THE HURRICANE SEASON OF 1962

GORDON E. DUNN AND STAFF

U.S. Weather Bureau Office, Miami, Fla.

[Manuscript received January 23, 1963]

1. GENERAL SUMMARY

Five tropical cyclones, three of hurricane intensity, were noted in Atlantic waters during 1962. This number is the smallest since 1939. Also, 1962 had the smallest number of hurricane hours in the past 30 years, with one exception, 1946. There was no major hurricane, and no tropical cyclone was noted in the Gulf of Mexico or the Caribbean Sea (fig. 1). Development of the first storm began on August 26, the latest date since 1941. Strangely enough the only portion of the United States mainland seriously threatened by a hurricane in 1962 was New England, although eastern North Carolina was briefly threatened (by Ella). All in all this year was the quietest hurricane season in the Atlantic area in several decades.

As far as known, no winds of full hurricane force were experienced on the mainland of the United States. Consequently damage and casualties were the lowest in many years amounting to four fatalities, six injuries, and approximately $2,000,000 damage (table 1).

One can only conjecture concerning the reasons for the weak tropical activity in the Atlantic during the summer and fall of 1962. In the general circulation, westerlies averaged well south of their normal position and blocking was unusually strong. It was a cool summer and early fall over most of the northern and central United States. Statistics on the sea surface temperature anomalies are not available to the writer. In all but one of the tropical cyclone cases this year, the perturbation in which the storm eventually developed could be traced back to the intertropical convergence zone (ITC), an unusual circumstance in the Atlantic area. Most of the storms appeared to develop downward in one way or another from an upper-level vortex and to have had considerable difficulty in transforming from a cold core to a warm core system. No tropical cyclone at any time possessed the moderate or small sized eye, the well developed wall cloud, and the typical concentrated organization of the classical hurricane. The unique requirements—which are not yet known—for major hurricane development were apparently never met in the Atlantic area in 1962.

Because of the lack of hurricanes, the contribution of the weather satellites in detecting and tracking was less spectacular in 1962 than in 1961. On numerous occasions cloud masses in the tropical areas of the Northern Hemisphere were photographed and it became apparent they could be associated with an upper vortex or trough (fig. 2), a weak perturbation on the ITC (fig. 3), or a fully developed hurricane (fig. 4). Characteristically different cloud patterns appear to be associated with each. Since both the upper vortex and the ITC perturbation may gradually transform into tropical cyclones, the associated cloud pattern may also gradually change from one type to another. Additional experience must be gained in order to classify some of the situations with a high degree of accuracy.

Although the synoptic situation over the Atlantic and the United States was mildly favorable, according to Ballenzweig [1], there was no tropical activity in June. Over the United States the month was generally cool with the maximum negative temperature anomaly centered in the southern Plains and the West Gulf States. The

TABLE 1.—*Casualty and damage statistics, North Atlantic tropical cyclones, 1962*

Cyclone	Intensity	Date	Damage (estimated)	Casualties		Principal areas affected
				Deaths	Injuries	
Alma	Hurricane	Aug. 26–Sept. 2	$35,000 North Carolina <$1,000,000 New England.	0	1 Mass	North Carolina, New England.
Becky	Storm	Aug. 27–Sept. 1				Remained over ocean.
Celia	Storm	Sept. 12–21				Remained over ocean.
Daisy	Hurricane	Sept. 29–Oct. 8	$1,100,000 New England Considerable Nova Scotia	1 1	4 Maine, 1 Mass	New England, Canadian Maritime Provinces.
Ella	Hurricane	Oct. 14–23	Some beach erosion South Atlantic coast.	2	0 S.C.	Center remained well off South Atlantic coast but minor effects there.

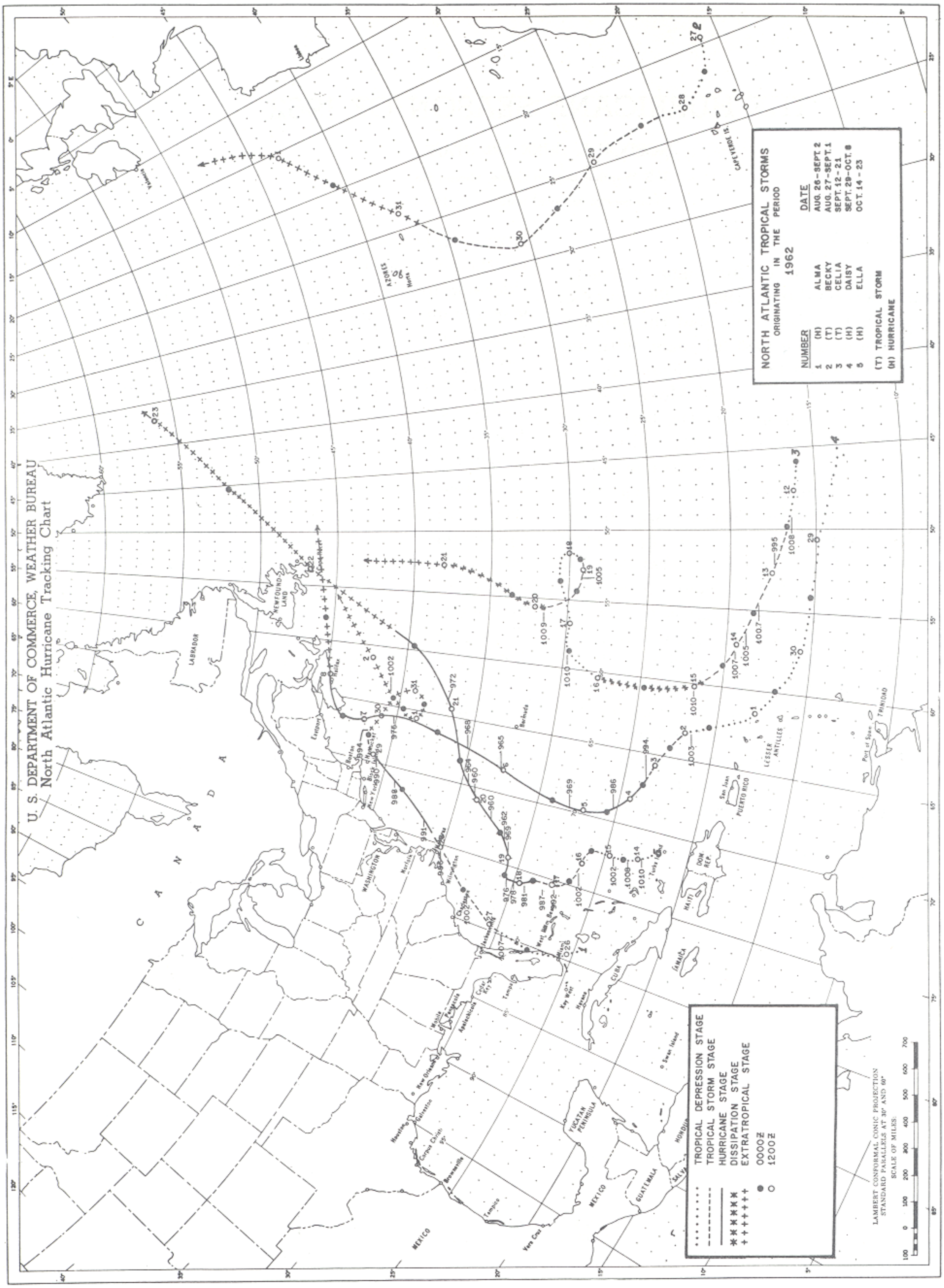
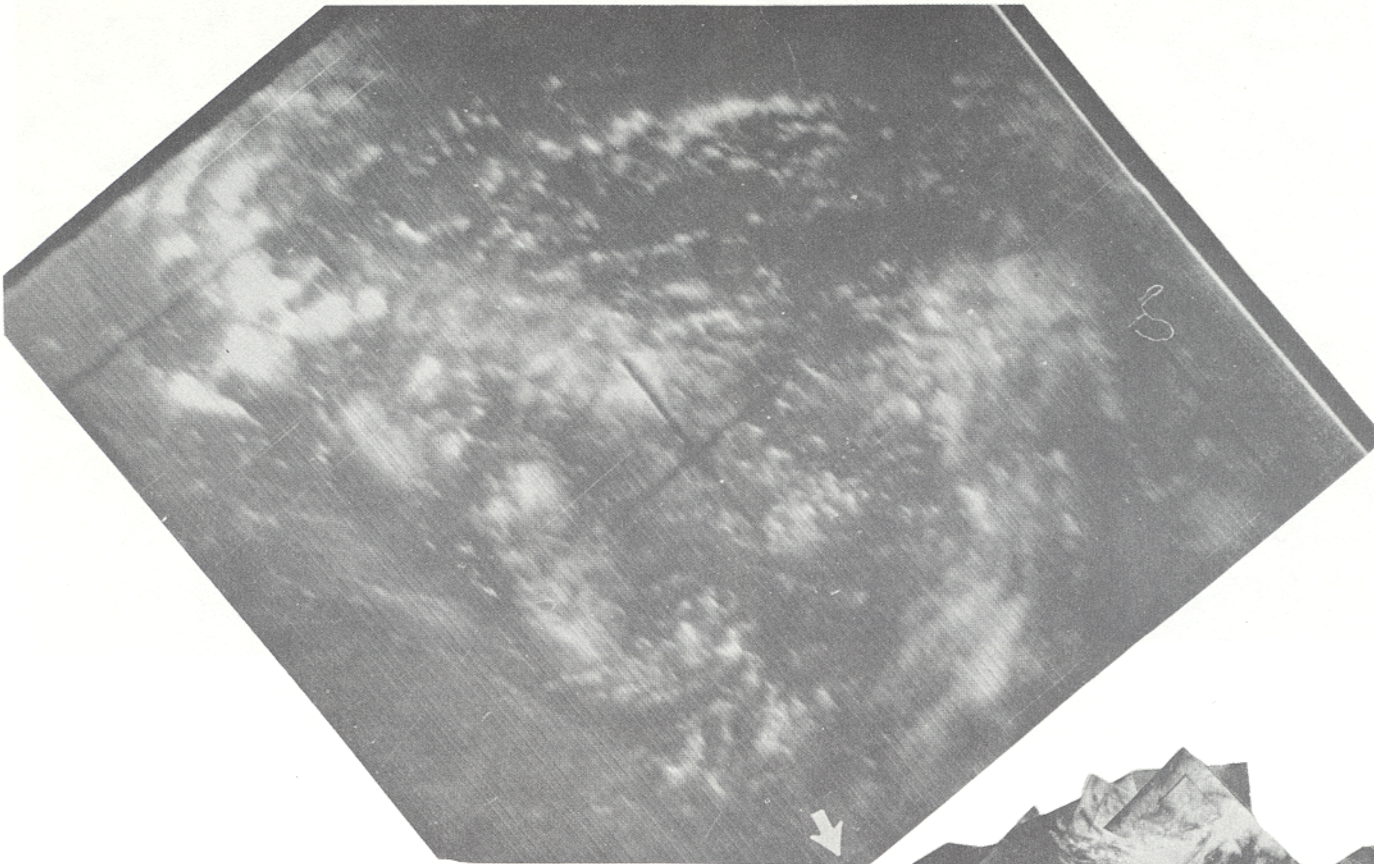
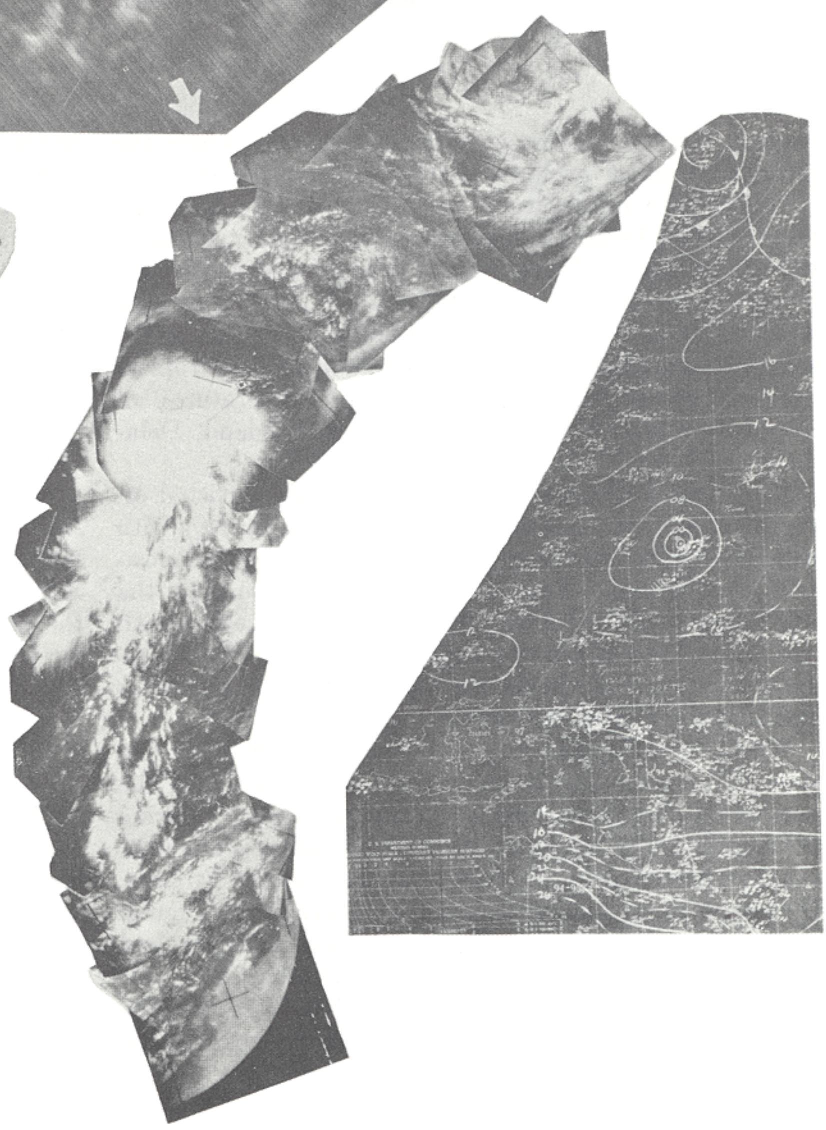


FIGURE 1.—North Atlantic tropical storms, 1962.

FIGURE 2.—Example of type of cloud mass associated with an upper-level trough as seen by TIROS (upper individual frame). In this case the clouds were associated with a sharp 200-mb. trough north of typhoon Ruth on August 15, 1962, when Ruth was near 18° N., 146° E. One cloud line appears to curve anticyclonically toward typhoon Ruth (to the south) and another anticyclonically toward the frontal system to the north (see map).




WEAK VORTEX
42°N 162°E
180°
40°N
18°N
CLR
VORTEX
18°N 146°E
WELL
DEVELOPED
CIRCULATION
CELLULAR
AUSTRALIA
NEW GUINEA
VSBL
15-6
130°E
20°S


0400
15 AUG 62
812 % 811
±1°
WAL 0720Z.

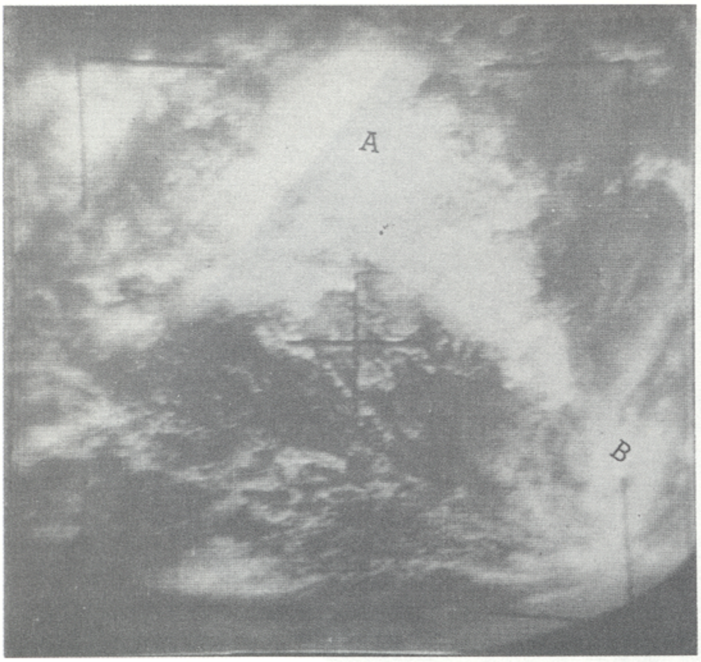


Figure 3.—Example of two somewhat different types of cloud masses (A and B) associated with "disturbances" on the intertropical convergence zone. This photo taken by TIROS V about 1630 GMT September 22, 1962.

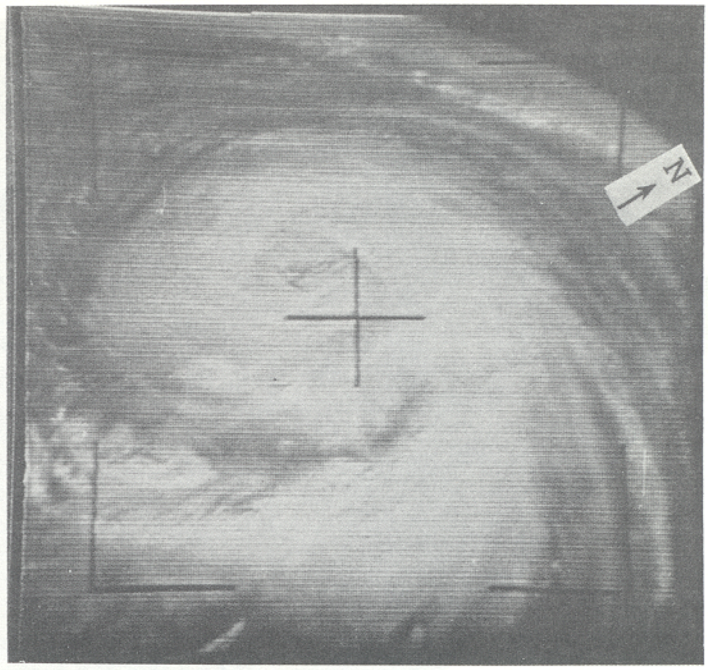


Figure 4.—Satellite photograph of a fully developed hurricane. TIROS V photo of hurricane Daisy at 1245 GMT October 5, 1962, when Daisy was at 27.3° N., 69.9° W.

western Gulf of Mexico is normally the area where the principal tropical cyclone activity takes place in June.

In July the mid-latitude westerlies were weaker than normal and displaced southward [2]. Strong blocking was centered in the Davis Strait. The greatest southward displacement of the primary axis of maximum west wind at 700 mb. in the Northern Hemisphere was in the southwestern Atlantic—the area where most July tropical cyclones develop. The coolest July temperatures of record were reported at stations in New England, Delaware, and Iowa.

In August a stronger than normal trough persisted off the Atlantic coast, especially during the first 15 days with westerly winds extending far south of their normal position at 700 mb. This trough, and consequently the westerlies, weakened during the latter half of the month and weak tropical activity began at the end. Temperatures were generally below normal over the northern two-thirds of the United States [3].

While four tropical cyclones were in progress at one time or another during September, which is about the normal number, none reached hurricane intensity during the month. The axis of strongest westerlies was about 5° south of normal from the Great Lakes across the Atlantic. O'Connor [4], in commenting on the weather and circulation of September, said: "In the western Atlantic and Caribbean areas the scarcity of tropical Lows this year was associated with westerlies south of normal over the United States and the Atlantic, accompanying blocking in Canada and Greenland. In these circumstances, subtropical easterlies, which are believed to be favorable for vortex motion, remained underdeveloped. However, late in the month, a much stronger than normal High developed in the central Atlantic accompanied by stronger than normal easterlies to the south. It was in this regime that Daisy formed, later developing into a hurricane during October." Temperatures continued well below normal over the northern and central portions of the United States east of the Continental Divide.

In October deeper than normal troughs extended from north to south along the east coast of North America resulting in the displacement of the westerlies southward of normal across North America and the extreme western Atlantic. However, over the middle and eastern Atlantic the subtropical High was a little stronger and slightly farther north than normal [5]. Two tropical cyclones, which is about normal, were in progress during the month.

2. INDIVIDUAL TROPICAL CYCLONES

Hurricane Alma, August 26–September 2.—A possible weak circulation center was first noted in the eastern Atlantic by TIROS V on August 14. Subsequent westward movement at about 10 kt. brought the perturbation to the vicinity of 12.5° N., 51° W. on August 18 where Weather Bureau research aircraft, on a routine flight to the Cape Verdes, located a weak center. Crossing the Windward Islands during August 20, the circulation moved west-northwestward at 10 kt. and was again located by Weather Bureau reconnaissance aircraft near 21° N., 69° W. on August 22.

Gradually recurving, the Low moved across eastern Cuba on August 24 remaining weak and unorganized. On the morning of August 26, slow development began between the Florida east coast and the western Bahamas, with the depression moving on a course which kept it a short distance off the United States east coast until August 29. As deepening continued, the first advisory was issued on August 27 when Alma was about 150 mi. east of the Georgia coast. Hurricane Alma reached maximum intensity August 28 north of the Virginia Capes but was classified as a hurricane for only 12 hours. No well defined eye with wall cloud development was ever observed and radar tracking was difficult.

Blocking over eastern Canada prevented complete recurvature into the westerlies. During the period August 30 through September 1, Alma drifted on a clockwise loop 200–300 mi. east-southeast of Cape Cod and slowly filled. On September 2 Alma accelerated northeastward and was absorbed by an active trough in the westerlies.

The weak circulation which persisted from approximately August 14 until August 26 underwent remarkably little change in size and intensity during this long period. (The distance traveled during this stage was 3,000 mi.) The forward speed remained quite constant at approximately 10 kt.

At both the surface and 500 mb. the situation was rather static throughout the period. At 200 mb. a possible contributing cause of the eventual intensification was noted. On August 22–23 an anticyclone at 200 mb. was moving through the Lesser Antilles some 600 mi. to the east of the surface disturbance. Both systems moved at about 10 kt. through August 24 maintaining about the same distance between them (fig. 5). During the period August 24–26 the anticyclone accelerated to about 17.5 kt. with the surface Low continuing at 10 kt. Development began when the upper High reached a position within 200 mi. of the surface system. Apparently surface deepening began to influence the upper anticyclone as well, since there was considerable intensification of it on the 26th. On August 27–28 Alma began to develop its own upper anticylone. A well developed upper High noted on the 28th just east of the tropical cyclone definitely was not the one which had been previously tracked. It is not maintained that this is the complete explanation of the development of the tropical cyclone but it may have been an important contributing factor.

Damage along the east coast was comparatively minor with no fatalities and only one injury. On the North Carolina Capes, Nags Head reported gusts to 53 m.p.h. and Hatteras 48 m.p.h. Tides in general were about 2 ft. above normal in the Hatteras-Norfolk area but up to 3 ft. at Nags Head. Beach erosion was slight. Over 8 in. of rain fell at Cape Hatteras on August 27–28.

After moving northeastward from the Capes, the storm increased in intensity and during the afternoon of the 28th, aircraft reconnaissance reported a sustained wind speed of 92 m.p.h. Alma began to weaken to tropical storm strength at about the time the center passed some 60 mi. to the east of Nantucket. Coastal areas of Massachusetts and Rhode Island were buffeted by northerly gales gusting to 60 m.p.h. Tides were generally less than 2 ft. above normal and there was little flooding of lowlands and shore roads. However, huge waves pounded exposed coastal installations inflicting widespread but mostly minor damage. Damage also resulted from wind and wave action. More than 100 small pleasure craft were sunk along the Massachusetts coast [6]. Total damage was estimated at less than $1,000,000 along the New England coast and $35,000 to crops and property in North Carolina. Benefits to agriculture and water supplies in the drought areas of New England more than offset property damage inflicted by the storm [7].

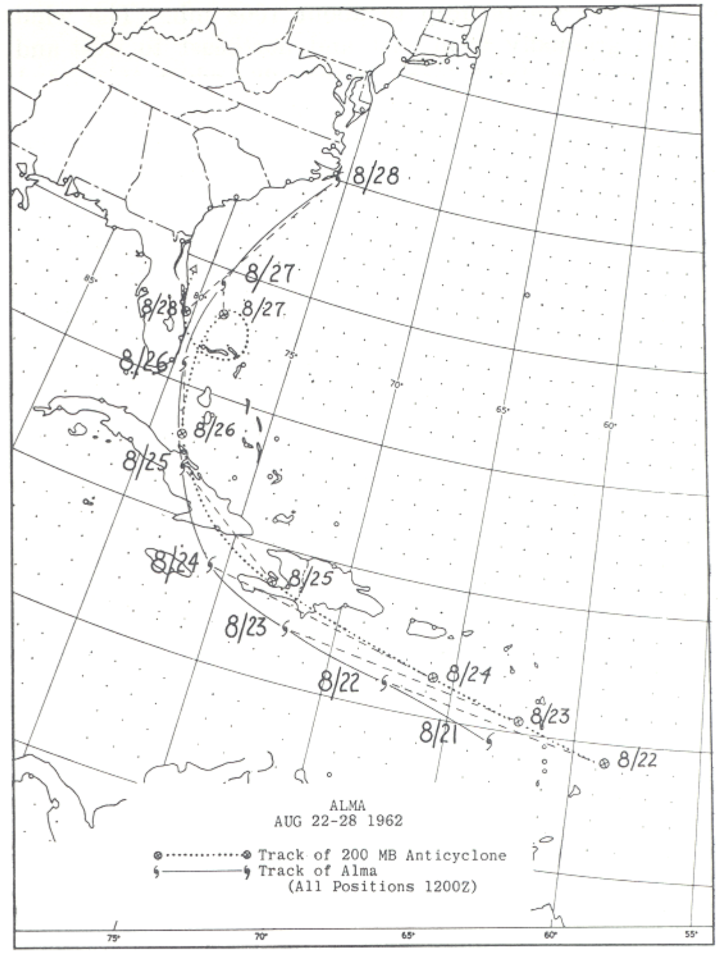


Figure 5.—Track of hurricane Alma (solid line) and of an anticyclone at the 200-mb. level (dotted line) August 22–28, 1962.

Tropical Storm Becky, August 27–September 1.—The first indication of Becky in the eastern Atlantic Ocean was an increase in cloudiness and showers in the Cape Verde Islands beginning at 1200 GMT, August 27. The bad weather lasted about 30 hr. and was accompanied by a surface pressure drop to about 1008 mb. The wind backed gradually from east and northeast to west and southwest by 1800 GMT, August 28, which suggested that a Low had moved northward east of the Islands.

Cloud pictures from the TIROS satellite on August 29, 1106 GMT, confirmed an area of weather with a possible vortex near 25° N., 25° W. Even though it is difficult to infer flow patterns from the TIROS data in the early stages of tropical cyclone development, once a well developed tropical cyclone appears, past experience suggests cloud patterns take on definite characteristics. The TIROS picture on the 29th had all the characteristics of a tropical storm.

Further verification was received 24 hr. later from a ship reporting NE winds force 9 (45 kt.) and rough seas near 30.7° N., 29.2° W. On the basis of this information, the U.S. Fleet Weather Central at Port Lyautey issued an advisory at 1730 GMT. The Weather Bureau does not normally issue advisories for Atlantic storms east of longitude 35° W. but arrangements have been made with military forecasting offices having responsibility in this area to use names from the official list of tropical cyclone names.

The first of two reconnaissance flights was made on the 31st when an eye fix at 1845 GMT located the storm at 39.1° N., 21.8° W. At this time there was no evidence of a warm center since the 500-mb. temperature was −10° C. The normal increase in temperature within the eye also was not indicated and the pilot added the remark that the storm showed no tropical characteristics. There is little doubt that the storm was extratropical at this time. A second flight on the next day did not even find a circulation at 500 mb.

The track of the storm followed nicely the steering current as indicated by the 500-mb. chart. The main feature at 500 mb. was a quasi-stationary cut-off Low south of the Azores on the 27th which later came in phase with a strong trough in the westerlies. This resulted in a large-amplitude trough between longitudes 25° W. and 30° W. which steered Becky on a generally northward and northeastward course.

Climatologically speaking this storm followed a very rare track. Indeed, this is the farthest east an observed storm has ever moved north in the period extending back to 1886. Only four other tropical cyclones which originated near the Cape Verde Islands have moved on a northward course east of longitude 35° W., and of these only one could be tracked northward to the latitude of the Azores. The other three eventually turned westward south of 35° N. However, it is likely that some tropical cyclones in this area have gone unobserved. At the hurricane seminar in Santo Domingo in 1956, representatives from the French Meteorological Center at Dakar displayed observational data of a year or two before indicating a fully developed hurricane moving on a track similar to that of Becky. It is not uncommon for troughs and occasionally cyclonic vortices to move westward off the African coast. The question is how many of these turn northward into the westerlies while remaining essentially cold? The answer to this is unknown; therefore, little can be said about the frequency of such occurrences which might help shed some light on the probability that Becky was cold or warm core.

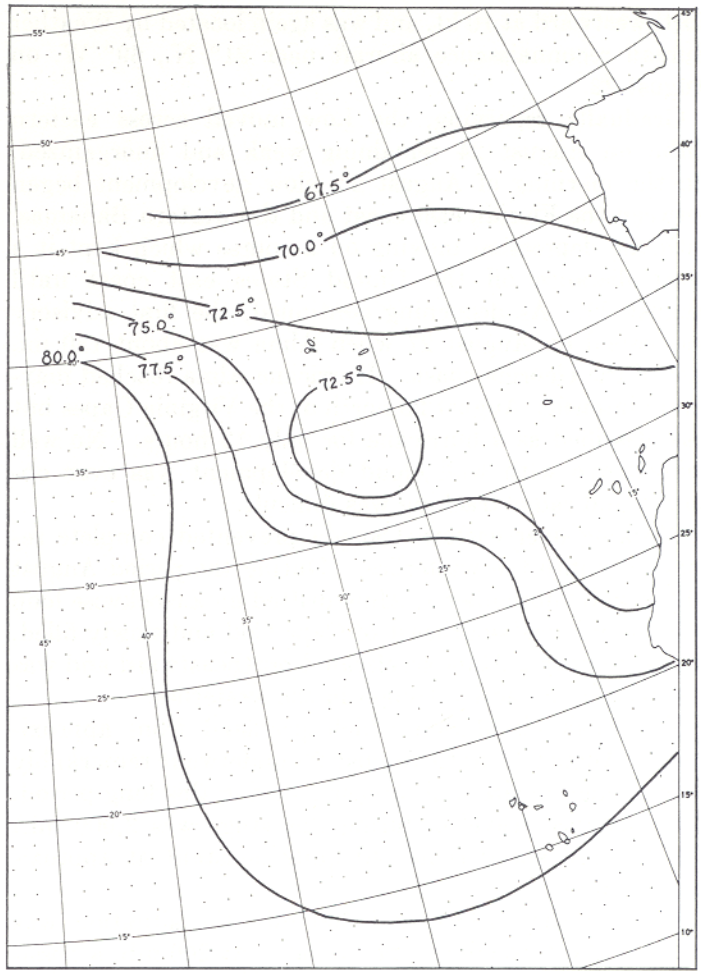


Figure 6.—Reported sea surface temperatures, August 27–31, 1962, while tropical storm Becky was moving on the track shown in figure 7.

Cool water temperatures along the African coast are cited as the greatest deterrent to tropical storms in this area. The mean August isotherms of sea temperature show temperatures well below 79° F. (the threshold value cited by Palmén [8] as necessary for tropical storm development) over all the area from the African coast westward to longitude 40° W. and north of the Cape Verde Islands. The water temperatures were checked for Becky by compositing four days of ship reports on one map. The resulting isotherms are shown on figure 6. Even though data in the immediate area of suspected formation are sparse, they suggest a large area of water temperatures above 78° F. along the early portion of the track. This is warm enough to support a tropical storm. Figure 7, the anomaly of sea temperature from the mean August values, shows a positive area of 2.5 ° F. near the point where the storm apparently reached maximum in-

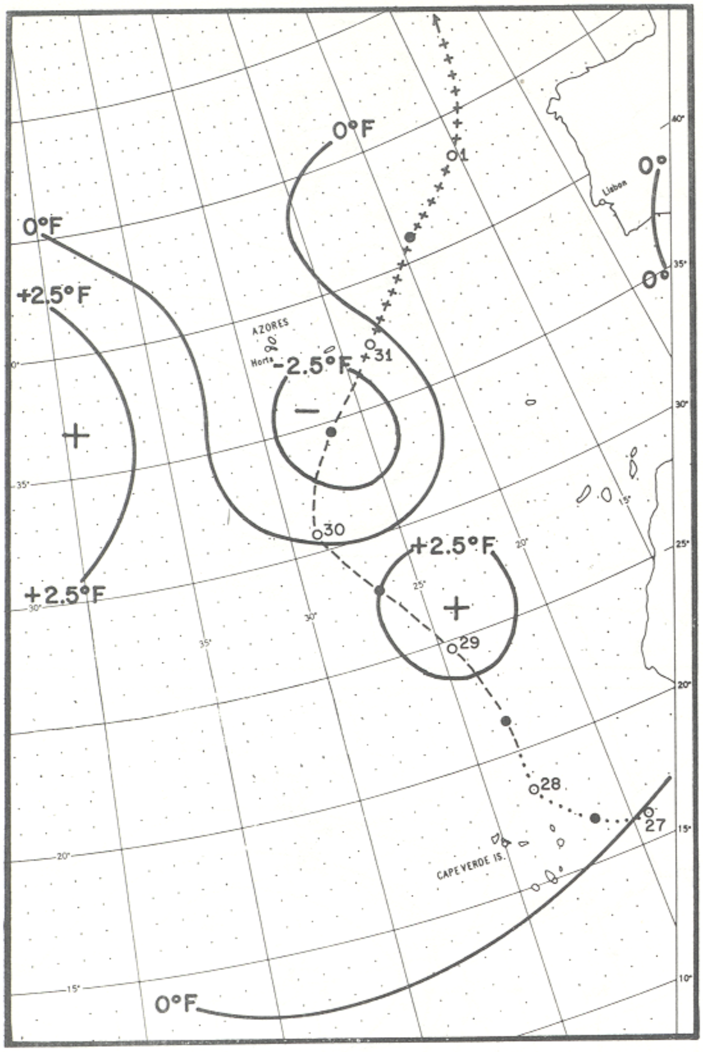


FIGURE 7.—Anomaly of sea surface temperature during period of existence of tropical storm Becky shown by track.

tensity. It is also interesting to note the negative anomaly south of the Azores which may have accounted for the rapid weakening.

Becky probably developed from a disturbance moving out of Africa. It may have reached tropical storm intensity and possessed a warm core for about 48 hr. extending from August 29, 0000 GMT to August 31, 0000 GMT. Once the storm moved over the cool waters south of the Azores, weakening followed and the extratropical stage was reached.

Tropical Storm Celia, September 12–21, 1962.—Tropical storm Celia formed in an easterly wave in the tropical Atlantic on September 12, 1962. A photograph from the weather satellite TIROS V showed an unorganized cloud mass near 12° N., 40° W. at 0000 GMT, September 11, which was probably the storm in an early depression stage.

The first indication of development was an observation from the ship *Mormacbay* at 18.4° N., 50.7° W. which reported an east wind of 35 kt., pressure 1014.9 mb., and an easterly swell of 13 ft. at 1200 GMT, September 12. As the *Mormacbay* continued southeastward, its pressure fell rapidly and at 2100 GMT on the 12th it reported a pressure of 1007.8 mb. with an east wind of 60 kt.

A TIROS V photograph on September 12 showed a definite circulatory pattern with spiral bands centered near 17.0° N., 47.5° W. Navy reconnaissance aircraft reached the storm area the evening of September 12, but did not obtain a good eye fix due to darkness and because radar coverage was not feasible.

The first advisory on Tropical Storm Celia, issued by the San Juan Weather Bureau Office at 0000 GMT, September 13, located the storm near 16.4° N., 48.6° W. with winds near the center estimated to be 55 to 60 m.p.h. A hurricane watch was issued for the northern Leeward Islands at 1600 GMT September 13.

Navy reconnaissance located the eye of Celia at 1000 GMT, September 13, near 17.4° N., 52.5° W. The eye was poorly defined, maximum winds were 45 kt., and minimum sea level pressure was 995 mb. by dropsonde. This was the lowest pressure ever measured during the life cycle of Celia.

On the 14th the storm began to take a more northwestward course and appeared to be very poorly organized. In fact, Navy reconnaissance late on the 14th reported that the associated weather no longer resembled a tropical cyclone. The hurricane watch for the northern Leewards was discontinued at 1600 GMT, September 14. Reconnaissance early on the 15th confirmed that the storm was no longer in evidence and the last advisory on Celia was issued by the Miami Weather Bureau Office at 1600 GMT, September 15.

The storm had moved underneath the eastern side of a trough in the westerlies at middle and upper tropospheric levels. At the surface there was a marked absence of any significant easterly gradient winds over a large area to the north and northwest of the storm. These factors no doubt contributed to the degeneration of Celia in an area climatologically favorable for development.

Celia was not in evidence from data on surface weather charts from the time of the last advisory until late on September 17 when it became apparent that there was a weak surface circulation well to the southeast of Bermuda. This no doubt was the remains of Celia and it apparently was reintensifying slightly. Surface ship reports in the area indicate that Celia probably regained tropical storm intensity for about 24 hr. around September 19 before turning northward and becoming extratropical. During this period of regeneration it apparently made a loop in the area some 600 mi. east-southeast of Bermuda.

A reconnaissance flight from Bermuda investigated the area early on the 20th and reported lowest pressure 1009.0 mb. with maximum winds 28 kt.

Hurricane Daisy, September 29–October 8.—It was nearly a week after the discovery of a weak circulation that Daisy reached hurricane intensity. On September 28 ship reports and a TIROS satellite picture indicated a circulation well to the east of the Antilles. The next day reconnaissance aircraft located a tropical depression near 15° N., 52° W. The core of this circulation was cold and remained so for several days.

The depression moved toward the west-northwest, turned northward on October 1, reached storm intensity on the 2d, and hurricane force on the 3d.

During its early history, the depression appeared to be located under minor vortices in the upper troposphere located in a rather strong east-west trough in the vicinity of latitude 20° N. By October 3 the upper tropospheric trough had nearly dissipated and the surface depression began to move away from the principal upper vortex which now had moved into the western Caribbean. The main intensification occurred from October 3 to October 5. By 1200 GMT October 4, the characteristic High over and to the right of the surface vortex had appeared and was very well developed by 1200 GMT on the 5th. However, it would appear that as in Ella, the anticyclonic development was simultaneous with or even subsequent to deepening and certainly did not precede intensification.

At 500 mb. in the several days prior to deepening, the closed circulation over the surface disturbance tended to move northwestward between two anticyclonic cells, one centered over the Bahamas and the other east of Bermuda. Deepening began as strong height rises at 500 mb. moved past the storm well to the north. Data directly over the cyclone are scarce, but there is some evidence that the transformation from cold core to warm core was very slow (as was true of most of the 1962 tropical cyclones) and major intensification did not take place until after a small and weak warm core had appeared.

The hurricane passed well west of Bermuda on the 6th and the lowest central pressure, 965 mb., was reported at that time with winds of about 100 m.p.h. Cold air began feeding into the circulation October 7. It reached land near Yarmouth, Nova Scotia, late that day and turned sharply eastward. Yarmouth reported 977 mb. as the weakening center passed there.

The combined impact in New England of a "northeaster" on the 5th and 6th and tropical storm Daisy on the 6th and 7th produced widespread and heavy damage. Casualties included two fatalities and five injuries. Heaviest rainfall yields were produced by the coastal storm while Daisy's contribution intensified and prolonged the floods. Rain fell almost continuously for 65 hours [9]. Areas that received more than 4 in. with flood damage included the eastern half of southern New England, eastern Vermont, New Hampshire except for the extreme northern parts, and southwestern Maine. Within the limits of these areas, amounts gradually increased to a record or near fall of 10 to 12 in. in Middlesex and Essex Counties, Mass.

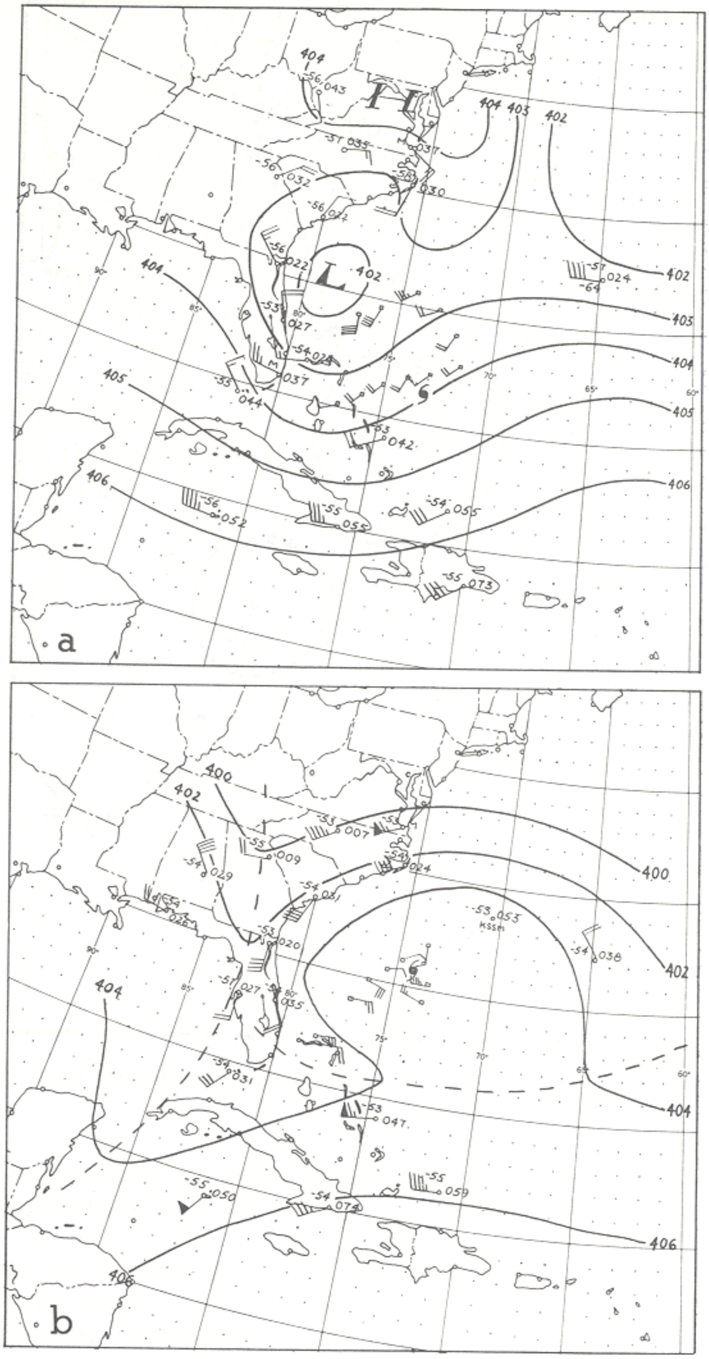


Figure 8.—200-mb. charts for (a) 1200 GMT October 16 and (b) 1200 GMT October 19, 1962 during development stages of hurricane Ella. (Aircraft data at approximately 40,000 ft.)

Highest winds were experienced over the coastal areas of Maine, especially the central sections where speeds of 60 to more than 70 m.p.h. were reported. Coastal installations were hammered by giant waves. Lobster fishermen suffered heavy losses and hundreds of small boats were ripped from their moorings and sunk or damaged. Acre-size Mt. Desert Rock, 22 mi. offshore from Southwest Harbor, Maine, was pounded and washed by mountainous waves, some of which reportedly reached elevations 50 ft. above sea level. Damage was said to be the heaviest in the 115-yr. history of the Coast Guard Base there.

Estimates indicate damage from the combined storms (coastal storm immediately preceding Daisy and Daisy) may have reached $10,000,000. Estimates of damage attributed directly to Daisy were $600,000 from surf and waves, mostly in Maine, and about $500,000 frcm wind for all of New England. Damage was also considerable in Nova Scotia.

Hurricane Ella, October 14–23.—The depression which was to grow into hurricane Ella developed in the southeastern Bahamas on October 14. Ships and islands near and to the north of the circulation center reported winds of 20 to 30 kt. on that date. The only prior indication of a disturbance was an area of increasing cloudiness and shower activity centered about 200 mi. northeast of Turks Island on the 13th. This area coincided with the northern portion of a weak 500-mb. Low which had become cut off at the base of a polar trough and was drifting slowly west-northwestward. The surface charts on the 13th showed a rather weak gradient with general easterly flow and a minor inverted trough with cyclonic curvature and shear in the vicinity of the unsettled weather.

The depression drifted toward the north, then west-northwestward, and gradually intensified. It attained tropical storm force on the 15th, but remained poorly organized. A turn to the north-northwest occurred on the 17th and Ella reached hurricane intensity about noon on that date. Intermittent gales and heavy seas affected the central and northern Bahamas but the hurricane-force winds were well to the north of the islands.

During the development stages of Ella, a marked upper-tropospheric trough in the westerlies extended from the Canadian Maritime Provinces to the western Bahamas. The 200-mb. analysis indicates that the initial deepening occurred under the east side of this upper trough. Data are too sparse to permit positive conclusions, but the wind field at this level was apparently divergent. It has been recognized that divergent flow at high levels is necessary for dispersion and air rising through a hurricane but some doubts have existed whether the often noted upper-tropospheric High is instrumental in the development, or merely the consequence of the formation and maintenance, of the storm. The 200-mb. chart for 1200 GMT on the 16th and another 72 hr. later are shown in figure 8. In this case it was possible to observe the gradual development of an anticyclonic pattern with a well-defined High (composed of a number of anticyclonic eddies) appearing over the storm at the 200-mb. level at about the time it reached hurricane intensity.

There is little doubt that in this instance the cyclogenesis began under a cold trough and that the upper-tropospheric anticyclonic pattern developed during or subsequent to the surface intensification.

On October 18, Ella continued toward the north-northwest with gradual deepening. Central pressure dropped to 976 mb. and maximum winds were reported as 80 kt. A ship 90 mi. southeast of the center reported heavy confused seas ranging up to 40 to 45 ft. The hurricane came under the influence of a short-wave trough passing to the north on the 19th and changed course first to the east, then to the northeast, accelerating from about 5 kt. to 12 to 15 kt. Some further intensification occurred with a minimum pressure of 960 mb. and maximum winds of about 90 kt. on the 20th. A gradual rise in central pressure followed, accompanied by a slow decrease in maximum winds and a spread of the gale area as Ella moved northeastward more rapidly on the 21st and 22d of October. However, by the evening of the 21st, her broad circulation pattern had begun to merge with that of a developing frontal wave moving through Nova Scotia with a resultant gradual loss of tropical characteristics.

An interesting feature of Ella was an unusually large eye. The diameter was reported as 25 mi. on the 16th, 40 to 60 mi. on the 19th, and 100 mi. on the 21st. Relatively cool, dry air covered the Atlantic coast while the hurricane was offshore but it was apparently unable to penetrate beyond the outer fringes of the storm and no marked weakening occurred until the center moved over colder water and the cyclone began to combine with the extratropical wave near Nova Scotia.

Property damage associated with Ella was minor, consisting mostly of beach erosion along the middle Atlantic coast. Two fisherman apparently lost their lives in the fringes of the hurricane during its closest approach to the coast. The men set out from near Charleston, S.C., on October 18 in a 14-ft. outboard motor boat. They were never found despite an intensive air and sea search.

REFERENCES

1. E. M. Ballenzweig, "Relation of Long Period Circulation Anomalies to Tropical Storm Formation and Motion," *Journal of Meteorology*, vol. 16, No. 2, Apr. 1959, pp. 121–139.
2. J. F. Andrews, "The Weather and Circulation of July 1962," *Monthly Weather Review*, vol. 90, No. 10, Oct. 1962, pp. 443–450.
3. L. P. Stark, "The Weather and Circulation of August 1962," *Monthly Weather Bureau*, vol. 90. No. 11, Nov. 1962, pp. 483–488.
4. J. F. O'Connor, "The Weather and Circulation of September 1962," *Monthly Weather Review*, vol. 90, No. 12, Dec. 1962, pp. 527–534.
5. R. A. Green, "The Weather and Circulation of October 1962," *Monthly Weather Review*, vol. 91, No. 1, Jan. 1963, pp. 41–46.
6. U.S. Weather Bureau, *Storm Data*, vol. 4, No. 8, Aug. 1962.
7. E. Sable, "Summary of Tropical Storm Alma," U.S. Weather Bureau, Boston, Mass. (unpublished).
8. E. Palmén, "On the Formation and Structure of Tropical Hurricanes" *Geophysica*, No. 3, 1948, pp. 26–38.
9. E. Sable, "Report on Hurricanes Daisy and Ella," U.S. Weather Bureau, Boston, Mass. (unpublished).