

THE WEATHER AND CIRCULATION OF JULY 1968

Rather Changeable but Predominantly Cool

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1. HEMISPHERIC MEAN CIRCULATION

The 700-mb. mean circulation in the Northern Hemisphere during July 1968 was characterized by a continuation of the fast westerlies which had prevailed over the Pacific during June [1]. A deep vortex (80 m. below normal) developed over northern Hudson Bay, in part contributed to by the amplification of an unusually strong ridge over the upper Yukon Valley and neighboring Arctic Ocean, where monthly mean heights were 120 m. above normal (fig. 1 and 2).

Amplification progressed downstream to the Atlantic where a ridge replaced the trough which had been there in June. The 700-mb. height anomaly values increased by as much as 180 m. between June and July south of Iceland (fig. 3). As the trough moved eastward, associated storminess caused heavy rains and floods in parts of England just before the middle of the month. The trough was located in the eastern Atlantic the first half of July, but moved in over the continent during the last half of the month, bringing to an end a long spell of warm, dry weather over Eastern Europe and Scandinavia. This vigorous, rapidly moving mean trough was reflected rather weakly in the monthly mean heights (fig. 1) but the month-to-month and midmonth height anomaly changes (fig. 3 and 4) give a better idea of its intensity and movement.

The 700-mb. heights rose with respect to the normal along the Arctic coast in the Taymyr Peninsula area of Russia during the entire month (fig. 3 and 4) as the extremely deep Low near Novaya Zemlya in June (fig. 1 and 2 of [1]) weakened somewhat although it was still deeper than normal (fig. 2). Weakening of the circulation in this region allowed a ridge to develop northward from the Lake Baikal area and in response heights fell over extreme northeastern Siberia and the Bering Sea (fig. 1 through 4).

The 700-mb. heights rose rapidly at midlatitudes over the western Pacific, particularly during the last half of the month, where the intramonth change was 130 m. (fig. 4). As a result the midlatitude westerlies moved rapidly northward over the Pacific from June to July, with the greatest change taking place during the latter half of the

month. As in June [1], peak mean wind speed during July was 20 m.p.s., more than twice normal.

Northward movement of the westerlies and the subtropical ridge over the western Pacific during the latter half of July was associated with the onset of tropical activity. Two tropical storms, one reaching typhoon intensity, developed in the usual area and moved westward and northwestward toward Japan and Formosa. A third tropical storm was active briefly in the South China Sea.

An unusual feature of the two Pacific tropical cyclones was their decrease in strength as they approached Japan, well before landfall or contact with polar air masses. It is interesting to note that water temperatures were as much as 4°F. below normal in the area (fig. 5). Probably the unusually cool water was unable to provide enough latent and sensible heat to maintain the full strength of the tropical storms as they approached Japan.

Note that an extensive band of colder than normal water extended most of the way across the Pacific in the general area where the fast westerlies prevailed. These abnormally cool waters were related to cloudiness associated with increased storminess which reduced the strong solar heating of the surface waters normally prevailing during early summer, as well as greater than normal southward transport of water south of the band of fast westerlies [4].

There were a number of tropical storms in the eastern Pacific which dissipated as they moved northwestward toward cooler waters. No tropical storms were observed in the Atlantic-Gulf-Caribbean area, in contrast to the unusually frequent early season activity in June [1].

2. MONTHLY TEMPERATURE AND PRECIPITATION

The strong ridge in western Canada and Alaska and the persistent deep Low over northern Hudson Bay (fig. 1 and 2) combined to repeatedly transport polar air southward over the United States, thereby producing much of the cool weather during July. Temperatures averaged below normal from the Appalachians to the Rockies, with greatest departures in the Plains (fig. 6). An unusually vigorous cold front during the first few days of the month pushed temperatures to record low levels over a wide area

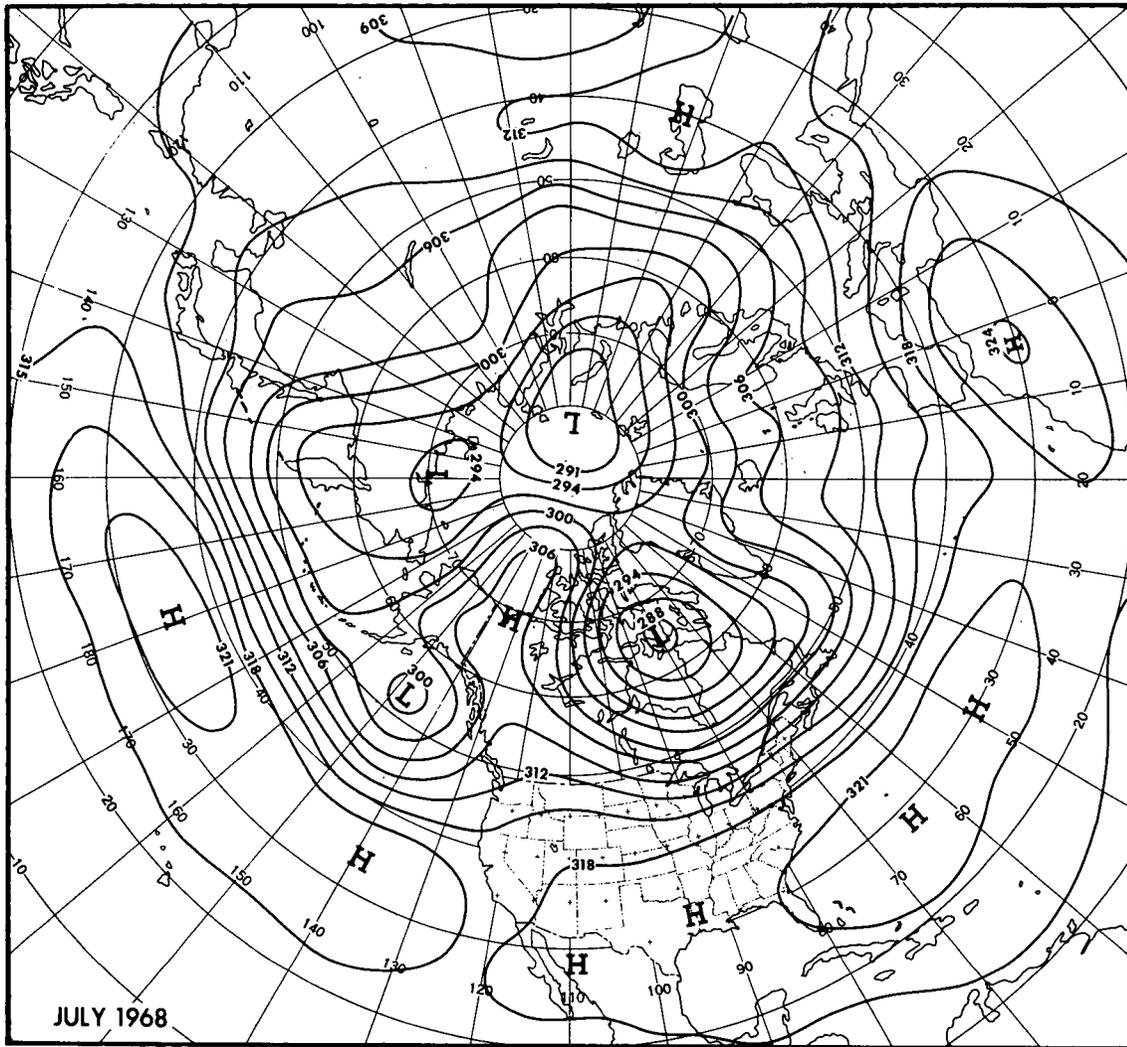


FIGURE 1.—Mean 700-mb. contours (decameters) for July 1968.

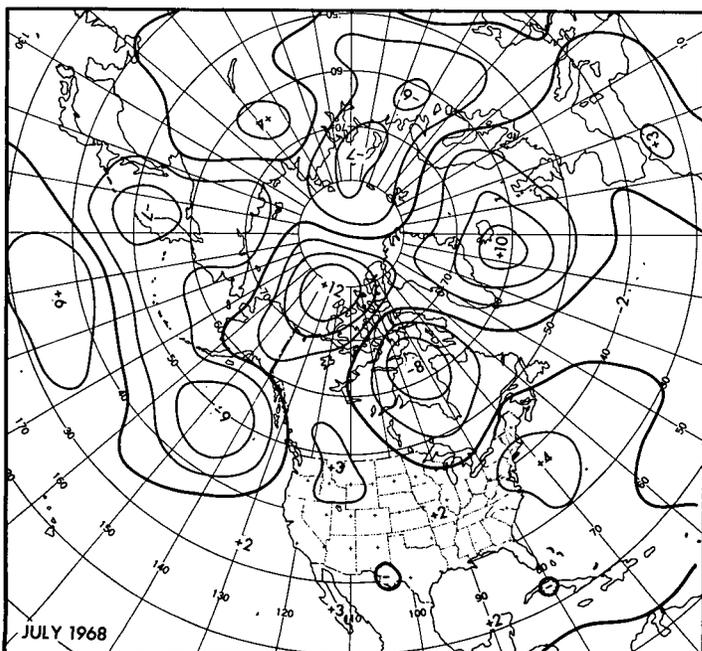


FIGURE 2.—Departure from normal of mean 700-mb. height (decameters) for July 1968.

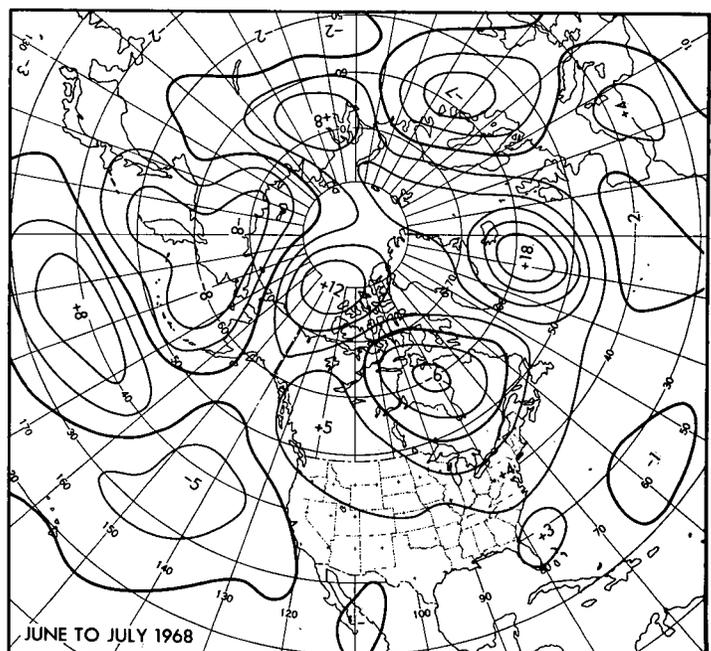


FIGURE 3.—Mean 700-mb. height anomaly change (decameters) from June to July 1968.

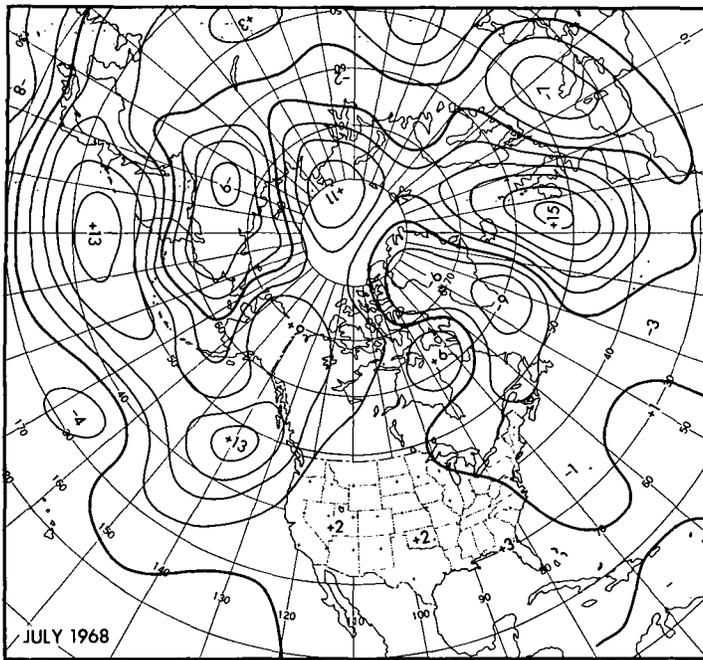


FIGURE 4.—Change in half-monthly mean 700-mb. height (decimeters) between July 1-15, and July 16-31, 1968.

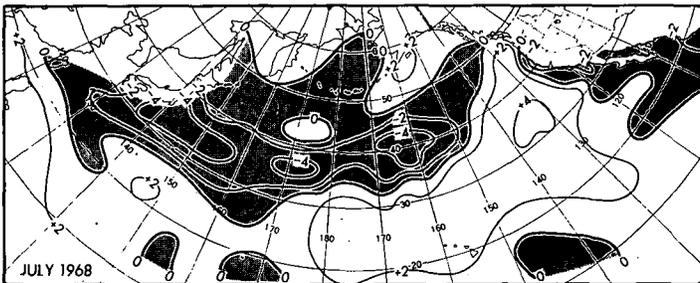


FIGURE 5.—Departure from normal of average sea surface temperature (°F.) in the Pacific Ocean for July 1968. Below normal areas are shaded (from [2] and [3]).

for several days, and several stations set new all-time daily low records for July (table 1).

Persistent strength of the Bermuda High and the Northwest ridge was associated with above normal temperatures in the Great Basin and most locations east of the Appalachians. The warmth in the West was nearly unbroken at some locations. Thirty consecutive days with maxima above 90°F. at Elko, Nev., tied the record for continuous warmth and contributed to a monthly mean temperature 5.8°F. above normal. At Walla Walla, Wash., 6 consecutive days above 100°F. and 8 such days for the whole month each came one short of tying records set back in 1886.

The ridge centered over eastern Alaska produced very high temperatures in the area by subsidence and abnormally strong insolation through the unusually clear air during the long polar summer days. The monthly mean at Fairbanks was 6.1°F. above normal and daily mean temperatures at Nome ran as much as 20°F. above normal.

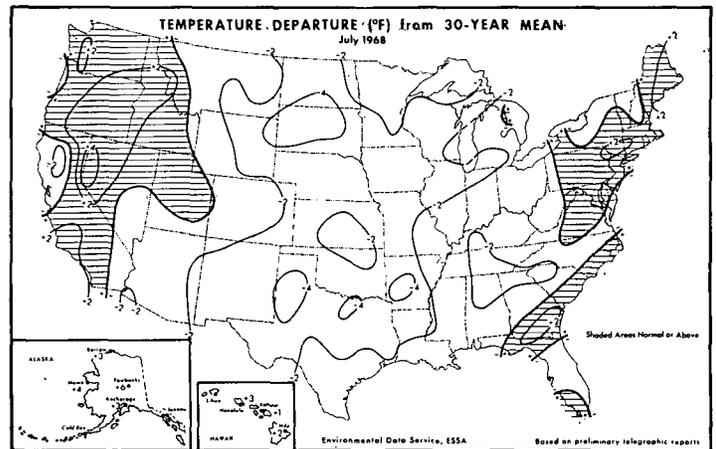


FIGURE 6.—Departure from normal of average surface temperature (°F.) for July 1968 (from [5]).

TABLE 1.—Record low temperatures for July established in 1968

Station	Date	Temperature (°F.)
Salt Lake City, Utah.....	1	40
Casper, Wyo.....	1	37
Topeka, Kans.....	3	49
Cleveland, Ohio.....	4	41
Youngstown, Ohio.....	4	42
Little Rock, Ark.....	4	56*
Huntington, W. Va.....	5	46

*Tied record.

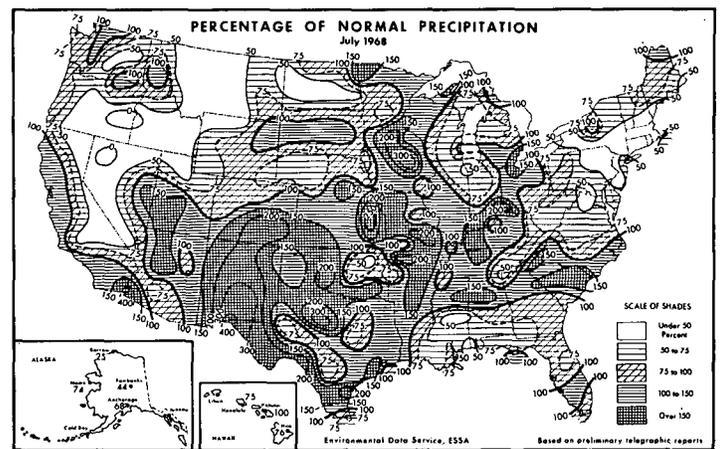


FIGURE 7.—Percentage of normal precipitation for July 1968 (from [5]).

The frequent polar fronts from Canada and the flow of tropical air around the abnormally strong Bermuda High combined to produce several outbreaks of heavy showers and thunderstorms across a wide area of the Country. Most areas from the Southwest to the northern Plains and the Carolinas had above normal precipitation, with the greatest excess expressed as a percentage of normal occurring in the normally dry areas of the Southwest (fig. 7). Several stations in the Southwest and the

TABLE 2.—Stations reporting record or near record rainfall during July 1968

Station	Total precipitation (in.)	Remarks
Waterloo, Iowa.....	12.60	Wettest month of record
Roswell, N. Mex.....	5.50	Wettest July in 75-yr. record
El Paso, Tex.....	5.53	3d wettest July of record and wettest since 1881
Albuquerque, N. Mex.....	3.33	3d wettest July of record
Pueblo, Colo.....	4.41	3d wettest July of record and wettest since 1921
Colorado Springs, Colo.....	5.27	3d wettest July of record
Topeka, Kans.....	10.17	4th wettest July of record and nearly all precip. fell in last half of month

TABLE 3.—Stations reporting record or near record dryness during July 1968

Station	Total precipitation (in.)	Remarks
Albany, N. Y.....	0.49	Driest July in 142-yr. record
Pittsfield, Mass.....	1.57	Driest July of record
Nantucket, Mass.....	.15	Tied driest July of record
Boston, Mass.....	.55	2d driest July in 151-yr. record
Portland, Maine.....	.65	2d driest July of record
Bismarck, N. Dak.....	.18	2d driest July of record and driest since 1936
Pendleton, Ore.....	.17	17th consecutive month with subnormal precip.

Central Plains reported record or near record rainfall during July (table 2).

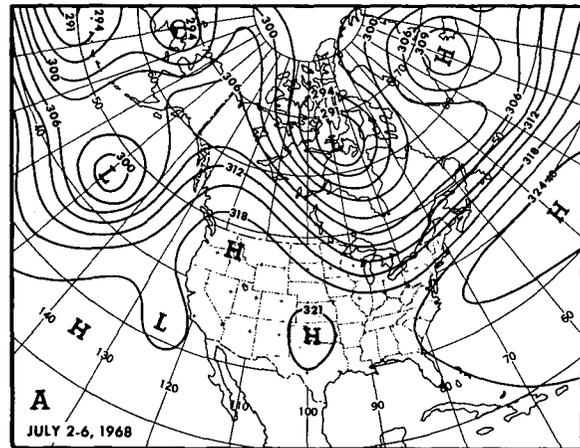
Precipitation was generally subnormal under the ridges in the Plateau and Alaska (fig. 7). Extreme dryness prevailed at several localities in the Northeast, with records being set or tied at several stations (table 3). A serious drought situation did not develop, however, due to adequate soil moisture from copious rainfall in late spring and early summer.

3. WEEKLY CIRCULATION AND WEATHER

JULY 1-7

The 700-mb. flow pattern was strongly amplified during the first week of the month with deep Lows over the eastern Pacific and northern Hudson Bay (fig. 8A). The ridge over the Pacific Northwest reached its greatest 5-day mean amplitude of the month, 100 m. above normal (fig. 8A,B). The Bermuda High was also stronger than normal, and located northwest of its normal position.

This pattern set the stage for a variety of weather, mostly record-breaking coolness for early July. A wide area of the Plains and Mississippi Valley averaged more than 6°F. below normal for the week (fig. 8C). Daily low temperature records were broken at numerous stations



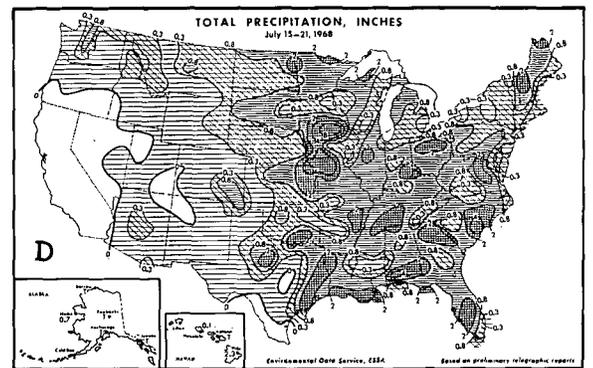
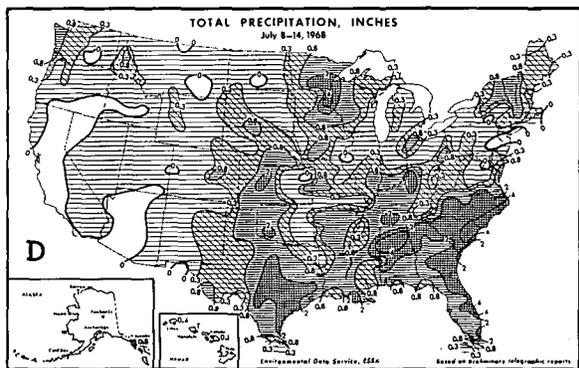
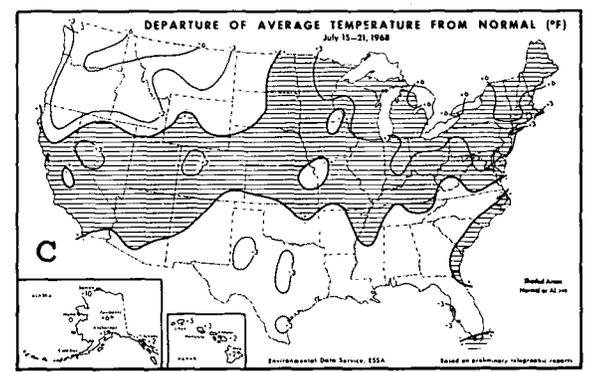
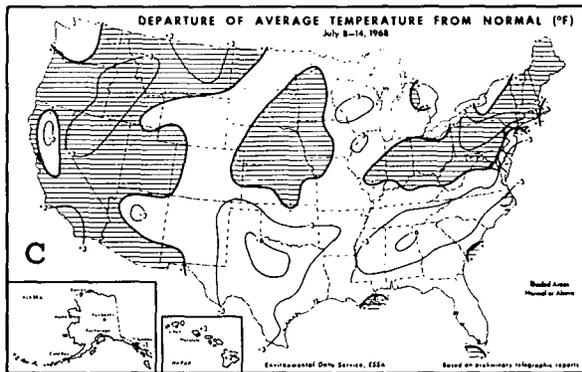
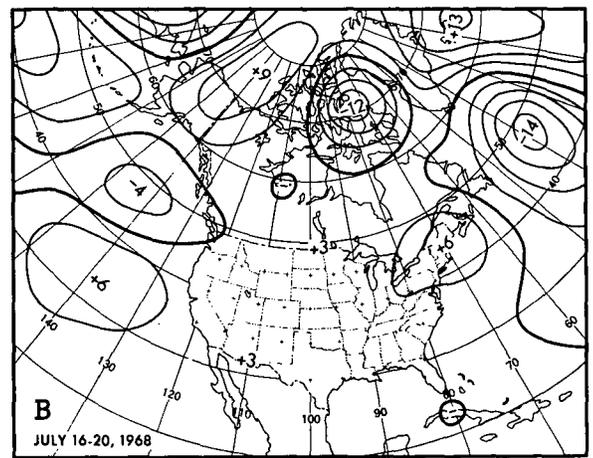
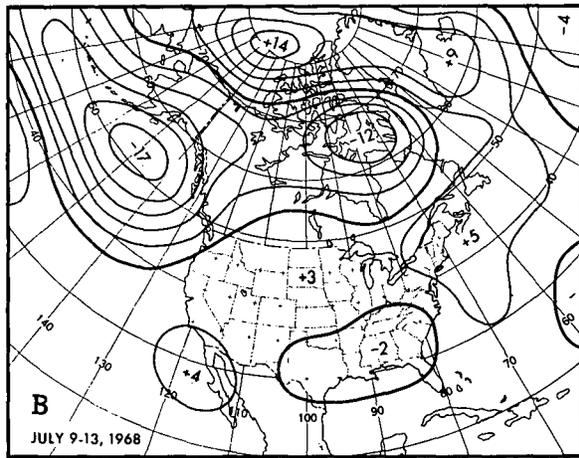
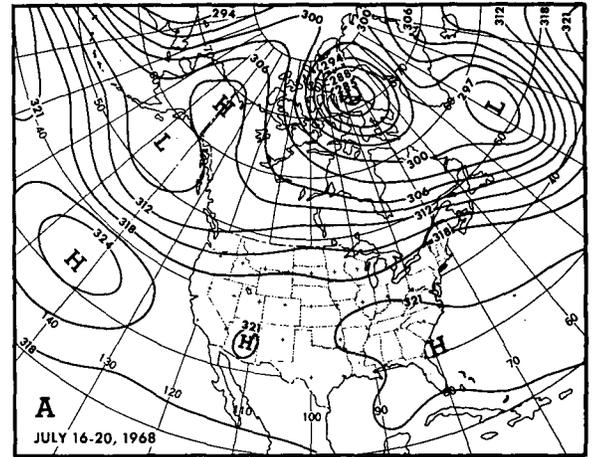
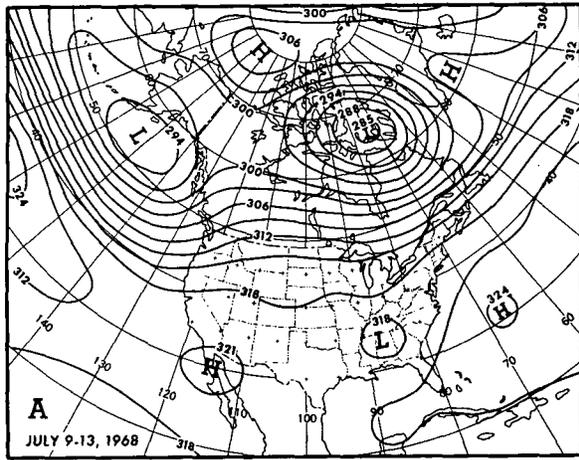


FIGURE 9.—Same as figure 8, (A) and (B) for July 9-13, 1968; (C) and (D) for week of July 8-14, 1968 (from [5]).

FIGURE 10.—Same as figure 8, (A) and (B) for July 16-20, 1968; (C) and (D) for week of July 15-21, 1968 (from [5]).

from the northern Rockies to the central Appalachians and from the Great Lakes to the Texas coast, as a front pushed southward all the way to the Gulf of Mexico—a rare occurrence in midsummer. New record low temperatures for July were also set at several cities during the first 5 days of the month (table 1).

The advancing cold air set off heavy thundershowers east of the Appalachians as it displaced a hot, humid air mass which had produced temperatures in the upper 90's in several Eastern cities the first 2 days of the month. Several areas received more than 2 in. of rain during the week as a whole (fig. 8D). Two-in. hail was reported in the suburbs of Washington, D.C., on the 2d and Norfolk, Va., on the 3d.

Return flow from the large cold High which set all the temperature records also contributed to record-breaking rains and floods in parts of the Southwest as tropical moisture was advected northward. Within a 4-day period, El Paso, Tex., received more than 4 in. of rain, an amount which represents more than half the normal annual rainfall at that location. Roswell, N. Mex., received nearly 3 in. of precipitation in 24 hr. The moist air spread showers westward all the way to San Diego, Calif. A maximum temperature of 82°F. on the 6th at Yuma, Ariz., during the rainy spell was the lowest daily maximum ever observed there during the month of July.

JULY 8-14

During the second week fast westerlies prevailed across the Pacific Ocean and southern Canada (fig. 9A). The 5-day mean midlatitude zonal index between 0° and 175°W. reached 9.4 m./sec., a value 2.7 m./sec. above normal. The 700-mb. height in the Gulf of Alaska was 170 m. below normal, while the Low over northern Hudson Bay was 120 m. below normal. Above normal heights prevailed over most of the United States (fig. 9B).

Early in the week a rather cool High crossed the northern part of the Country, setting more daily minimum temperature records in the Great Lakes area and northern New England. Mean temperatures continued high in the Plateau region and parts of the Northeast, while lowest readings relative to normal were observed over the Southern Plains and the Southeast (fig. 9C).

Heavy precipitation, much of it over 2 in. for the week, was recorded in the cool areas (fig. 9D). One town in eastern Mississippi reported nearly 16 in. of rain. The heavy showers in the Southeast were released by instability associated with a week cutoff Low which persisted in the area long enough to be reflected in the 5-day mean circulation (fig. 9A).

JULY 15-21

Above normal heights prevailed over most of the United States and southern Canada during the third week as the intense cyclonic activity in the Gulf of Alaska weakened somewhat (fig. 10A,B).

Cool air moved into the Northwest with strong gusty winds and thunderstorms at several localities to give

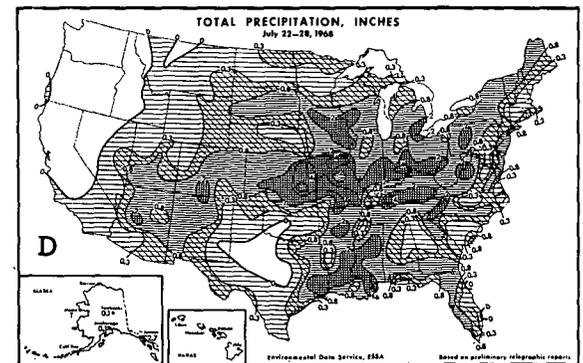
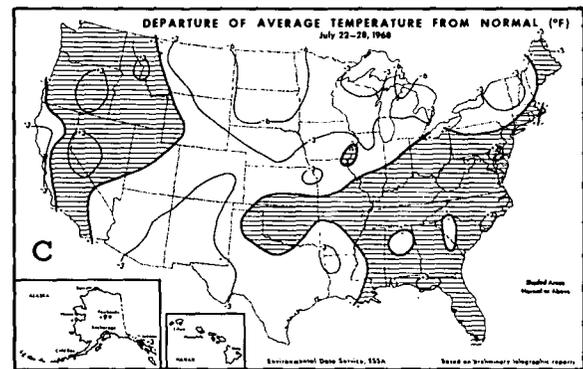
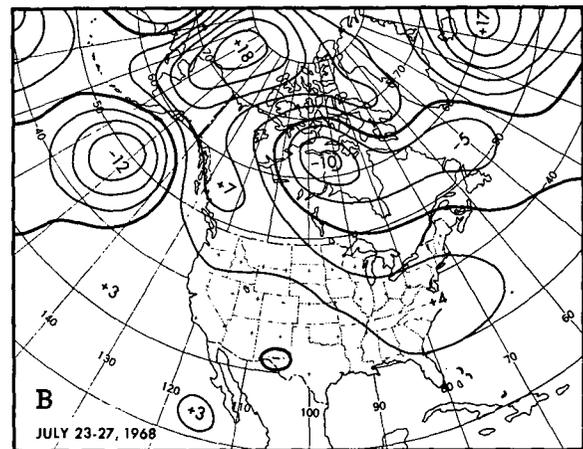
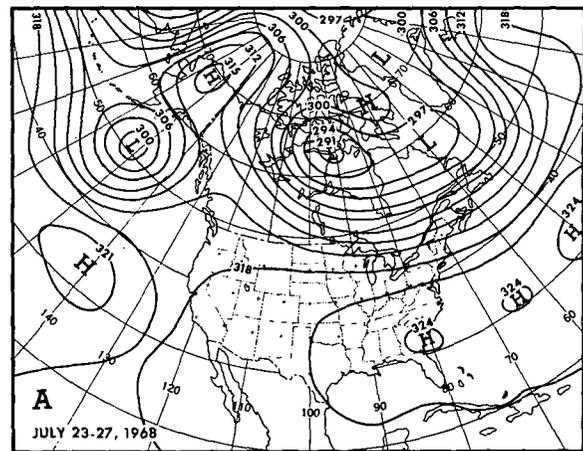


FIGURE 11.—Same as figure 8, (A) and (B) for July 23-27, 1968; (C) and (D) for week of July 22-28, 1968 (from [5]).

temporary relief from the extended hot spell which had prevailed in the area, but unseasonably warm and humid air overspread the Great Lakes area and the Northeast where some sections averaged more than 6°F. above normal (fig. 10C). Several stations in these areas reported record daily maximum temperatures from the 15th to the 18th. Small areas of Texas still remained in excess of 3°F. below normal.

The passage of a cold front across the warm area toward the end of the week set off numerous thunderstorms which were severe in some localities. Waterloo, Iowa, reported a record 8.81-in. rainfall within a 24-hr. period (table 2). Scattered tornadoes and funnel clouds were observed throughout the Midwest. Showers continued throughout most of the South.

JULY 22-28

Redeepening of the Gulf of Alaska Low to 120 m. below normal during the fourth week resulted in the reestablishment of the warm ridge in the Northwest while the Hudson Bay Low continued very deep (fig. 11A,B). The Bermuda High was firmly established westward to the Southern Plains.

Temperatures responded to the circulation changes in about the expected manner. Maxima rose to over 100°F. again in the Columbia River Basin as the ridge aloft strengthened, and weekly mean temperatures were more than 9°F. above normal in parts of Alaska under the influence of the strong ridge there. Another abnormally cool summertime Canadian airmass moved southeastward in the strengthened flow between the ridge and the Hudson Bay Low. Weekly mean temperatures were more than 6°F. below normal in the Northern Plains (fig. 11C). Daily

minimum temperature records were set at several stations from Montana to the Great Lakes area on the last 3 days of the month. Some places with record lows during the fourth week of the month had recorded new highs just the previous week. Under the influence of the strong Bermuda High temperatures rose to near record levels in parts of the Carolinas, the highest readings in several years.

Precipitation was again excessive in part of the zone subject to the rapid changes in temperature. More than 4 in. of rain was recorded during the week in parts of eastern Kansas and Missouri (fig. 11D) and heavy thunder-showers were observed from there to the mid-Atlantic coast. Kennedy International Airport in New York measured 1.80 in. on the 24th, the greatest amount ever recorded in an observational day. Rainless conditions returned to the Northwest, under the influence of the ridge.

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