 28°39' N.
)G = 76°52' W.

- Le 12 -" à 19h.00 : (L = 29°30' N.
)G = 76°15' W.

- Le 13 -" à 08h.00 : (L = 30°30' N.
)G = 74°27' W.

- Le 13 -" à 09h.00 : (L = 30°39' N.
)G = 74°27' W.

- Le 13 -" à 10h.00 : (L = 30°47' N.
)G = 74°18' W.

- Le 13 -" à 12h.00 : (L = 31°06' N.
)G = 74°18' W.

- Le 13 -" à 24h.00 : (L = 31°45' N.
)G = 73°24' W.

- Le 14 -" à 07h.00 : (L = 32°15' N.
)G = 72°00' W.

- Le 14 -" à 12h.00 : (L = 32°33' N.
)G = 70°54' W.

Date	Heure	Vent	(Ind.) Baro- mètre	Etat de la Mer	Observations
I2/I0	0100	E/9	2993	Houle	
"	0300	E/9	2998	"	Coups de vent et grains
"	0500	ENE/8	2982	"	Pluie continuelle
"	0700	ENE/8	2992	"	Très mauvaise visibilité
"	1100	ENE/7	2992	"	
"	1300	ESE/8	2989	"	
"	1500	ESE/7	2990	"	
"	1900	E/6	2990	"	Pluie - vent en rafales
"	2300	SE/8	2985	"	
I3/I0	0100	E/6	2989	"	
"	0300	E/7-8	2987	"	
"	0500	E/5-6	2980	"	
"	0700	ESE/7-8	2974	"	
"	1100	SSE/9	2969	"	Vent soufflant en tempête
"	1300	SSE/9	2965	Grosse	Direction instable
"	1500	SSE/9	2965	Houle	
"	1900	S/9	2971	"	
"	2100	SSE/7	2971	"	
"	2300	SSE/7-8	2973	"	
I4/I0	0100	SE/8	2973	"	Bonne visibilité
"	0300	E/8	2973	"	Eclairs sur tout l'horizon
"	0500	E/8	2972	"	
"	0700	E/7	2972	"	
"	1100	ESE/5-6	2986	"	Beau temps - clair - Bonne visi- bilité
"	1300	ESE/5	2987	"	
"	1500	ESE/5	2986	"	
"	1900	ESE/5	2996	"	
"	2300	ESE/3	2997	"	Temps humide, ciel se couvrent. Bonne visibilité.

report of this expedition, as published by Langmuir [2], places the storm at the time of seeding (1638-1708 GMT of October 13) at the position shown in figure 1. This position is identical to that shown on the map for 1230 GMT of that date as published in the Northern Hemisphere Sea Level Synoptic series (fig. 2).

The implication, which one could draw from this, is that at the time of seeding the storm had stopped moving, which might be interpreted further as an indication that the storm was about to make a change in its course. However, as one examines this picture further, he finds that the location of the hurricane, as shown on the synoptic chart for 1230 GMT of October 13, hinges almost entirely on a report received by radio from a vessel SS *Lisieux*. No other reports were listed as having been received from this vessel. Therefore, before any conclusion could be reached regarding the accuracy of the 1230 GMT hurricane position, it was decided to attempt to verify the report as received by radio. The National Weather Records Center at Asheville, N. C., has no record of the report, but finally through the cooperation of the French Line, which owned

the vessel at the time, the report was tracked down. The log, which they furnished, is shown in table 1. This log shows that at 1230 GMT the ship had been experiencing a wind from the east, rather than from the west, and that the 1230 GMT position of the hurricane, as shown on the Northern Hemisphere map, is in error.

3. COLLECTION OF ADDITIONAL DATA

Further searches of the archives of the National Weather Records Center verified most of the other reports received at the time, but several, which were not received by radio, were added to the collection. In addition, in order to make as complete a survey as possible of the track of the storm in question, the New York City Office of the Weather Bureau made inquiry to many other shipowners which had vessels in the vicinity of the storm. Through the courtesy of various companies thus contacted, several logs were made available to the Weather Bureau which contained weather information not otherwise entered on Weather Bureau forms, especially information entered

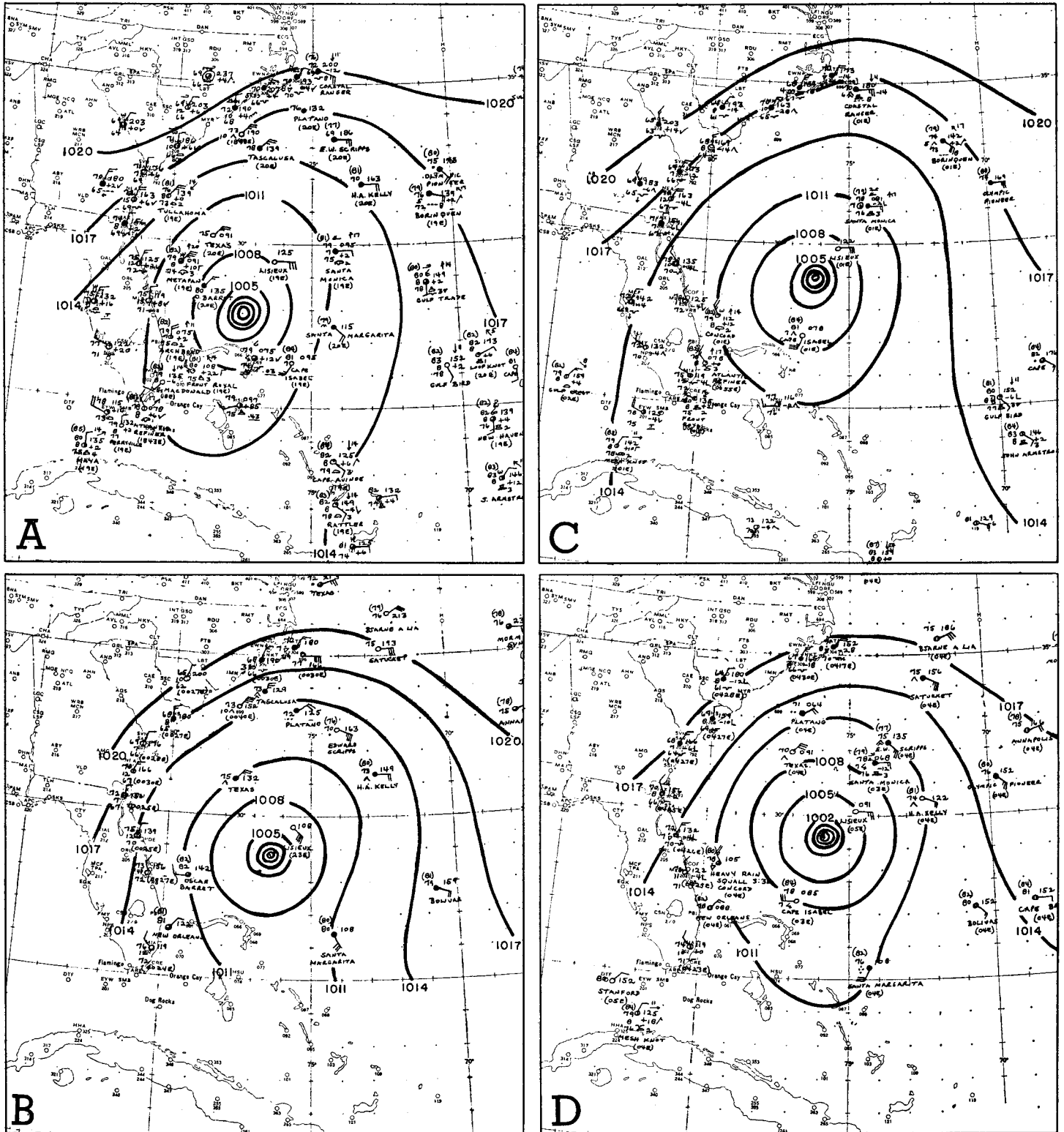


FIGURE 3.—Synoptic sea level charts, based on all data procured from all available sources, showing the history of the hurricane on October 13 and 14, 1947. (A) 0030 GMT, October 13, (B) 0500 GMT, October 13, (C) 0630 GMT, October 13, (D) 0900 GMT, October 13.

each four hours in the logs at times other than the regular time of collection of synoptic weather reports. This made possible the construction of synoptic charts for midnight and noon of the days in question, as well as charts for 4 a. m. and 4 p. m. (75th meridian time).

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4. ANALYSIS OF DATA

These reports, along with coastal reports for the same time, have been plotted with those for the regular synoptic periods on the charts shown in figure 3. After setting aside the data for noon of October 13 for later study, the

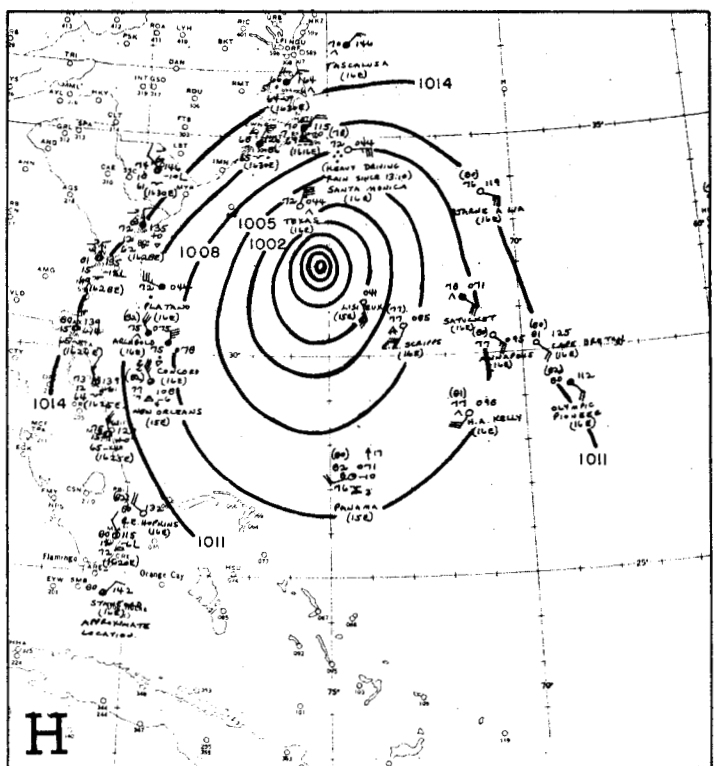
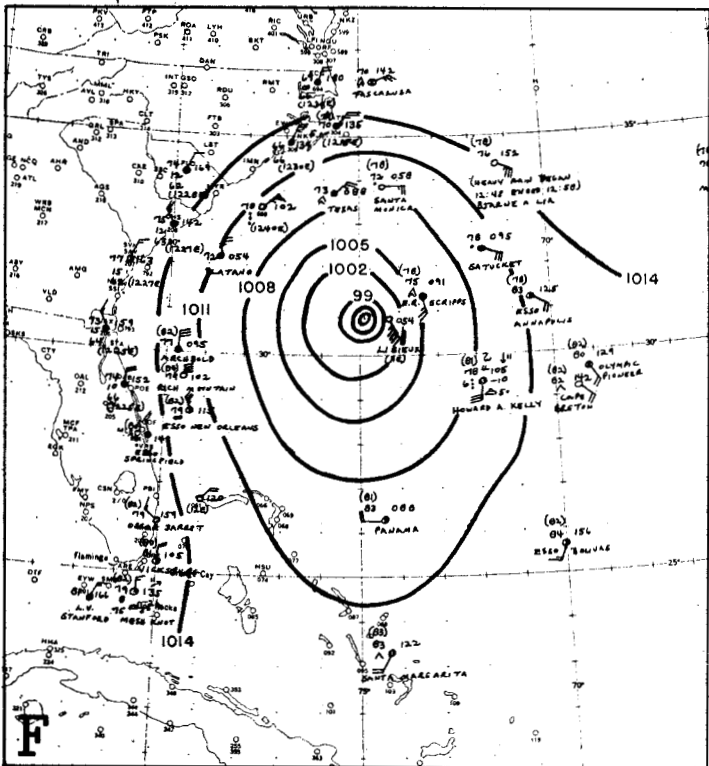
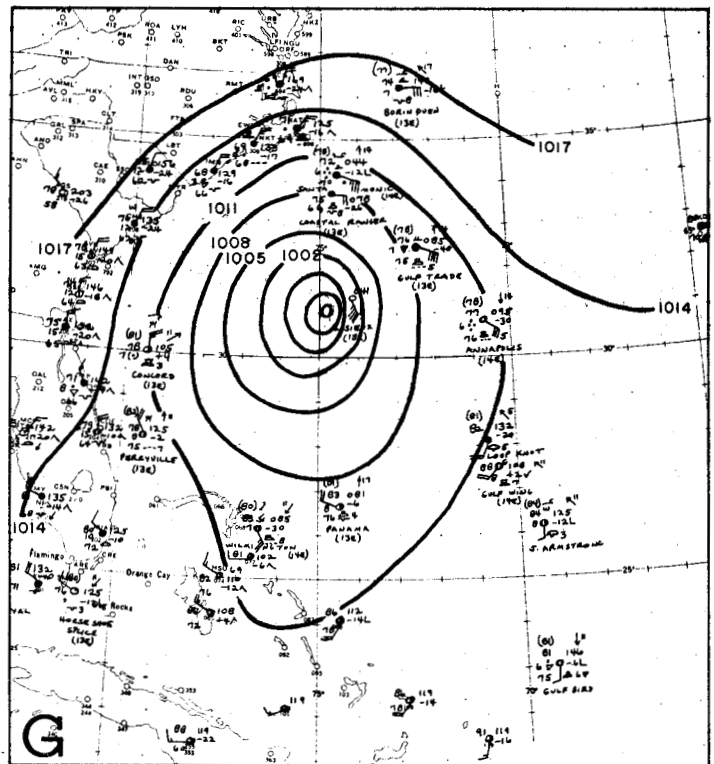
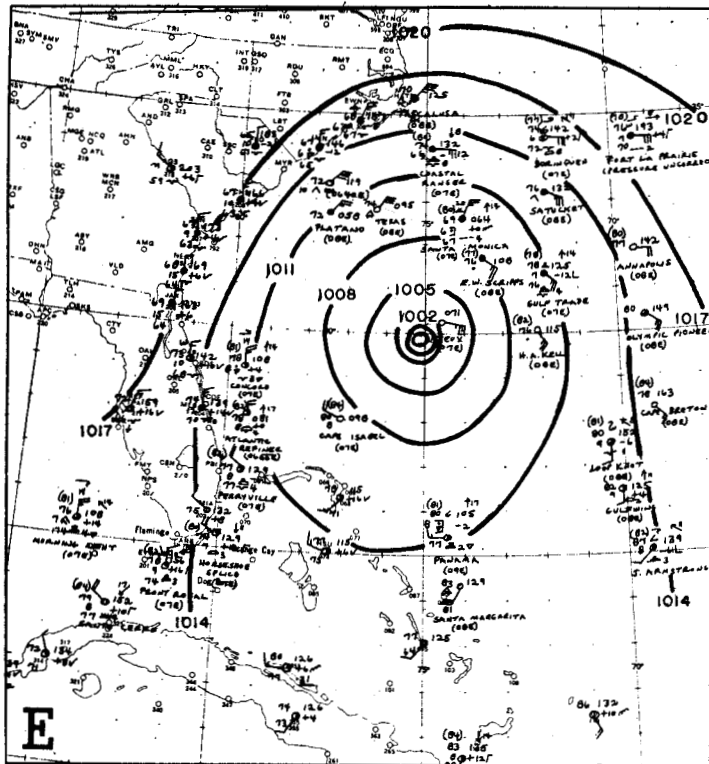


FIGURE 3.—Continued. (E) 1230 GMT, October 13, (F) 1700 GMT, October 13, (G) 1830 GMT, October 13, (H) 2100 GMT, October 13.

charts were analyzed, with an attempt being made to determine any consistent errors in the barometric pressures reported by the various ships. By a process of trial and error, a set of average corrections was developed as shown in table 2. From this came the consistent and symmetrical picture of the storm circulation shown in the maps.

Following this, in order to make the best possible estimate of the position and intensity of the storm at the time of seeding, the same corrections were applied to the reports contained in the ship logs for noon of the 13th. As a result of the corrections, the hurricane position was found to be somewhat to the west of the position where it

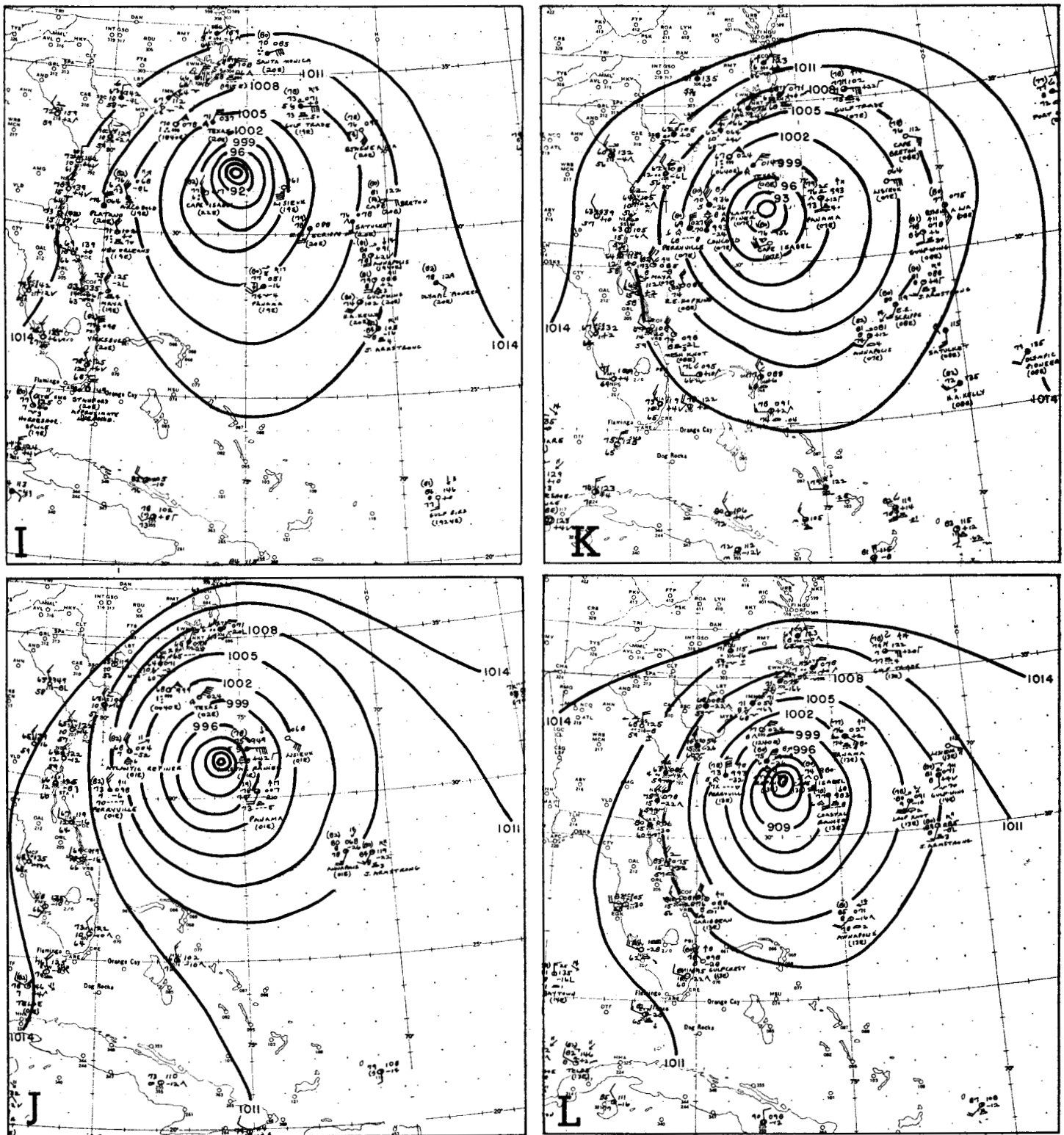


FIGURE 3.—Continued. (I) 0030 GMT, October 14, (J) 0630 GMT, October 14, (K) 1230 GMT, October 14, (L) 1830 GMT, October 14.

was originally believed to have been located (fig. 1), which means that some change in course of the storm was then in progress. Figure 4 shows the track of the storm thus analyzed.

A further detailed analysis was then made of the wind and pressure variations shown by the two ships closest to

the storm at that time, the *E. R. Scripps* and the *Lisieux*. Their data are plotted in figures 5 and 6 and in a manner which shows the track of the vessels as well as that of the hurricane as determined above.

In figure 5 it can be seen that from 0400 to 0800 EST the pressure fell 2.7 mb. on the *Scripps* at a time in the diurnal

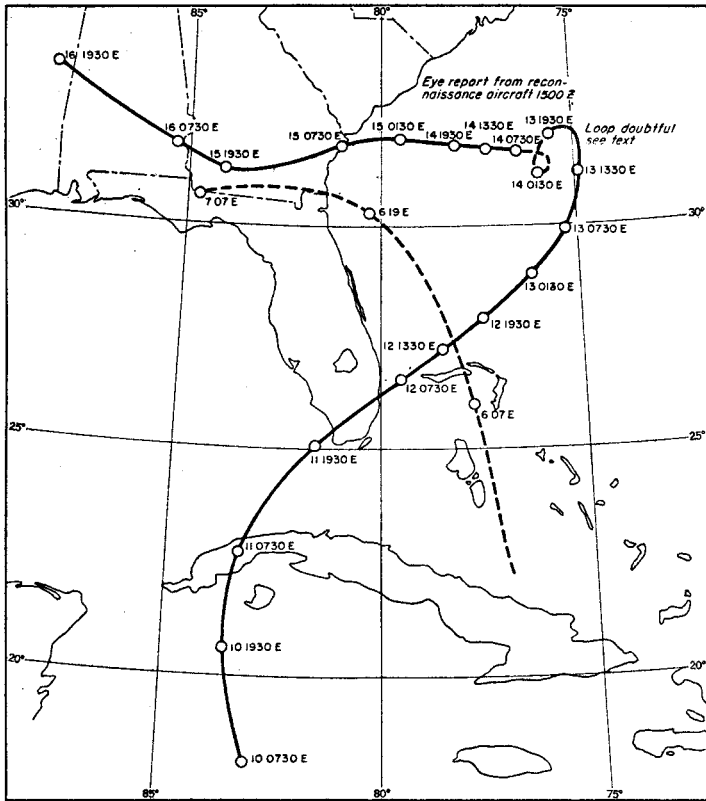


FIGURE 4.—Track of the hurricane of October 12-14, 1947 (solid), as deduced from analyses shown in figure 3, and track of the tropical storm of October 5-7, 1947 (dashed).

cycle when pressure was normally rising. Then, in the next 4 hours it fell only 1.7 mb., suggesting strongly, along with the shift of the wind into a more southerly direction, that the hurricane, which had been on a northeastward course toward the vessel between 0400 and 0800 EST, had shifted its course slightly to the north.

The data for the *Lisieux* in figure 6 show a shift in the

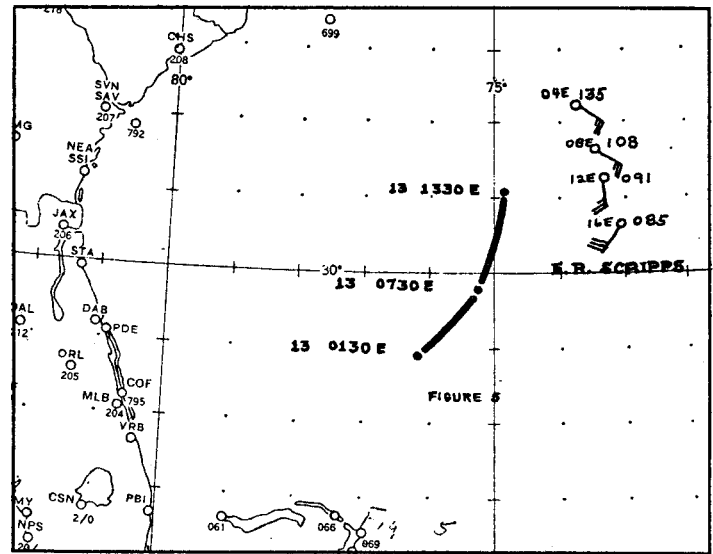


FIGURE 5.—Weather reports from the *E. R. Scripps* and the hurricane track, October 13, 1947.

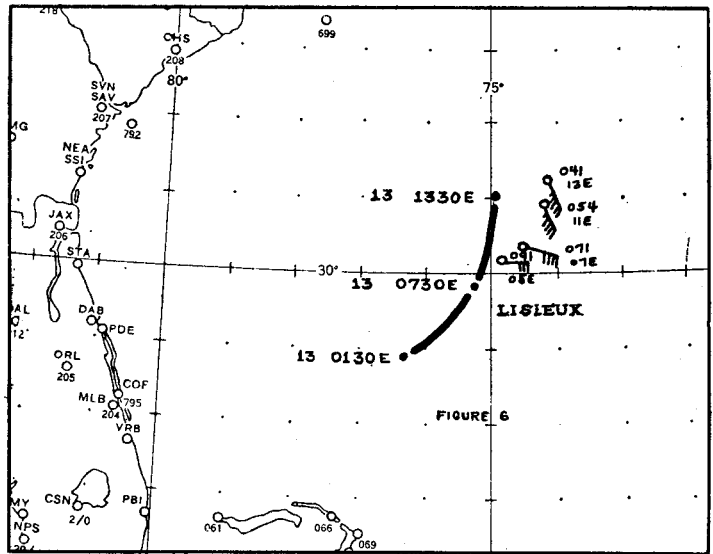


FIGURE 6.—Weather reports from the *Lisieux* and the hurricane track, October 13, 1947.

TABLE 2.—Corrections applied to the ships' barometers

Name of ship*	Correc-tion	Name of ship*	Correc-tion
<i>E. R. Scripps</i>	** -3.0	<i>Telde</i>	0.0
<i>Santa Monica</i>	** +2.6	<i>R. E. Hopkins</i>	-2.5
<i>Howard A. Kelly</i>	** -2.0	<i>J. L. Sullivan</i>	** -6.0
<i>Platano</i>	** +4.5	<i>Metapan</i>	** +1.0
<i>Borinquen</i>	+2.0	<i>Santa Sofia</i>	-1.5
<i>Satucket</i>	0.0	<i>Cape Avinoo</i>	-2.0
<i>ESSO Annapolis</i>	** 0.0	<i>Rattler</i>	-2.0
<i>Texas</i>	** -5.0	<i>New Haven</i>	-1.0
<i>Gulf Trade</i>	0.0	<i>Front Royal</i>	-1.0
<i>Gulf Wing</i>	+1.5	<i>Liberator</i>	0.0
<i>Bjarne A. Lia</i>	** -1.0	<i>Horseshoe Splice</i>	0.0
<i>Cape Breton</i>	** -1.2	<i>Tallahoma</i>	0.0
<i>Panama</i>	** 0.0	<i>Seven Pines</i>	-1.0
<i>Loop Knot</i>	-1.5	<i>J. Armstrong</i>	-1.0
<i>Olympic Pioneer</i>	** 0.0	<i>W. Ellery</i>	0.0
<i>ESSO Bolivias</i>	** -2.0	<i>African Moon</i>	0.0
<i>Coastal Ranger</i>	0.0	<i>Coastal Liberator</i>	0.0
<i>Santa Margarita</i>	** 0.0	<i>Santa Cecelia</i>	-3.0
<i>Lisieux</i>	** -4.3	<i>Mormac Sun</i>	** 0.0
<i>Cape Isabel</i>	-8	<i>Archbold</i>	** 0.0
<i>Oscar Barret</i>	** -5.0	<i>Rich Mountain</i>	** +1.0
<i>Concord</i>	0.0	<i>ESSO New Orleans</i>	** 0.0
<i>Atlantic Refiner</i>	+3.0	<i>ESSO Springfield</i>	** 0.0
<i>Tascalusa</i>	** +3.0		

*Some of these ship reports do not appear on the sea level maps because of space limitations.
 **Corrections to ships' barometers used to analyze the 1700 GMT map, October 13, 1947.

wind from east-southeast to south-southeast between 0700 and 1100 EST, which is a further indication of a change in the direction of the movement of the hurricane.

In the analyses shown in figure 3, particularly those for 1830 and 2100 GMT of the 13th, and 0030, 0630, and 1230 GMT of the 14th, considerable weight was given to a flight report of the United States Navy, Atlantic Fleet on October 13, 1947, after the seeding operation. Pilot Lt. Cdr. N. H. Rudd and Aerologist Lt. E. H. Ryner made the following observations from a position (verified by Loran) at 32.1° N. and 75.1° W:

At 2000Z the eye was attained. Precipitation and turbulence ceased instantaneously and visibility increased to 5 miles. Radar showed the eye to be elliptical with a major axis orientated north northwest-south southeast and 16 miles long. The minor axis was 12 miles in length. Clouds were scattered fracto-stratus at 400

to 600 feet and a solid deck of thick alto-stratus estimated at 12,000 feet. The sea was confused in the outer edges of the eye and calmed to almost a glassy condition in the very center of the eye. Lowest pressure was found to be 982 millibars at a point 6 miles before reaching the eye. This pressure was obtained by reducing pressure at flight level of 500 feet to sea level, using the standard lapse rate.

The analyses were made under the assumption that the position and time given by the pilot are both correct. The subsequent small loop is based largely upon the east wind reported by the *Coastal Ranger* at 0630 GMT of October 14. Loops of this kind may not be unusual during hurricane turns. Detailed analyses of hurricane Ione of 1955 [3] and of the Cedar Keys hurricane of September 1950 [4] provide documentation of their occurrence. The data available in the present instance to demonstrate the phenomenon cannot be considered adequate evidence when compared with radar coverage. The loop is presented as one solution to the data available for analysis in this case.

In the report by Langmuir [2], reference is made to an extensive squall line which was seen by radar extending southeastward from the storm center at the time of the seeding operation. A reconnaissance aircraft, which passed south of the storm center on the forenoon of the 13th, reported that he passed through a "cold front". No attempt has been made during the present analysis of this storm to show these and other squall lines and lines of convergence which may have been present.

5. REMARKS CONCERNING THE SYNOPTIC SITUATION ASSOCIATED WITH THE TURN

An examination of tropical cyclone tracks [1], [5] indicated that another tropical storm (fig. 4), though not of full hurricane intensity, made a similar turn on a track shown as having occurred on October 6, 1947. This storm moved northward over the Bahama Islands, then curved westward and moved inland in the vicinity of Jacksonville, Fla. This raises the interesting question as to whether a persistence in the broadscale weather regime could have resulted in such a similar recurrence within a week in approximately the same area. A phenomenon similar to this in connection with hurricanes Connie and Diane of 1955 was noted by Namias and Dunn [6].

Namias [7] had shown previously that abnormal circulations established over the southern portions of the North Atlantic Ocean show a marked month-to-month persistence. That a persistently abnormal pattern in the United States North Atlantic area was operating during the month of October 1947 has been shown by Ballenzweig [8]. Ballenzweig also showed that the pattern which then existed favored the movement of existing hurricanes into the southeastern United States.

The 500-mb. constant pressure chart for 0400 GMT of October 13, 1947, is shown in figure 7a, and the 24-hour, 500-mb. height change field is shown in figure 8a. These

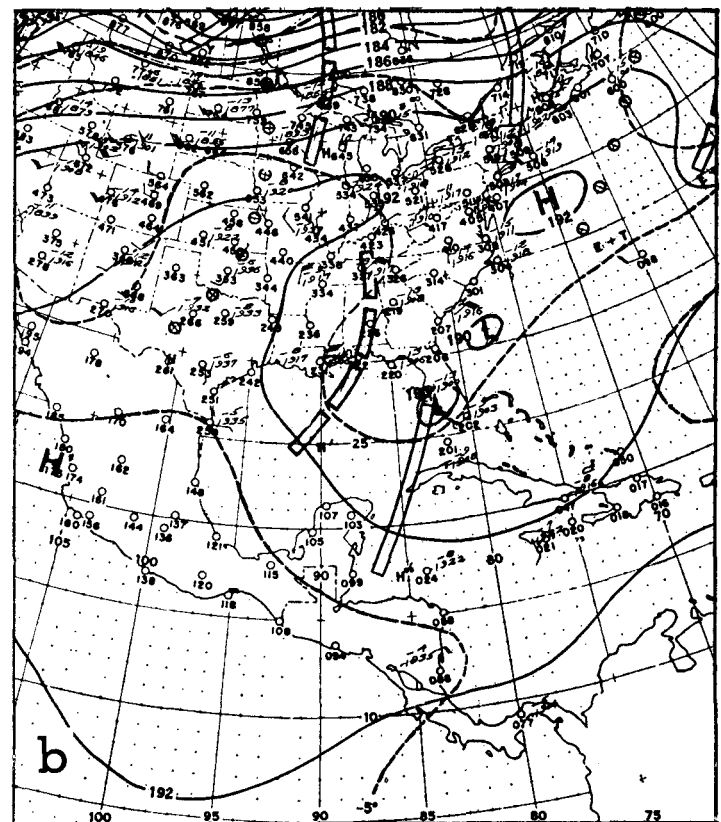
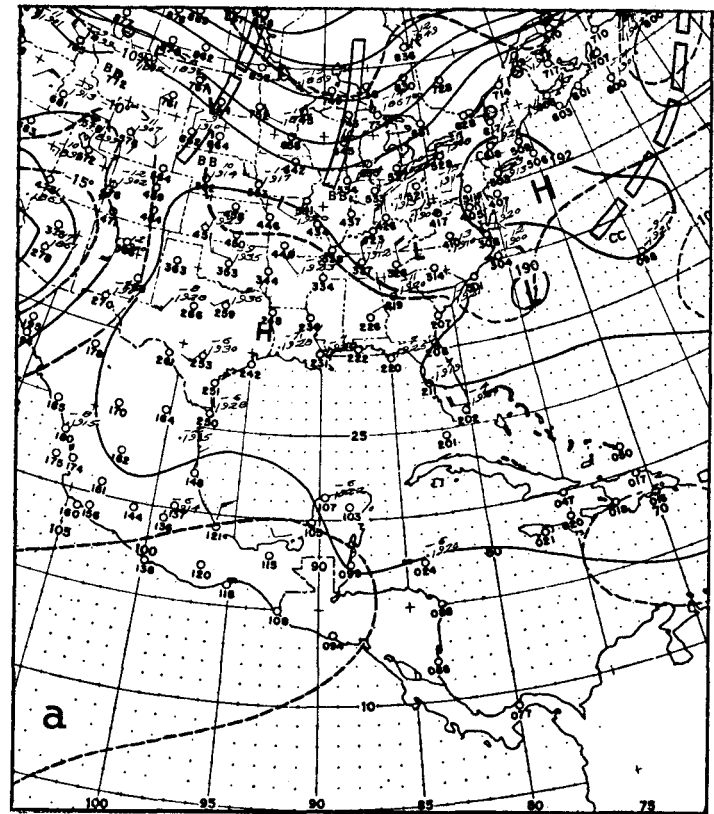


FIGURE 7.—Portions of 500-mb. charts from *Northern Hemisphere Historical Weather Maps* for (a) October 13, 1947, 0400 GMT, and (b) October 6, 1947, 0400 GMT.

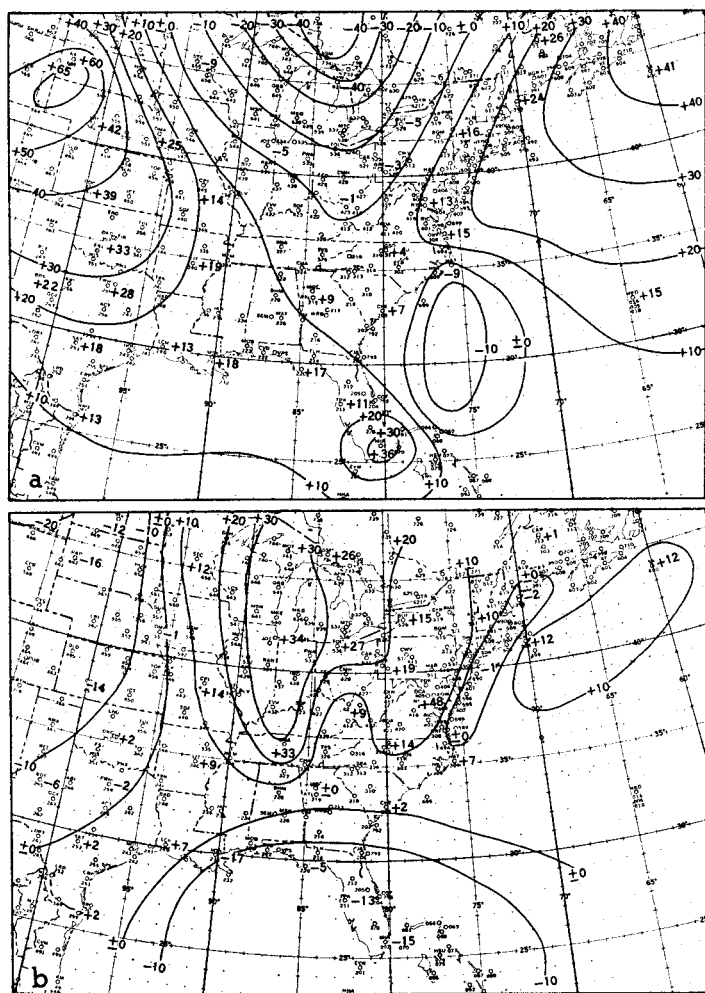


FIGURE 8.—24-hour 500-mb. height change fields for (a) October 13, 1947, 0400 GMT, and (b) October 6, 1947, 0400 GMT.

charts show the changes in the large-scale circulation which took place ahead of the projected hurricane track. These effects contributed to the blocking of any further movement toward the northeast as the hurricane reached the periphery of the High. The existence of the latter was probably the principal reason why the 500-mb. trough in the Mid-West failed to sweep the hurricane into its circulation as it moved eastward.

The 500-mb. chart for 0400 GMT of October 6 is shown in figure 7b. Therein one finds a similar but less intense blocking High toward the northeast in the projected path of the storm. The 24-hour height changes up to the time of this chart are shown as figure 8b indicating that a somewhat similar but less intense height rise had taken place northeast of the storm. A further height rise then served to intensify the blocking effect over the Lake Erie region.

It is reasonable to suppose, therefore, that the final tracks of both storms were the normal outcome of accompanying anomalies in the general circulation and their reflection in the circulation patterns making up the environmental steering pattern over eastern North

America and the adjacent portion of the North Atlantic Ocean.

ACKNOWLEDGMENTS

The authors are indebted to several individuals and agencies who assisted in the collection of reports for us in the analysis of this Atlantic hurricane. We wish first of all to express our appreciation to the officials of the French Line, with headquarters in Paris, France, for their untiring efforts in locating weather data as logged by the cargo-passenger steamer, SS *Lisieux*, during a voyage from the United States to France. The French Line officials were most helpful in securing this information for us from the present owners of the ship.

Officials of the New York City Weather Bureau office devoted many extra hours to the process of visiting various shipping lines in New York Harbor to obtain data which might furnish clues to the storm movement. We wish especially to thank Mr. C. J. McGregor and Mr. L. E. Truitt.

Also, we wish to thank Mr. William Haggard of the Office of Climatology and the officials of the National Weather Records Center, Asheville, N. C., for further assistance in supplying data.

Dr. C. L. Jordan and other officials of the National Hurricane Research Project were especially helpful in reviewing the manuscript. It was Dr. Jordan who directed our attention to interesting aspects of the storm track which revealed themselves after the data from the SS *E. R. Scripps* and SS *Lisieux* were plotted, as shown in figures 5 and 6.

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