THE WEATHER AND CIRCULATION OF OCTOBER 1964

An Unusually Dry Month

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1. THE DROUGHT

October was a pleasant month throughout most of the country with an abnormally large number of days without precipitation. This was favorable for outdoor activities such as construction and harvesting as well as for recreation; however, the continuation of widespread drought caused increased concern in many areas. In the western and northern Plains, and in the middle and upper Mississippi and Ohio Valleys, the germination or survival of late seedings was imperiled. Pastures were very poor in many sections resulting in premature liquidation and winter feeding of meat and dairy herds. In parts of the Northeast water supplies were dwindling or exhausted, and hauling of water for livestock was frequent, while forest fire danger was high and increasing.

In some cities, as shown in table 1, October 1964 (fig. 1) was not only the driest of any October on record, but was also the driest of any month in records dating back in some cases as far as 1871.

At other cities, notably Toledo, Ohio (0.28 in.), and Seattle, Wash. (1.00 in.), it was the driest October on record. It was the 7th consecutive month of below normal precipitation at Denver, Colo., and the 6th at Reading, Pa., and Worcester, Mass. At many other cities from coast to coast October 1964 was the second to the fifth driest on record. At many of those, including Dubuque, Iowa, and Aberdeen, S. Dak., both of which reported only a trace of precipitation for the month (compared with normals of 2.74 in. and 1.19 in. respectively), it was the driest October since October 1952, which was the driest month ever recorded in the combined 48 States [1]. Even in some areas of above normal precipitation, notably parts of Texas, most of the rain fell on only 2 or 3 days, which was below the usual frequency in October.

Even before this month, the drought was already of long standing, extending back to another dry October in 1963 [2], and even earlier in some places. In the Northeast, record rainfall deficits from January to October 1964, of as much as 13.64 in. at Albany, N.Y., and 14.46 in. at Pittsfield, Mass., intensified the drought, which began about the fall of 1961, to an extreme not observed since 1909 to 1914, and from Virginia to Pennsylvania since 1930 [3]. From May to October 1964, Washington, D.C. reported a deficit of 12.37 in., while over large areas of Illinois, Indiana, and Ohio, and near the Arkansas, Texas, and Louisiana borders, as well as in parts of Alabama and Georgia, the May–October deficit was near 8 in. In the normally more arid western and northern Plains, deficiencies of 4 to 6 in. accumulated during this period.

TABLE 1.—*Stations for which all-time monthly records for dryness were established or equaled in October 1964*

Station	Precipitation (in.)	
	Total	Departure from normal
Fort Smith, Ark.	Trace	−3.45
Evansville, Ind.*	0.01	−2.56
Fort Wayne, Ind.	0.14	−2.72
Cairo, Ill.	Trace	−2.88
Moline, Ill.	0.01	−2.45
Peoria, Ill.	0.03	−2.50
Burlington, Iowa	0.06	−2.64
Great Falls, Mont.	Trace	−0.73

*Record equaled.

2. THE AVERAGE CIRCULATION

The prevailing circulation during October at 700 mb. is shown in figure 2. Its pattern of height departures from normal (fig. 3) may also be considered a good approximation of the height changes from September. An

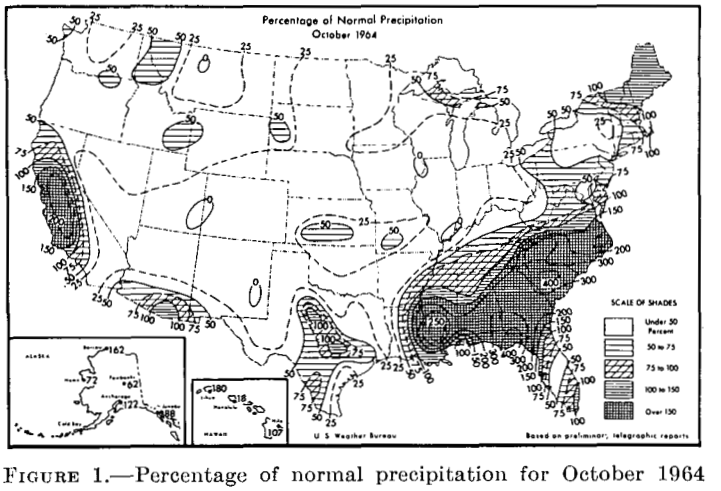

FIGURE 1.—Percentage of normal precipitation for October 1964 (from [5]).

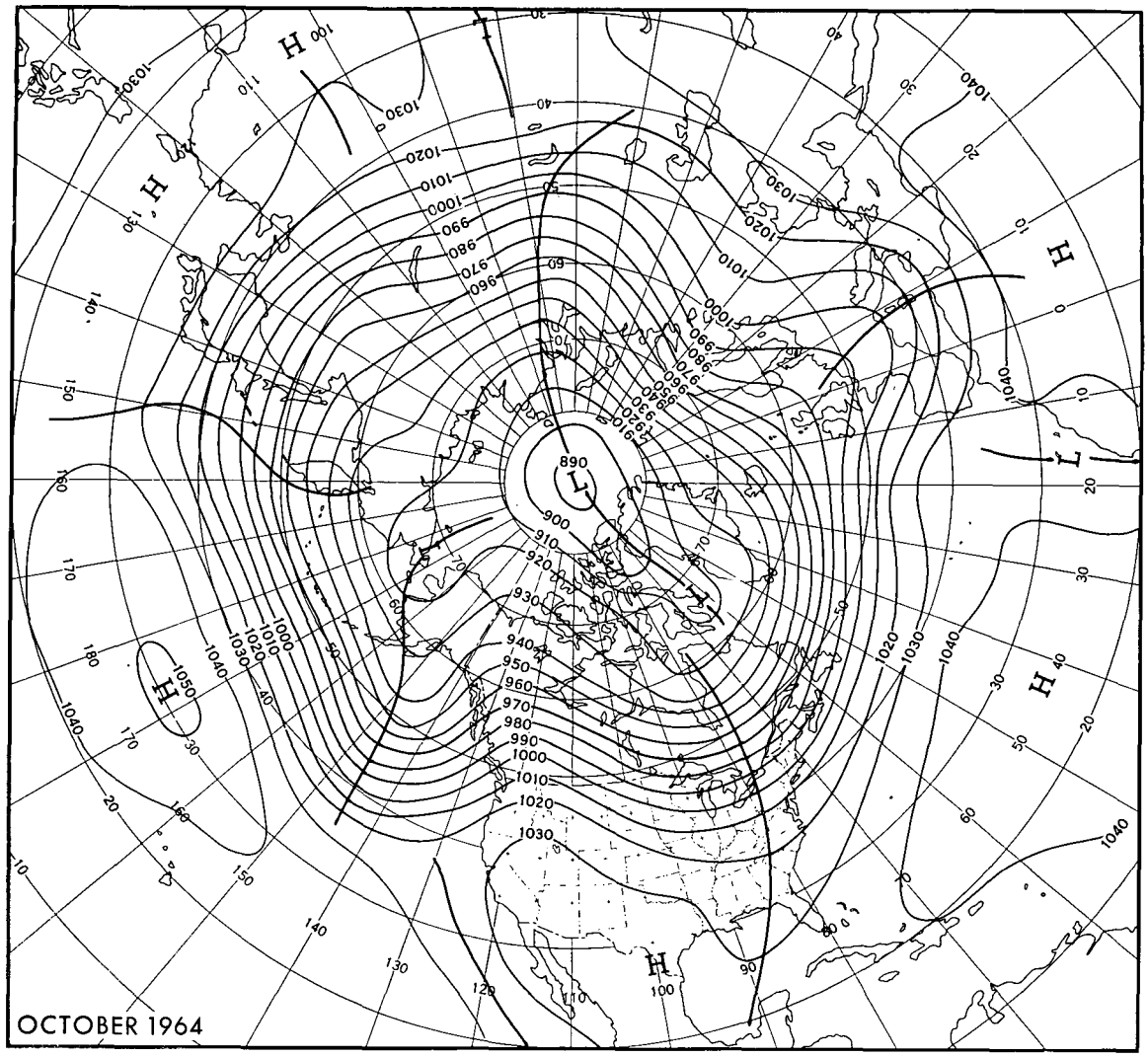

FIGURE 2.—Mean 700-mb. contours (tens of feet) for October 1964.

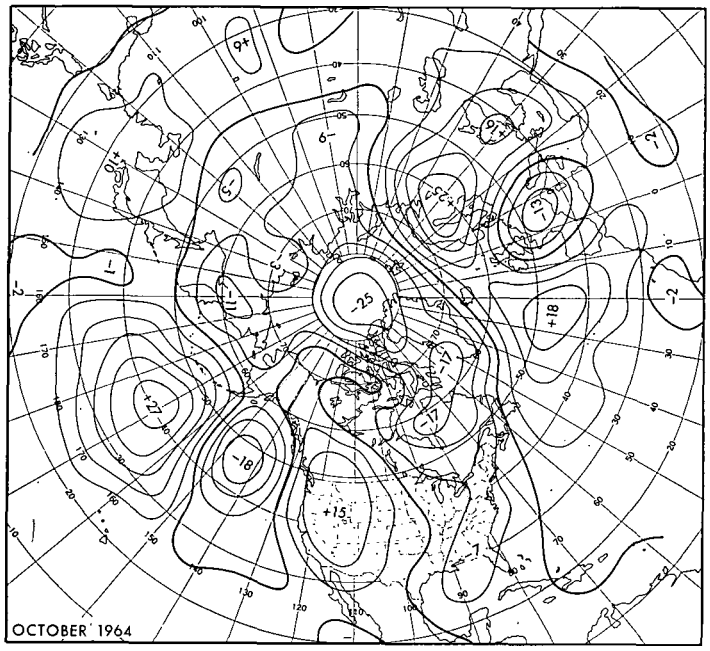

FIGURE 3.—Mean 700-mb. height departure from normal (tens of feet) for October 1964.

important feature of the circulation was the development of a stronger than normal Pacific High accompanied by a shift of the axis of the westerly wind belt north of the normal position (fig. 4), a factor noted by Namias [4] as contributing to large-scale drought in the United States. This was compensated for by a deeper than normal trough in the eastern Pacific as well as by a southward shift of the axis of maximum wind speed. The response downstream over North America was the strengthening of the ridge over the West, and the deepening of a mean trough in the East. Despite this amplification, the average location of the axis of maximum west wind speed (fig. 4) did not shift significantly from its usual location although wind speeds were stronger than normal. However, the pattern of strong positive height anomalies in the West, and negative departures in the East (fig. 3), implied an abnormal geostrophic northerly flow over most of the interior of the country. The northerly flow, thus enhanced, inhibited precipitation and thereby contributed to the drought both by a reduction of available moisture

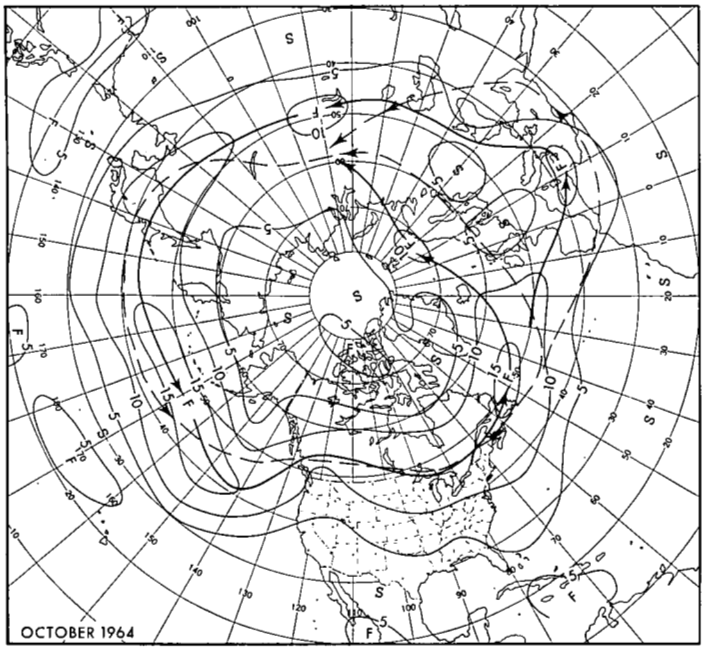

FIGURE 4.—Mean 700-mb. isotachs (meters per second) for October 1964. Axes of observed maximum wind speed are indicated by solid arrows while normal axes for October are dashed.

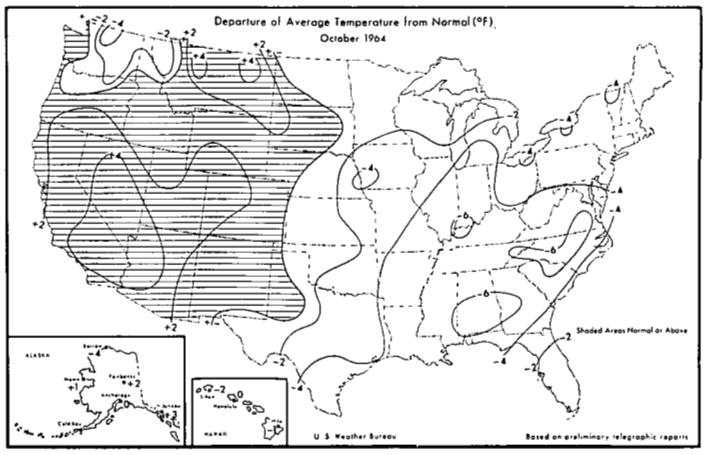

FIGURE 5.—Departure of the average surface temperature from normal (°F.) for October 1964 (from [5]).

from the dry continental air mass source in the north and by the suppression of vertical motions associated with migratory disturbances in the westerlies. This also tended to limit the strength of the relatively few disturbances which crossed the United States from the Pacific, since the principal storm track (not shown) was north of the mean axis of westerlies in the Canadian regions of strongest cyclonic shear.

At sea level, higher than normal pressure dominated the United States during the month, reflecting a variety of cold anticyclones which traversed the East from the Great Lakes to the Gulf Coast, steered by the persistently strong northwesterly current aloft. In Canada, a zone of lower than normal pressure extended from the Yukon southeastward across Hudson Bay along the principal track of cyclonic disturbances during the month.

Over the eastern North Atlantic and northern Europe a merger of positive height anomalies at 700 mb. (fig. 3) cut off a negative anomaly center near the Mediterranean. This was also manifested at sea level in an area of below normal pressures over northern Italy, with greater than normal cyclonic activity.

The strong ridge over northern Russia at 700 mb. together with westerlies north of normal (figs. 2 and 4) helped maintain lower than normal heights over Siberia, although sea level pressures were above normal indicating that temperatures were lower than usual in the low troposphere.

3. PRECIPITATION

The prevalence of enhanced northerly flow between the western ridge and the eastern trough restricted above normal precipitation to peripheral areas of California, southern Arizona, Texas, northern New England, and the Southeastern States (fig. 1). Even in some of those areas the periods of rainfall were less frequent than usual. Nevertheless some accumulations established new records. In the Southeast the remains of two hurricanes, Hilda and Isbell, helped produce the wettest October on record at Florence, S.C., with 8.16 in., and Baton Rouge, La., with 9.46 in. It was the second wettest October at Tallahassee, Fla., with 10.48 in., and at Wilmington, N.C. with 9.81 in., and the fourth wettest October at Jackson, Miss. (7.83 in.) and Charlotte, N.C. (7.20 in.). On a 24-hr. basis, record amounts of 8.38 in. fell at Baton Rouge, La., on October 3–4; 6.97 in. at Jackson, Miss., on October 4; 5.95 in. at Tallahassee, Fla., on October 14–15; 0.87 in. and 0.67 in. at Sacramento, Calif., on October 28 and 29; and 1.12 in. at Idaho Falls, Idaho, on October 29–30.

Except for the rains from Hilda early in the month, most of the heavy rains were associated with upper Lows cut off to the south of the westerlies as described in the weekly chronology in section 5.

4. TEMPERATURE

A strong contrast in temperature anomalies occurred during October between unseasonably mild weather in the western half of the Nation and abnormally cool weather in the eastern half (fig. 5). The warmth in the West was noteworthy because it was the first month since November 1963 that temperatures were above normal in some areas, notably near Yuma, Ariz., and Boise, Idaho. The warmth was related to persistence of the strong ridge aloft, but, except at Las Vegas, Nev., no new records were established for the month as a whole. However, daily maximum temperatures established new records for individual dates in a number of instances. Among these were 92° and 91° F. at Pueblo Colo. on

October 1 and 3, 89° F. at North Platte, Nebr. on October 15, 89° F. at Springfield, Mo. and 95° F. at Midland, Tex. on October 17, and 97° and 95° F. at San Diego, Calif. on October 19 and 20.

In the East, however, it was one of the coldest Octobers on record at a large number of cities including Tampa, Fla., Charlotte, N.C., and Columbia, S.C., where it set new records. At Richmond, Va., Macon, Ga., and Tallahassee, Fla., it was the second coldest October. It was the third coldest at Youngstown, Ohio, and Birmingham, Ala., and the fourth coldest at Corpus Christi and San Antonio, Tex. At a number of other cities it was the coldest October since 1952, which was the most recent October with a similar large-scale circulation pattern of strong northerly flow between a deep trough in the East and a ridge over the Rockies [1].

A very large number of new minimum temperature records were established for individual dates and so early in the season, including multiple new records at some places. The lack of cloudiness associated with the extreme dryness favored greater temperature ranges than usual over large areas, in part the result of excessive nighttime radiation which enhanced minimum temperature anomalies. Some of the daily minimum temperatures were the lowest ever recorded in October. Among those were 18° F. at Toledo, Ohio, on October 11, and on October 12 at Portland, Maine. Notable among cities with multiple record minima between October 5 and 24 were Toledo, Ohio, with new records on 9 days, Evansville, Ind., on 8 days, and Burlington, Vt., on 7 days. Other cities with new minimum records on as many as 5 days were Lansing, Mich., Cleveland, Ohio, Raleigh, N.C., Pittsburgh, Pa., and Madison, Wis.

5. WEEKLY EVOLUTION

WEATHER OF OCTOBER 1–4

The circulation and weather for the week ending October 4 are shown in figure 6. Heavy precipitation fell from the lower Mississippi Valley to the Atlantic Coast in advance of a deepening trough and strong cold front which ended unseasonably warm weather east of the Rockies. The south-of-normal westerlies swept hurricane Hilda from the Louisiana coast on October 3 across northern Florida on October 5 and produced rains exceeding 10 in. in parts of southeastern Louisiana and southern Mississippi. Of the several tornadoes which occurred in connection with Hilda, the most destructive, at Larose, La., on the morning of October 3, left 21 dead and many injured. Many streams flooded in the Southeast, especially the Pearl Basin in Mississippi and the French Broad Basin in western North Carolina.

WEATHER OF OCTOBER 5–11

A deep trough, associated with abnormally cold weather, prevailed east of the Rockies during this period, whereas it was mild in the West under a strong upper ridge (fig. 7).

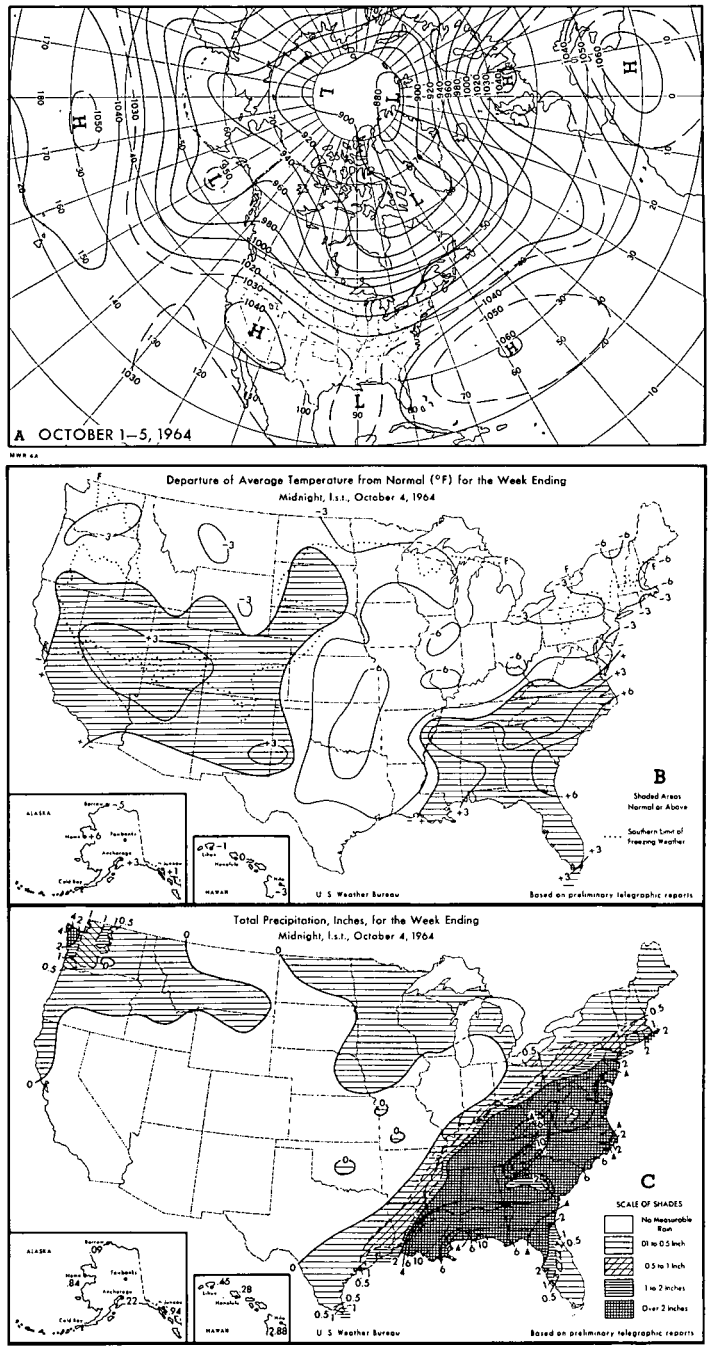

FIGURE 6.—(A) Mean 700-mb. contours (tens of feet) for October 1–5, 1964; (B) Departures of average temperature from normal (°F.) and, (C) Total precipitation (in.). (B) and (C) for week ending October 4, 1964, are from [5].

Precipitation was relatively light over most of the country, as a result of the prevalence of more northerly flow than usual, except in the Southeast on the 5th when the remains of Hilda prolonged the heavy precipitation of the previous week. Major lowland flooding occurred in the Carolinas from the earlier rains, notably at Kinston, N.C., on the Neuse River, where flooding on October 12 was the greatest since 1928, and at Lumberton, N.C., on

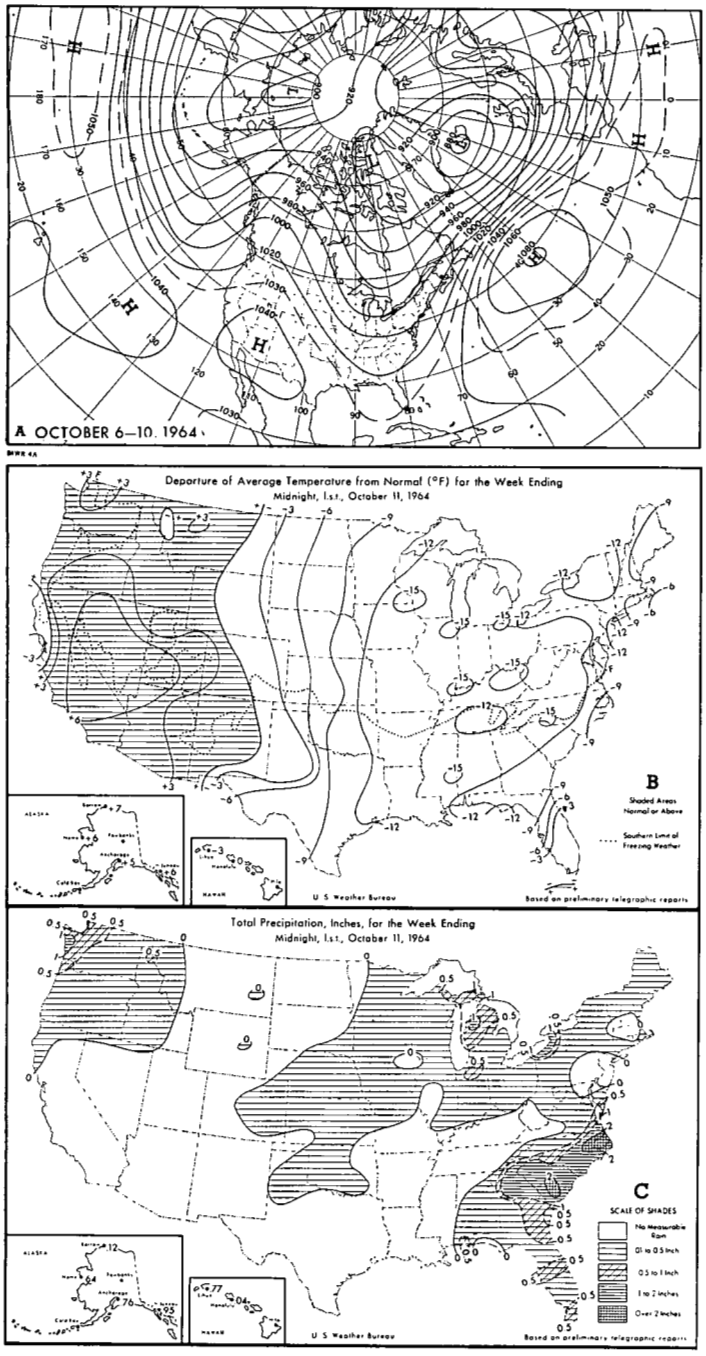

FIGURE 7.—(A) Mean 700-mb. contours (tens of feet) for October 6–10, 1964; (B) and (C) same as figure 6 for week ending October 11, 1964.

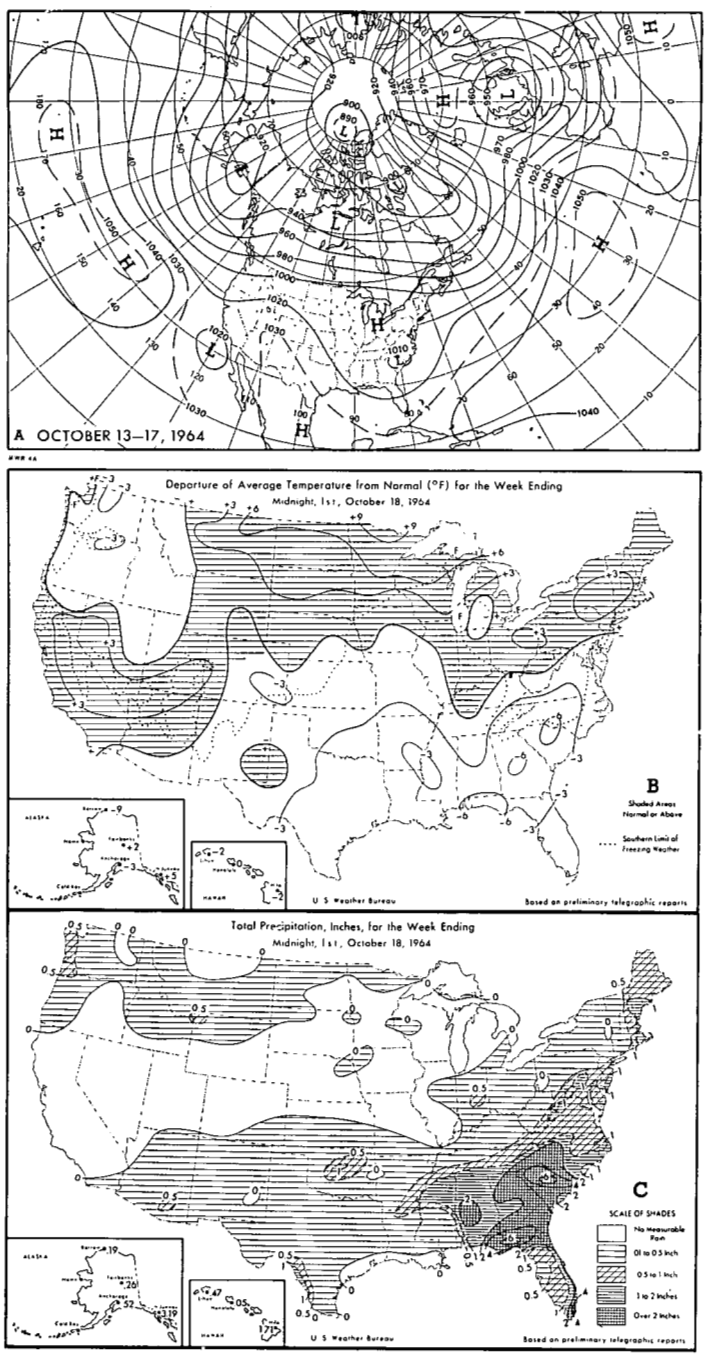

FIGURE 8.—(A) Mean 700-mb. contours (tens of feet) for October 13–17, 1964; (B) and (C) same as figure 6, for week ending October 18, 1964.

the Lumber River. Heavy lowland flooding also occurred in the Santee River system in South Carolina along the Broad, Saluda, and Congaree Rivers.

The first snow fell in parts of the Upper Great Lakes region (6 in. on October 6 near Grand Marais, Minn.) and across northern New York and Vermont accompanying a Low which crossed that region from October 6 to 10. In the wake of this disturbance another cold High from Canada moved into the eastern United States to maintain the cool weather which started in the previous week.

WEATHER OF OCTOBER 12–18

During this week the weather turned warmer east of the Rockies as the earlier amplified circulation flattened and the westerlies increased over southern Canada (fig. 8). Nevertheless, it remained cooler than normal in the

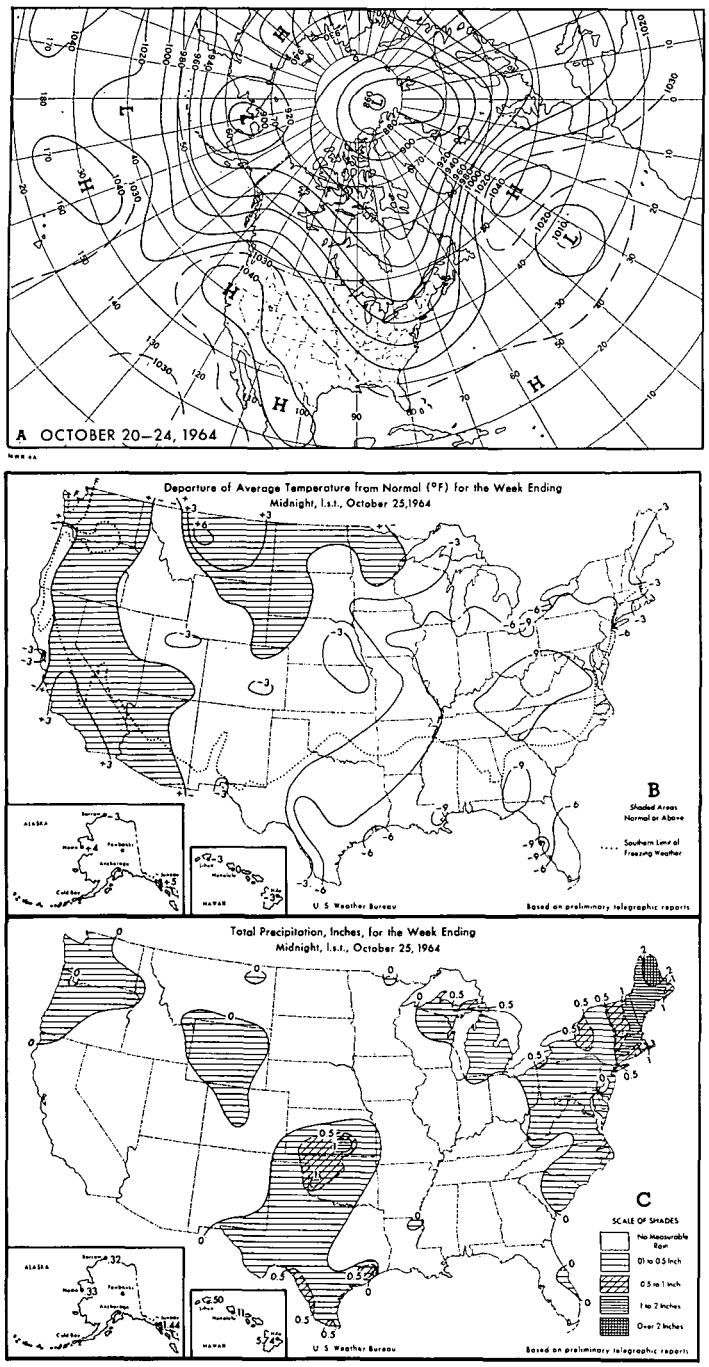

FIGURE 9.—(A) Mean 700-mb. contours (tens of feet) for October 20–24, 1964; (B) and (C) same as figure 6 for week ending October 25, 1964.

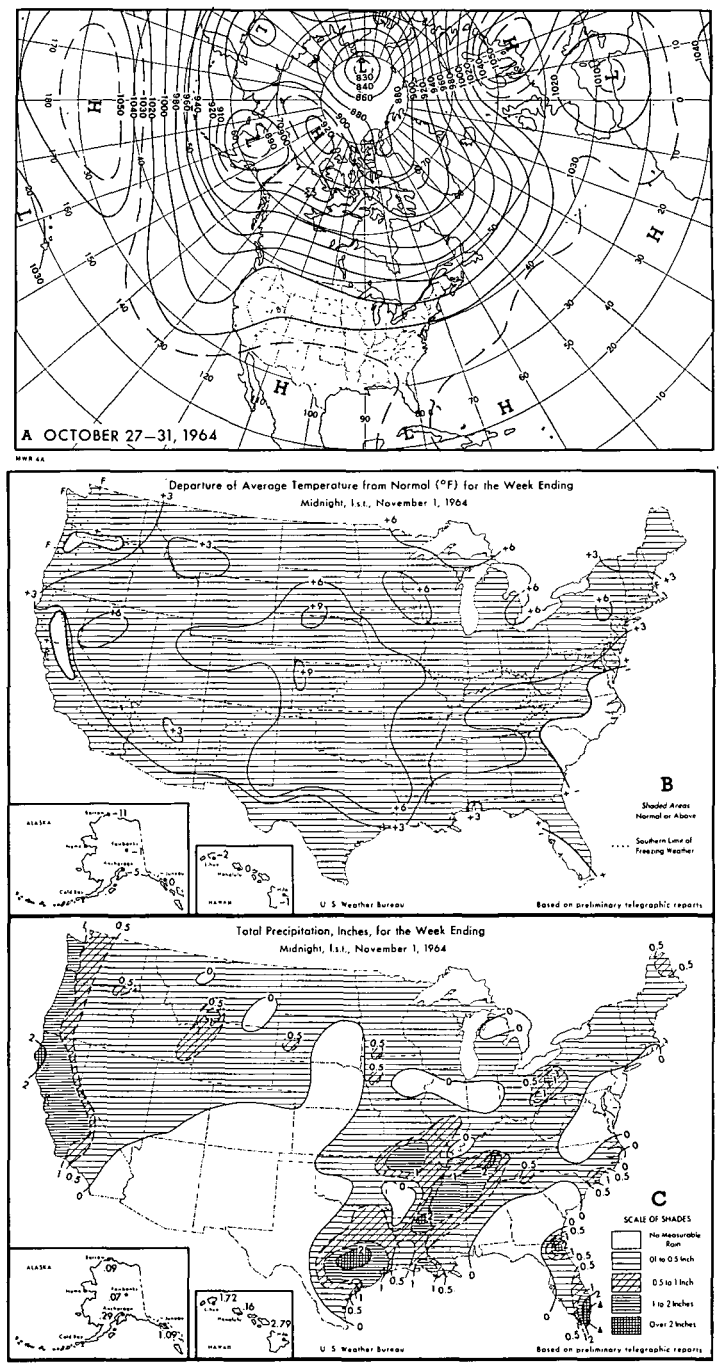

FIGURE 10.—(A) Mean 700-mb. contours (tens of feet) for October 27–31, 1964; (B) and (C) same as figure 6, for week ending November 1, 1964.

South, due in part to a cut-off upper Low which moved eastward and absorbed hurricane Isbell into its circulation as the latter weakened near the Carolina coast. Of the heavy rains in the Southeast, resulting from the merger of the upper Low from the west and Isbell from the south, some notable amounts were 5.95 in. at Tallahassee, Fla. on October 14–15, the greatest 24-hr. amount since records began there in 1895, and 5.46 in. at Columbia, S.C. on October 15–16. Extensive lowland flooding again occurred in parts of South Carolina in the Pee Dee, Santee, and Edisto Basins. The heavy rains moved northward along the Atlantic seaboard to New England where 1.42 in. fell at Boston, Mass. on October 17–18. In the wake of this disturbance a strong cold High in the northern Rockies spread southeastward lowering temperatures over the East by week's end.

WEATHER OF OCTOBER 19–25

The weather turned cooler east of the Rockies as the westerlies again shifted southward in response to intensification of the ridge in western North America (fig. 9). A disturbance from northwestern Canada crossed the Great Lakes on October 21, while heavy rains again fell in New England from a coastal storm on October 20–21. Added to the heavy rains of October 17–18, this brought marked relief from the excessive dryness, especially near the coast. These disturbances were followed by another cold High from Canada which was propagated by the strong northwesterly flow aloft into the Southeast where it became entrenched after October 23. On the 25th heavy rains developed in parts of the Southern Plains in association with an upper-level disturbance.

WEATHER OF OCTOBER 26–NOVEMBER 1

The ridge in western North America weakened during the last week of October and, as a result, most of the country warmed, as the flattened westerlies spread mild Pacific air to the east coast (fig. 10). Early in the week heavy rains, associated with an upper disturbance over the Southern Plains, spread across parts of the South. Meanwhile off the California coast an upper Low became partially cut-off, bringing heavy rains to California on October 27–29, and across Nevada to the central Rockies on October 29–30.

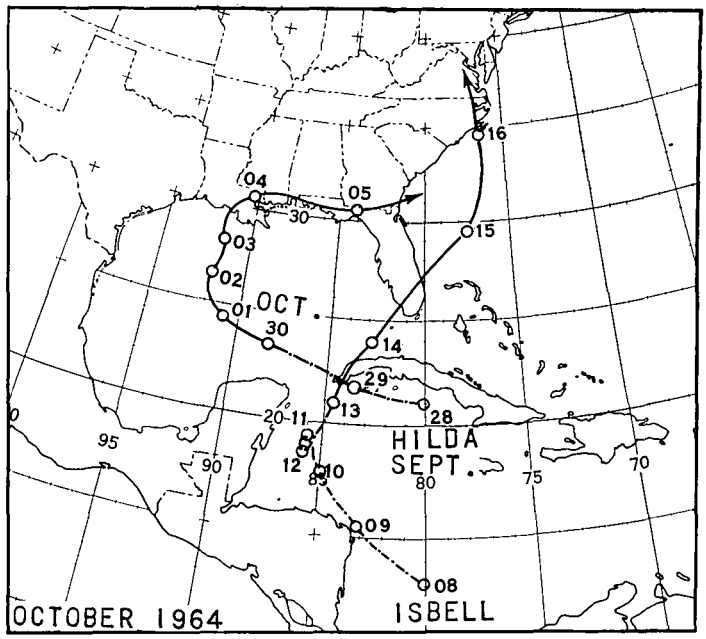

FIGURE 11.—Preliminary tracks of hurricanes Hilda and Isbell.

6. TROPICAL LOWS

Two tropical Lows developed in the Caribbean and affected seaboard areas of the United States in October as shown in figure 11. Both formed during periods

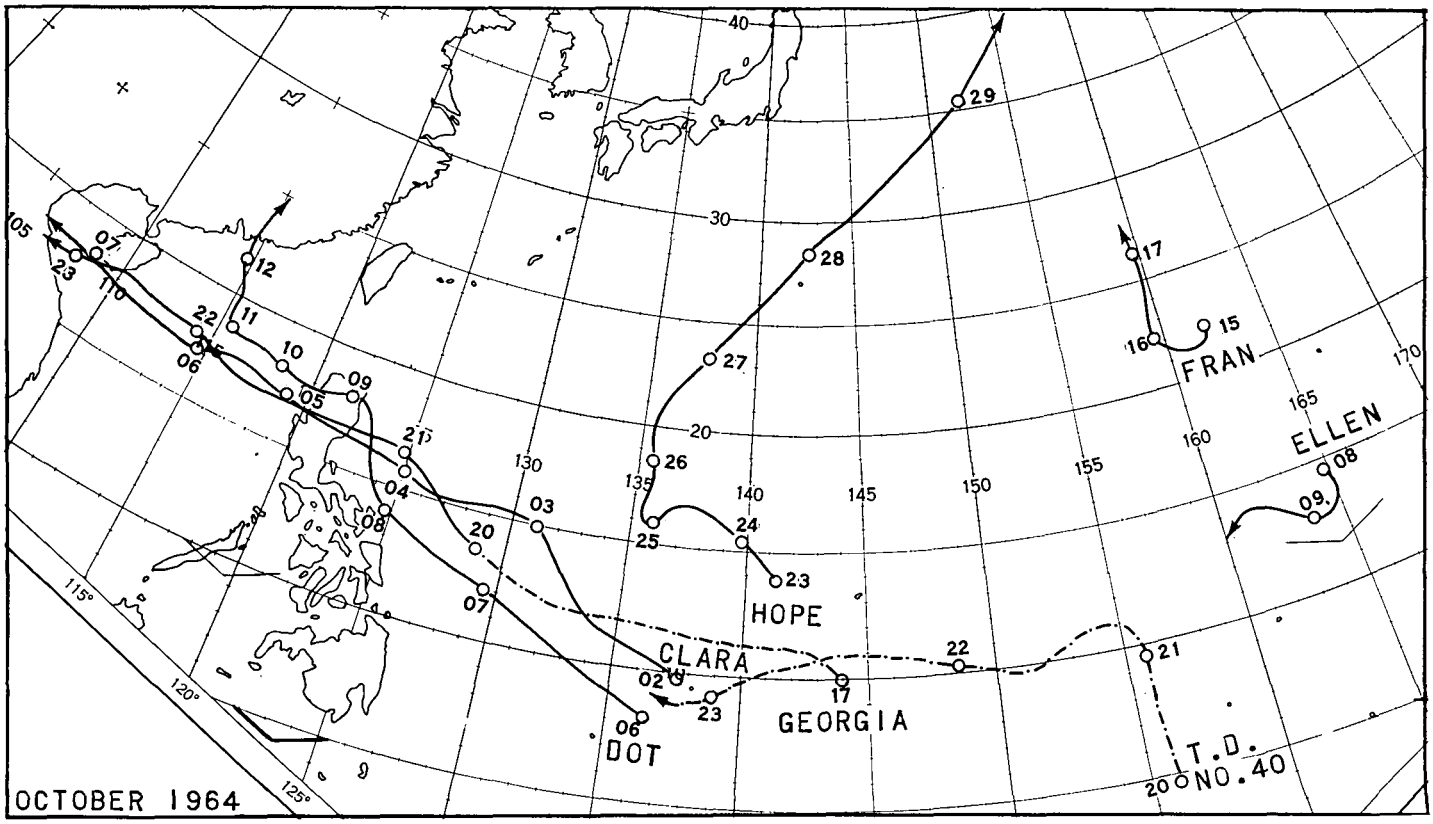

FIGURE 12.—Preliminary tracks of tropical Lows in western Pacific.

when the western cell of the upper-level anticyclone in the Atlantic was stronger than normal and north of its usual location. This circumstance maintained stronger-than-normal easterlies, which is believed favorable for vortex formation, near the spawning grounds in the Caribbean. During the period when hurricane Hilda developed, the upper High near Bermuda in figure 6A was associated with heights of as much as 260 ft. above normal (not shown). Hilda was then steered by the unusually strong southeasterly flow in the northern Caribbean toward the mean trough over the lower Mississippi. It struck the Louisiana coast near Franklin, with 120 m.p.h. winds and a pressure of 962 mb. at about 1800 EST October 3, and caused extensive damage.

The remains of Hilda had barely reached the north Atlantic before hurricane Isbell developed in the southern Caribbean. By that time, the Atlantic High at 700 mb. had shifted northeastward to a position southeast of Newfoundland (fig. 7A) and strengthened to an intensity of about 570 ft. above normal. The eastward shift of the Atlantic High and the deep trough from Florida northward permitted Isbell to follow a northward track which was farther east than Hilda's path. Isbell passed between Dry Tortugas and Key West on the morning of the 14th with a pressure of 997 mb. at Key West Harbor, and crossed Florida north of Miami accompanied by numerous small tornadoes. Some injuries were reported but damage was relatively light.

During the remainder of the month the positive height anomaly southeast of Newfoundland continued across the Atlantic to northern Europe as the subtropical anticyclone and easterlies in the Atlantic weakened.

In the western Pacific, tropical activity was normally active (fig. 12) and similar to September [6] in that three typhoons, (Clara, Dot, and Georgia) moved across the South China Sea into the mainland after crossing the northern Philippines. Presumably the failure of all except Hope to recurve was associated with the strength of the subtropical ridge south of Japan. The strength of the ridge was related to the negative height anomaly of the circulation over the interior of northern Asia, which was in turn related to the strength of the European ridge (figs. 2, 3).

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