A Study of Hurricane Baker of 1952

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Introduction: In a previous paper Sherman and Carino, 1953 it was pointed out that in the streamline analysis of a complete hurricane, the hyperbolic point associated with it may be of aid in deciding the direction of motion of the disturbance. Sectionals were shown of the analysis of the complete track of hurricane Able and the possibility of anticipating the recurvature was indicated from the dispolacement of the hyperbolic point with respect to the cyclonic indraft point at the surface. No claim was made however, in the above-mentioned paper that the direction of movement of the hurricane can be positively determined by the application of such an analysis on the surface wind data. It simply pointed out the feasibility of such an analysis and how it may be applied as a forecasting aid. This is a report of a study of hurricane Baker of 1952 by the application of a similar principle and technique. Unlike the result obtained from hurricane Able of 1952, the track of the surface hyperbolic point associated with hurricane Baker did not show any indication of anticipating recurvature. An explanation for such a phenomenon will be given in this paper. Analyses of the wind fields at 8000 feet and 10000 feet were made and better results were obtained.

Discussion: Figure 1 shows the track of the hurricane. It will be noted that the surface hyperbolic point associated with the cyclonic indraft point did not indicate any signs of recurvature contrary to the path taken by hurricane Able When during the process of recurvature, there was observed a rapid displacement of the hyperbolic point from its previous position. As hurricane Baker changed its course from northwest to north,

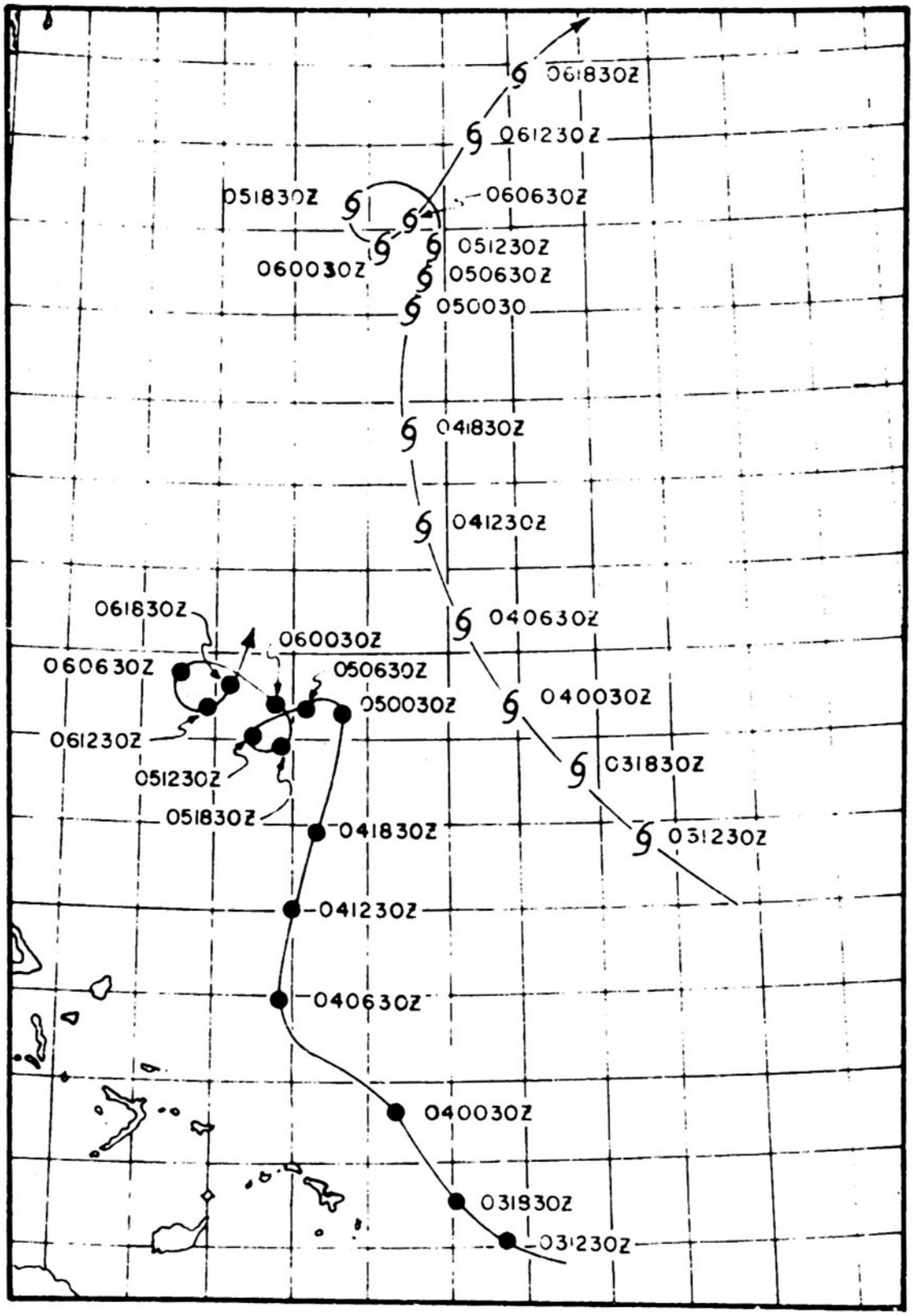


Figure 1. Track of surface cyclonic indraft point and corresponding hyperbolic point of hurricane Baker

the surface hyperbolic point remained south of it at all times. Before the analysis was started, it was anticipated that like hurricane Able, the surface indication of recurvature will be indicated by the displacement of the hyperbolic point, but no such phenomenon was observed. Instead, a gradual northward movement of the hyperbolic was noted.

The surface chart during the period of recurvature showed an intense and cold anticyclone centered over Ohio. This anticyclone brought about a predominant northerly flow at the surface along the eastern section of the United States when hurricane Baker was still out in the Atlantic Ocean at approximately 31°N 70,5°W. Obviously, as long as this flow persisted, the singular point will remain south of the cyclonic indraft point. During the recurvature of hurricane Baker, this surface northerly flow persisted, so the hyperbolic point remained south of the hurricane and its orientation with respect to the eye of the disturbance did not change abruptly as was expected at the surface. This anticyclone at the surface is due to the cold air at lower levels so that with increase in height, it would be expected to be weaker and shallower. Qualitatively then, the northerly flow will not persist with height but will eventually be overrun by the southeasterly flow along the southwestern section of the Bermuda High. This change in flow will invariably displace the hyperbolic point from its surface position with increase in elevation and will result in a large forward slope with height of the hyperbolic point. Another way of looking at it is the large slope of the Asymptote of Convergence associated with the hurricane, with height. A knowledge of its surface position under

such a circumstance will not mean much and it will then be advantageous to analyze upper air charts if data are available. A discussion of the 4 upper air charts which were analyzed will be given in Appendix B. Figure 2 shows the upper air track of the hurricane.

Another significant feature of the track of the hyperbolic point of Baker was its more of less stationary nature when the cyclonic indraft point apperently made a complete turn on the 5th and the 6th of September. Whether the disturbance followed such a loop as indicated in uncertain. It is possible that during that period hurricane Baker did not perform a loop but rather stagnated in the general area. This observation on the behavior of the hyberbolic point seems to be plausible based on the fact that the distance between the cyclonic indraft point and the hyperbolic point associated with it will change only with variations in the intensity of the disturbance. From the available information the hurricane did not change considerably in intensity during that period.

Summary: The result of this study leads to the following observations and tentative conclusions:

1. This type of analysis may be used as a forecasting aid only in certain specific cases when there is observed no rapid displacement with height of the hyperbolic point. An example of a case when it cannot be applied is the existence of a cold high west of the forward left quadrant of the hurricane which will invariably result in a large slope of the asymptote of convergence and thus bring about a considerable tilt with height of the hyperbolic point. Although at the initial stage of the hurricane the hyperbolic point may be vertical with elevation,

it is possible that in the later stage there may be observed a considerable slope with height.

2. In specific instances when there is a rapid displacement of the hyperbolic point with height, a knowledge of its position at the surface, will not be adequate. Analysis at higher levels will be necessary. However due to the usual inadequacy of upper wind reports especially over ocean areas, such an analysis can seldom be made.

3. The slow movement of the eye of the hurricane was accompanied by the stagnation of the hyperbolic point in a general area. Since the hyperbolic point is as much a part of the hurricane as the cyclonic indraft point, one may well imagine it as moving with the eye at the same speed with the exception of course of rapidly changing intensity and a change in the basic current.

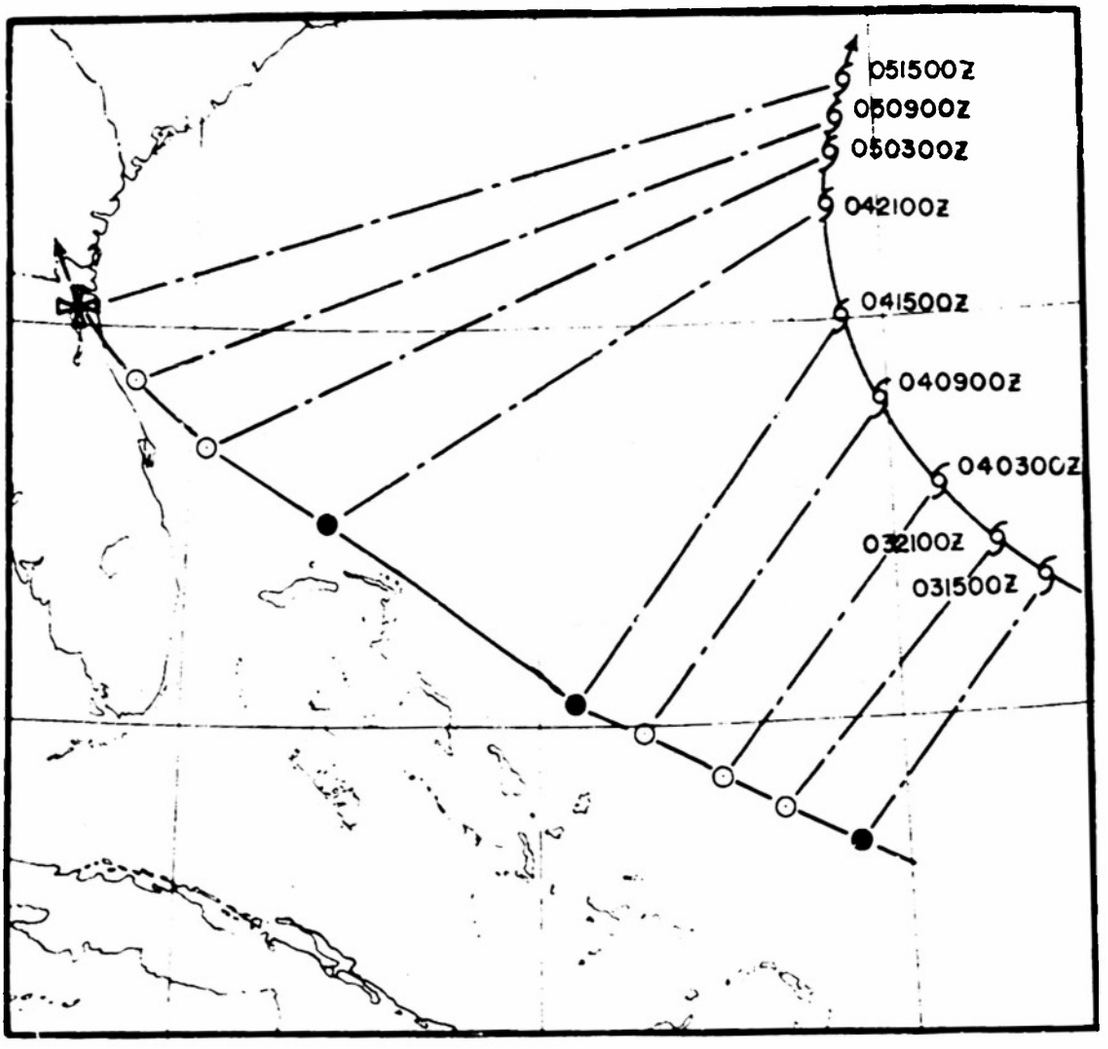


Figure 2 Track of the upper level cyclonic indraft point and the associated hyperbolic point of hurricane Baker.

LEGEND:

- Position of the cyclonic indraft point every 6 hours
- ● Position of the hyperbolic point at the analyzed 8000 ft. level charts
- ⊙ Extrapolated position of the hyperbolic point at 8000 ft.
- ✠ Position of the hyperbolic point at the analyzed 10000 ft. level chart

Appendix A: Surface Streamline Charts

The determination of the positions of the hyperbolic points on the first 3 charts, 1230 GMT and 1830 GMT of September 3, 0030 GMT of September 4, had been adequately determined on the basis of sufficient land, ship, and aircraft reports which fixed the asymptotes of convergence and divergence quite well.

The position at 0630 GMT of September 4 had been placed largely from extrapolation due to lack of adequate information. It may be mentioned however that the general and widespread northeasterly flow over Florida, New Providence Island (25°03'N 76°16'W), and Eleuthera Island (25°12'N 76°16'W) had limited the position of the hyperbolic point to be placed no farther west of 74°W.

This type of flow persisted on up to 1230 GMT of September 4 and slightly changed to a more northerly stream later due to a change in the orientation and position of the anticyclone. As a consequence of this flow pattern at the surface, the hyperbolic point was held back from moving west so it remained practically south of the cyclonic indraft point even during and after recurvature.

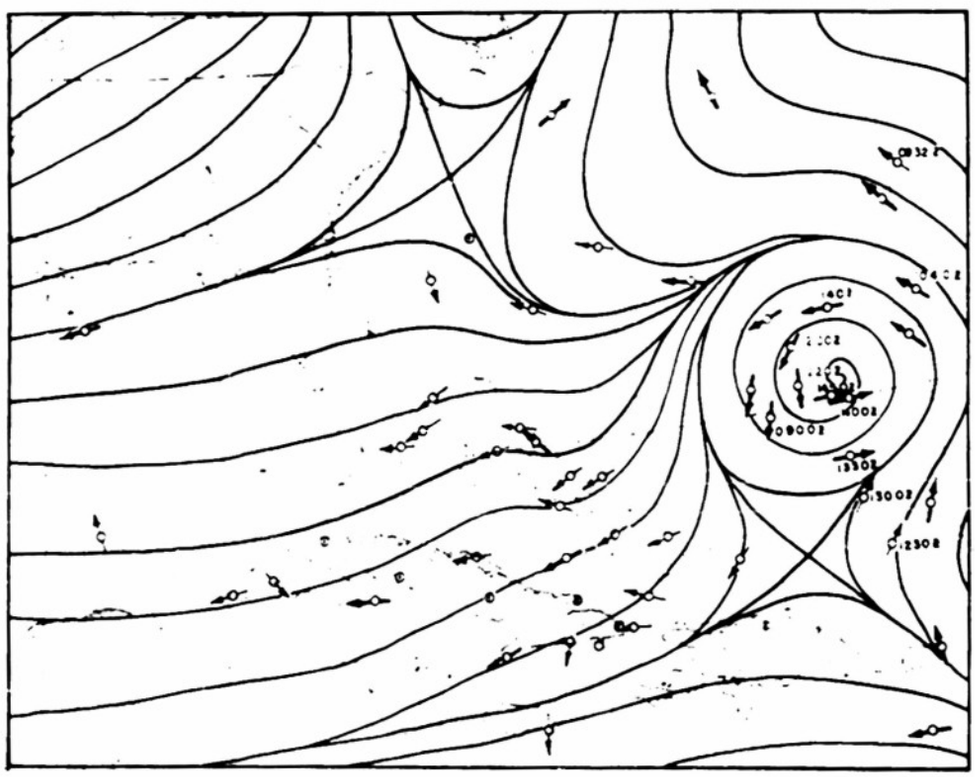
No analysis was made for 0630 GMT of September 5 due to insufficiency of the surface data.

APPENDIX A

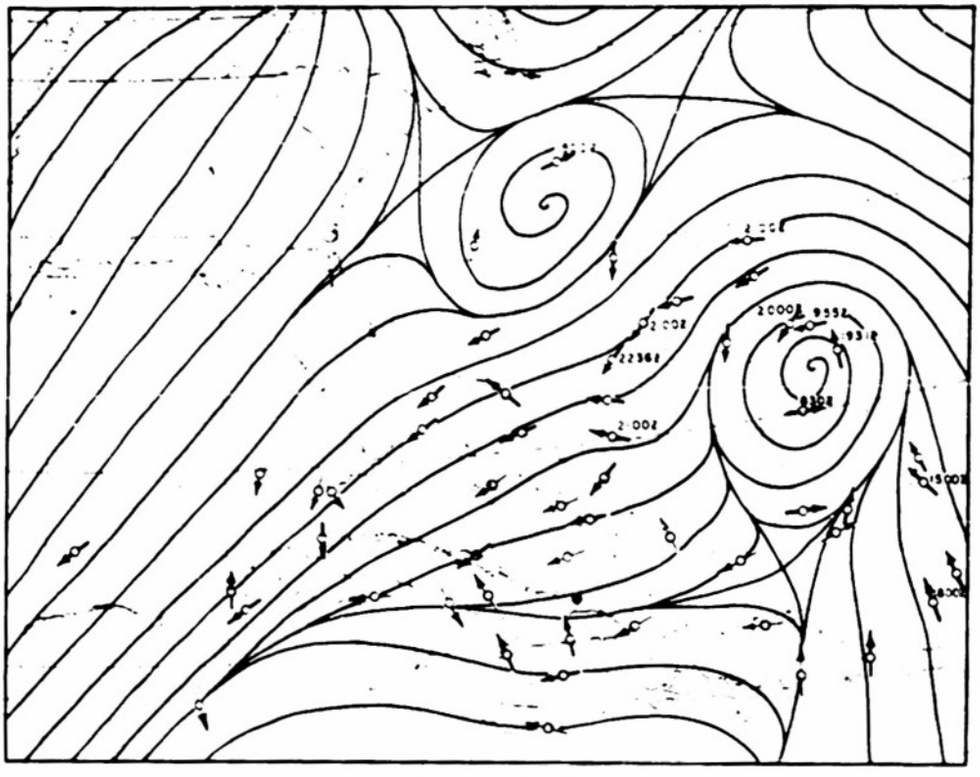
SURFACE STREAMLINE CHARTS

LEGEND

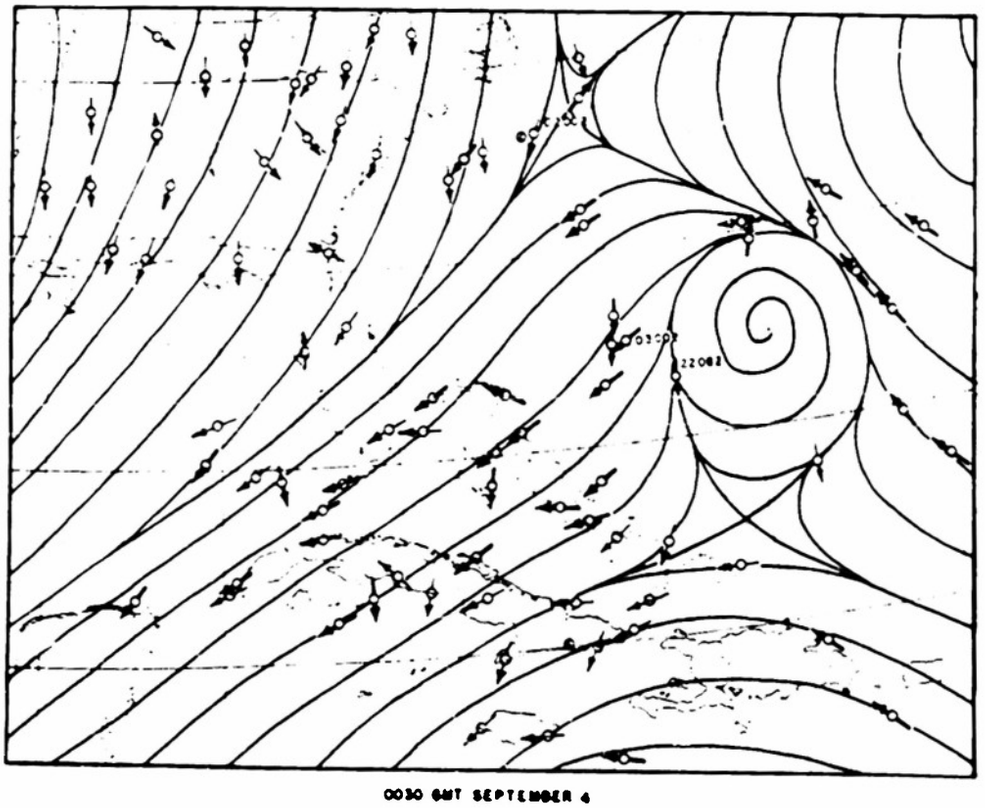
- wind speed greater than 8 knots
- wind speed of 8 knots or less
- calm



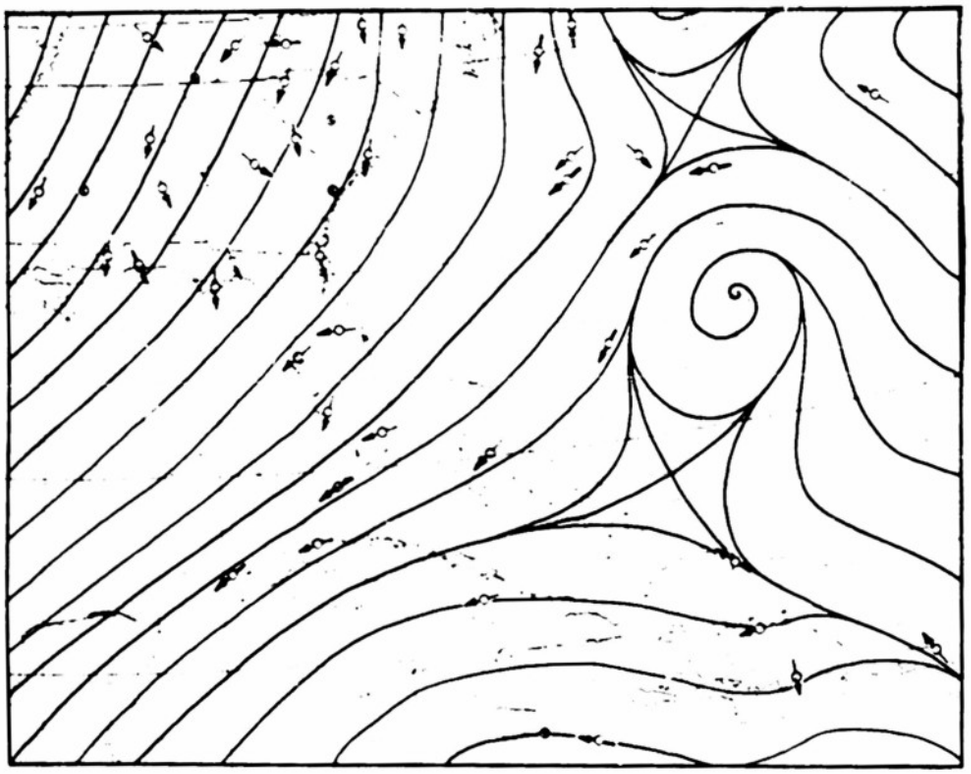
230 GMT SEPTEMBER 3



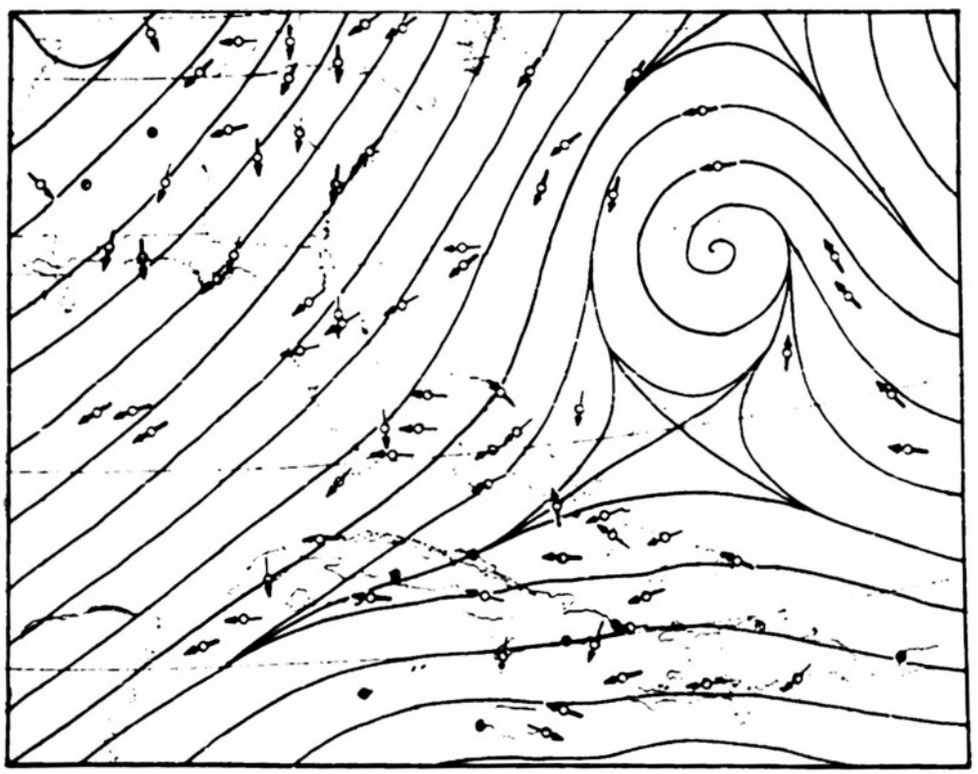
0130 GMT SEPTEMBER 3



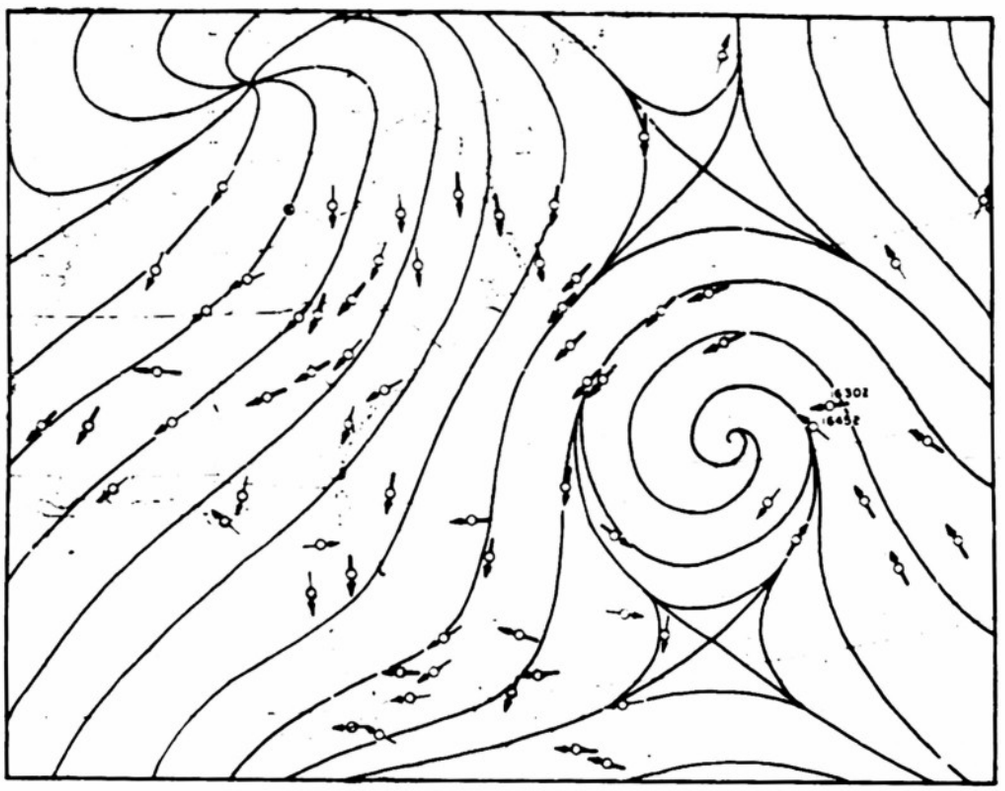
0030 GMT SEPTEMBER 4



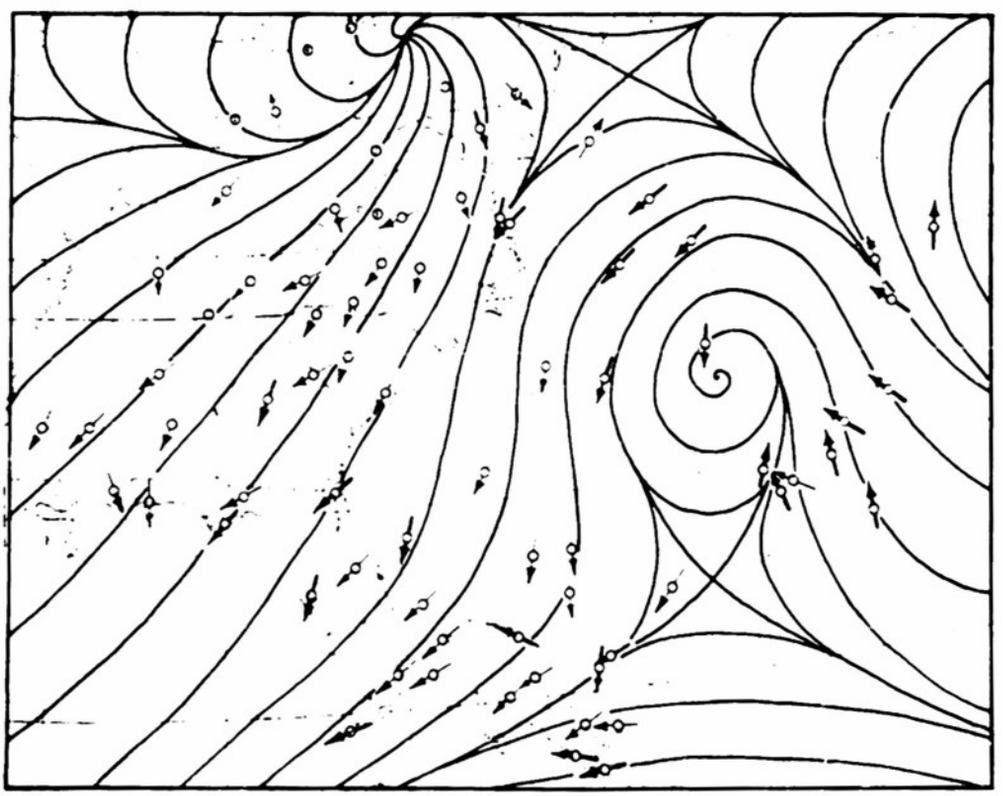
1630 GMT SEPTEMBER 4



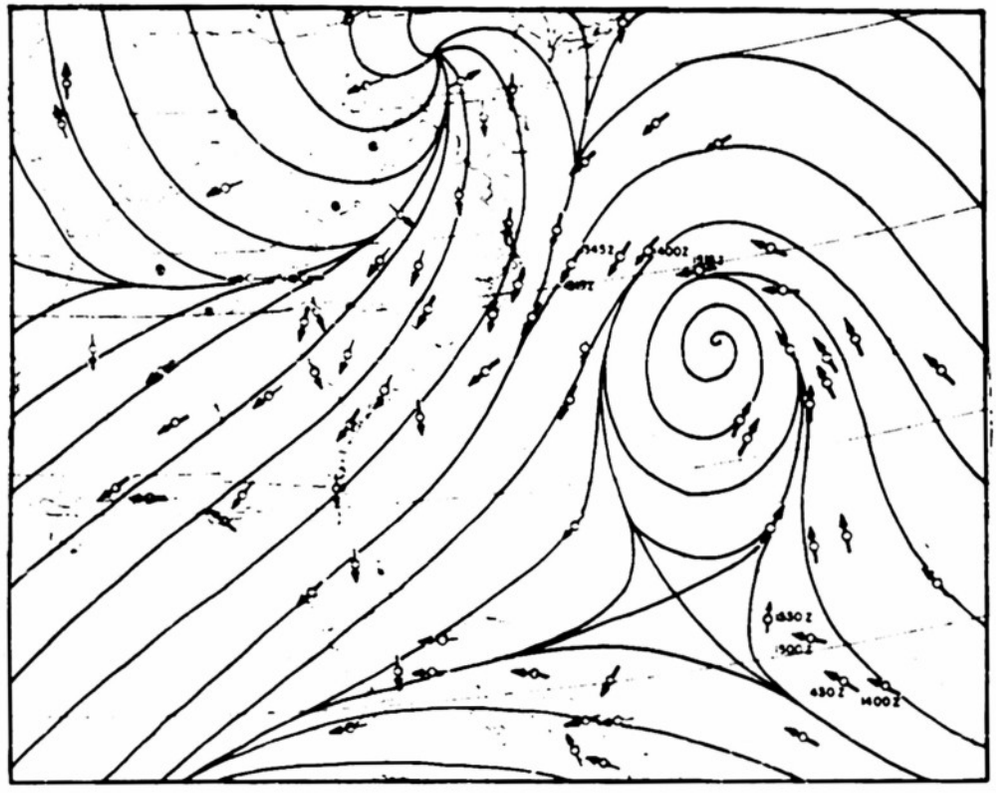
1230 GMT SEPTEMBER 4



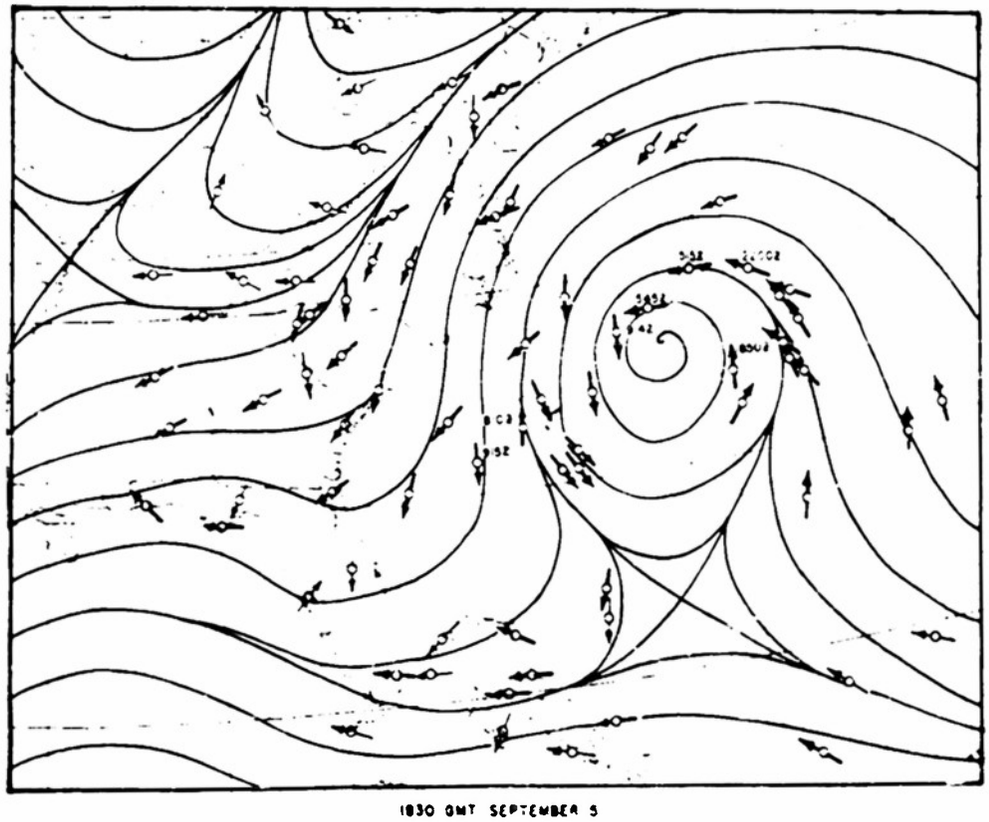
0830 GMT SEPTEMBER 4



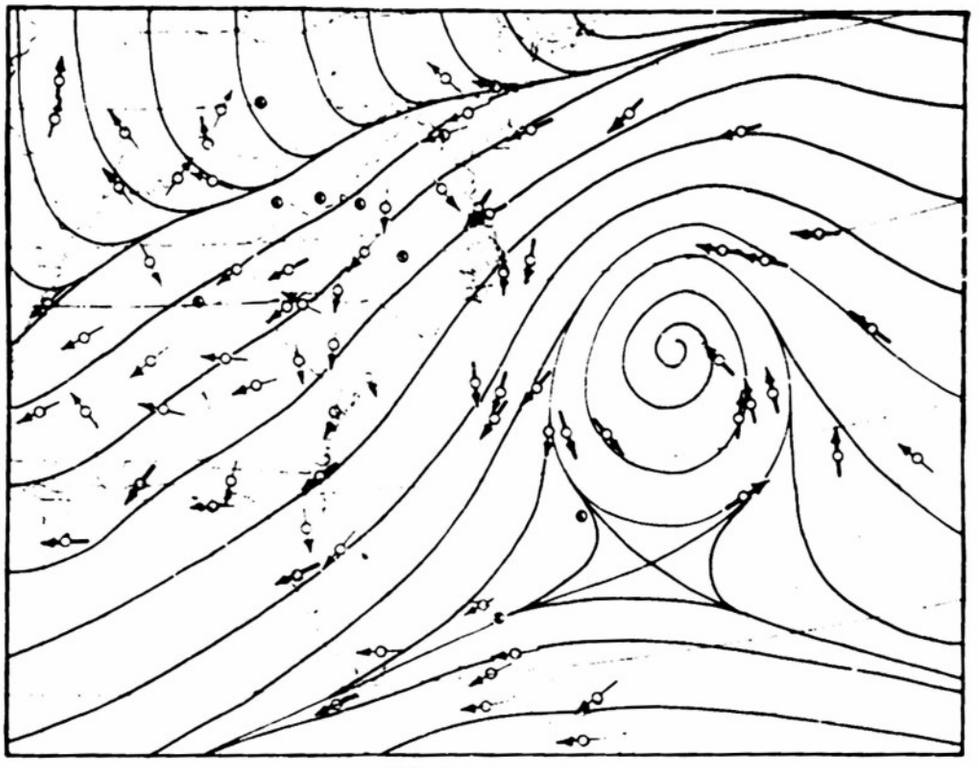
0030 GMT SEPTEMBER 5



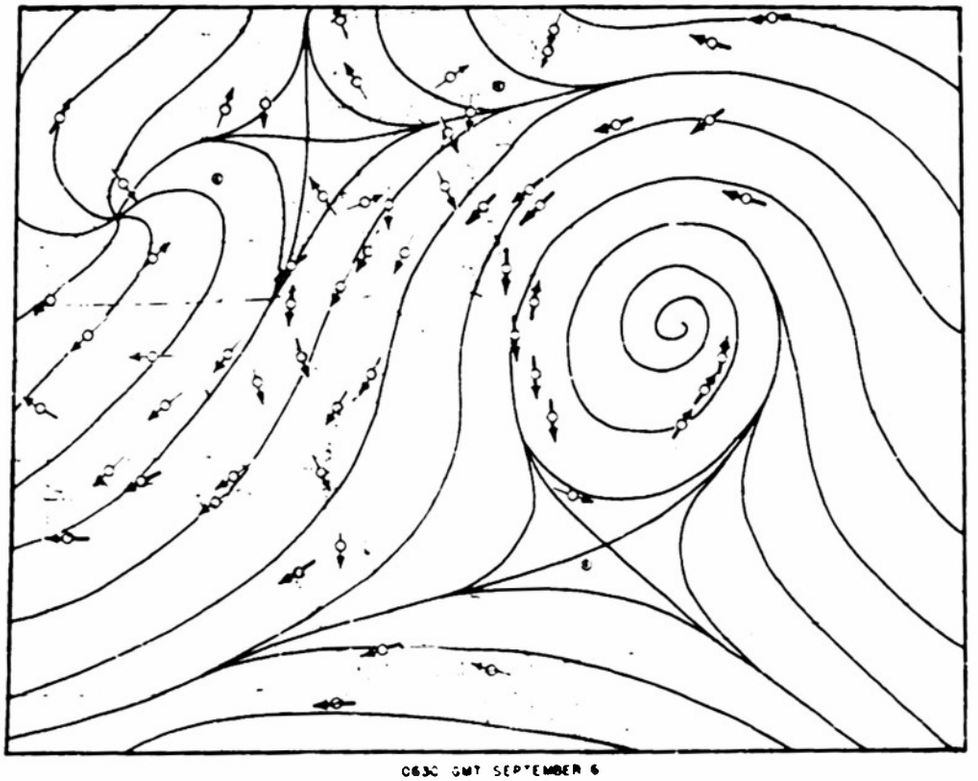
2300 GMT SEPTEMBER 5



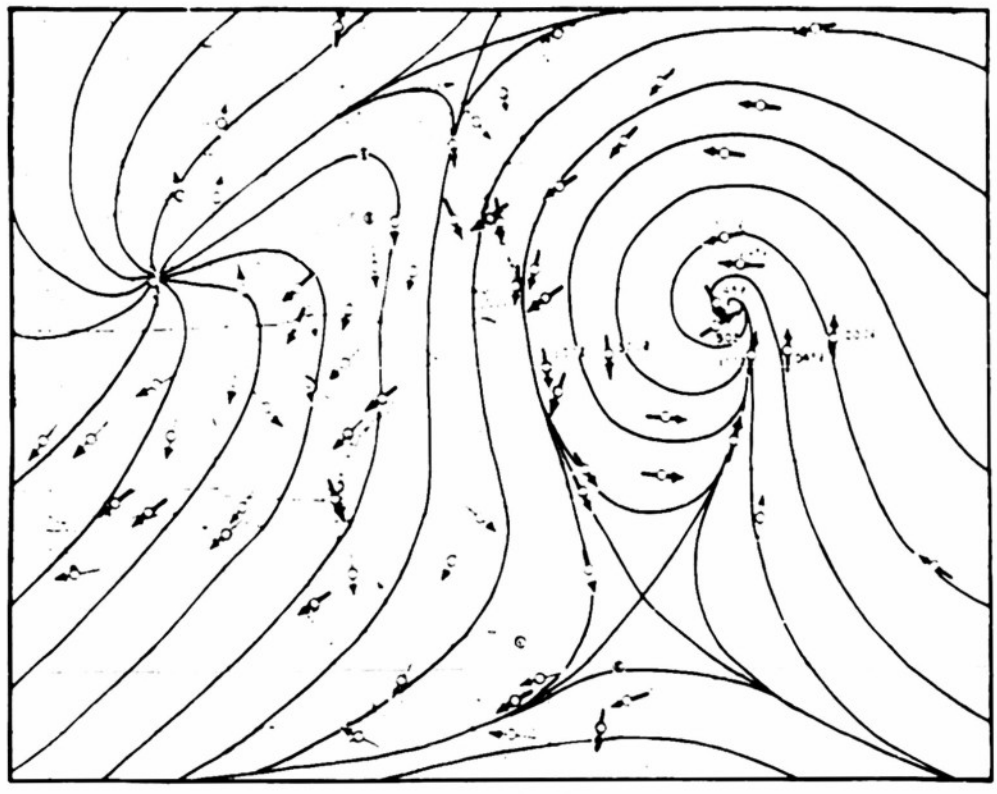
1830 GMT SEPTEMBER 5



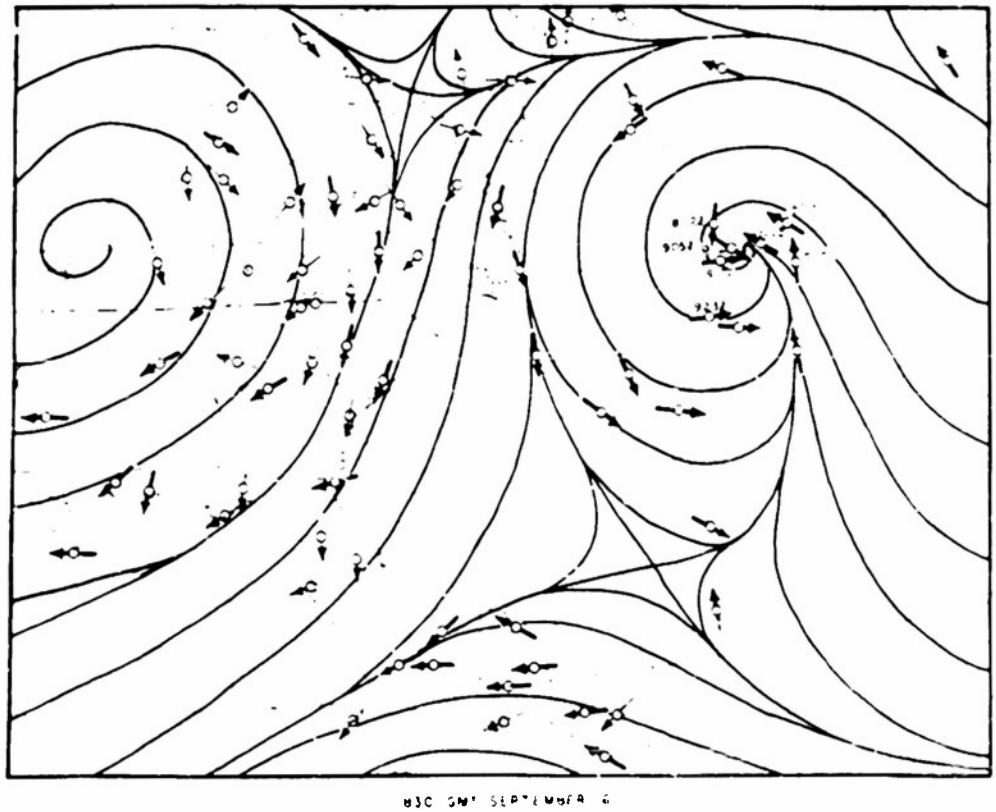
0030 GMT SEPTEMBER 6



0630 GMT SEPTEMBER 6



23[illegible] GMT SEPTEMBER 6



0[illegible] GMT SEPTEMBER 6

Appendix B: Upper Wind Charts

1500 GMT September 3 8000 feet: The anticyclonic circulation centered east of Florida is indicated by the wind reports from Jacksonville, Miami, Key West, and New Providence Island (25°03'N 77°23'W). It is also definitely known that a cyclonic circulation exists in the vicinity of 27N 67W. These 2 systems are drawn for and the asymptotes of convergence and divergence are located based on very inadequate data. It will be noticed that only the western section of the asymptote of convergence had been determined based on actual reports so the location of the hyperbolic point is very doubtful. In a general way, it can be pointed out that based on the plotted wind reports the hyperbolic point will not be farther north than 26°N and no farther east than 72°W. Another basis for the position of the singular point as shown in the analysis is the surface position at 1230 GMT of September 3. Notice that over South Florida, Northern Cuba, and the other islands in the Caribbean area that the predominant flow is from the east-northeast at the 8000 foot-level. This is also the type of flow pattern over roughly the same area at the surface at 1230 GMT of the same day. From this observation, it can be inferred that the surface hyperbolic point will not slope much with height but on the contrary will be more or less vertical.

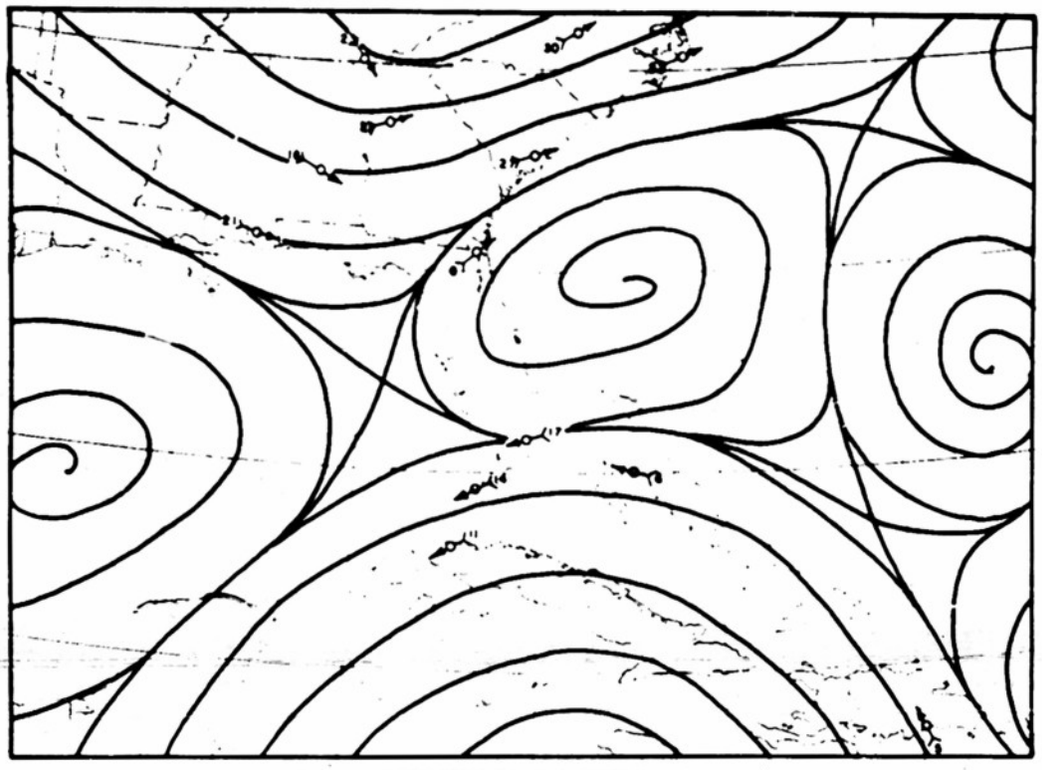
1500 GMT September 4: Note that the anticyclonic circulation in the preceding chart is again found in this chart. The wind reports from Tallahassee, Jacksonville, Tampa, and Miami definitely substantiate its existence. The position of the hyperbolic point is better located since the western section of the asymptote of convergence and the southern section of the asymptote of divergence had been fairly fixed.

2100 GMT September 4 8000 feet: Anticyclonic circulation is still present in the chart although the area affected is smaller in extent. The general east-northeasterly flow pattern is indicated by the wind reports of Grand Bahama Island (26°41'N 78°59'W) and Key West of Florida. The position of the hyperbolic point is definitely north of the Bahama Island and from the good location of the asymptote of convergence, the hyperbolic point has been well-determined. Note from the previous chart to this chart that there has been an abrupt change in the position of the hyperbolic point. During the interval of time between these 2 charts, hurricane Baker made its recurvature northward.

1500 GMT September 5 at 10000 feet: The time, date, and level of this chart was specifically chosen due to the availability of the winds reported by a reconnaissance aircraft which was dispatched from Jacksonville, Florida to make a fix on the eye of the hurricane. The flight was made at approximately 10800 feet. These data together with the rawin and pibal reports in the United States and a few isolated reports from the Caribbean at 10000 feet offered enough information to make a relatively good fix of the hyperbolic point. The asymptote of convergence and divergence had been well determined. The rapidly diverging wind on either side of the northern sector of the asymptote of divergence is evidenced by the reported north wind of Charleston on one side and the northeast winds from Spartanburgh in South Carolina and Atlanta on the other side. The western limit of the south sector of the asymptote of divergence is fixed by the general southeasterly flow

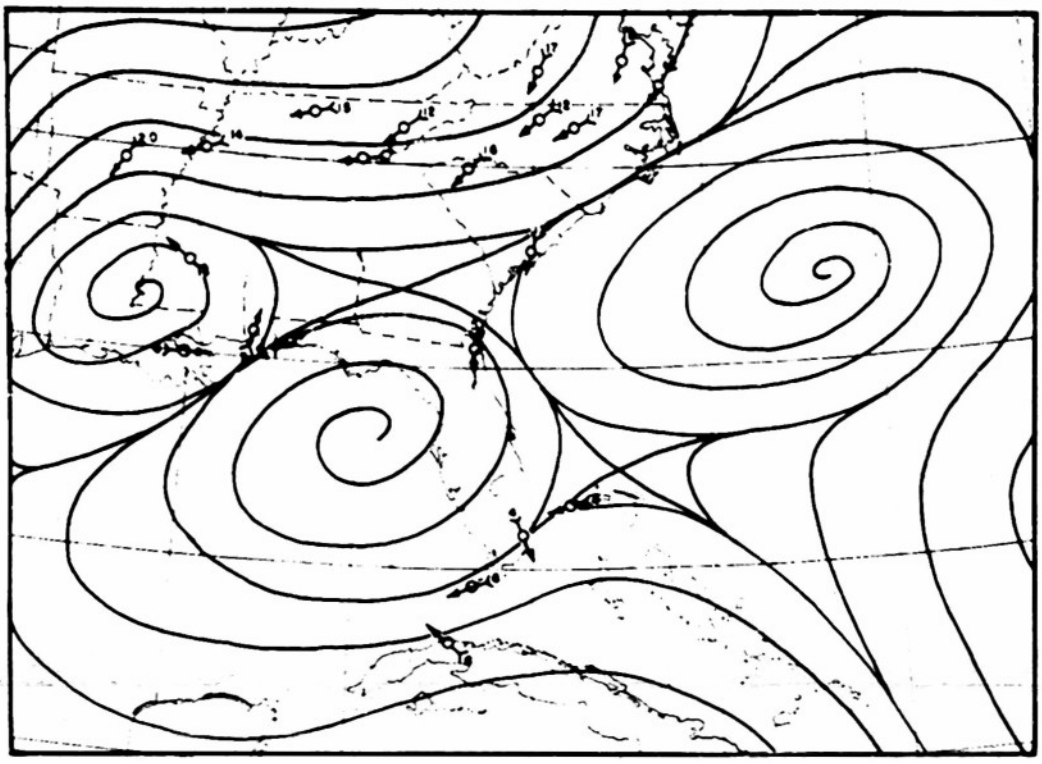
as indicated by reports from Tampa and Miami. In a similar manner the asymptote of convergence is located on the basis of the wind reports from Tallahassee, the first position of report of the aircraft at 1711 GMT, and the general southeast flow in the Gulf of Mexico west of Florida.

APPENDIX B UPPER AIR CHARTS

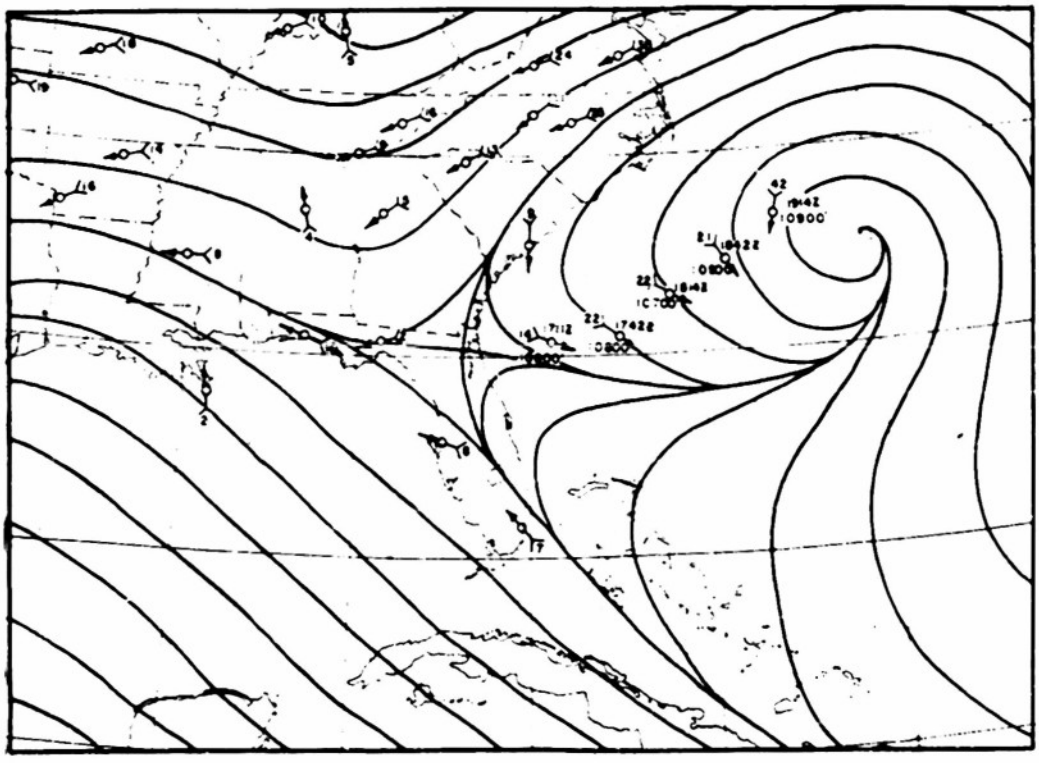


8,000 FEET - 1500 GMT - SEPTEMBER 3

8,000 FEET - 1500 GMT - SEPTEMBER 4



8,000 FEET-2 00 GMT-SEPTEMBER 4



10,000 FEET - 1500 GMT - SEPTEMBER 8

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1. Sherman, 1953: A Proposed Modification of Hurricane Reconnaissance Procedures, Bull., Amer. Meteor. Soc., 34.

2. Sherman and Carino, 1953: A Note on Hurricane Able of 1952, Technical Report to Office of Naval Research.

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