

WEATHER AND CIRCULATION OF MAY 1971

Persistent Cool, Wet Weather Associated With Blocking Over North America

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1. WEATHER SUMMARY

Continued blocking over North America combined with a very slowly changing mean flow in upper levels produced highly persistent temperature and precipitation patterns over the conterminous United States. This regime excluded any sustained advection from sources of unusual cold or heat as maritime Pacific air masses prevailed. The westerly flow, with its rain shadow effect, contributed to continued dryness in much of the Southwest.

More than normal precipitation eased the drought in southern Florida. The drought in the Southwest was relieved somewhat in southern Texas and northern Oklahoma as 2 in. or more of rain fell the last week of May. From Texas to the Central Great Plains, widespread instability, repeated each week, was responsible for many tornadoes and other severe weather including hail the size of baseballs in southern Texas. This strong convective activity accompanied seven daily upper level troughs that migrated from an unusually active mean trough in the Southwest.

2. MONTHLY MEAN CIRCULATION

Monthly mean 700-mb flow in May 1971 (figs. 1 and 2) persisted strongly from April 1971. Principal features shifted slightly and changed intensity relative to normal; but in general, the long waves seemed reasonably fixed.

In the Atlantic, the pattern remained amplified as heights increased by as much as 56 m relative to normal west of Gibraltar (fig. 3). Near Greenland, heights decreased by more than 90 m near the Low in Baffin Bay. The mean 700-mb jet in the North Atlantic this month (fig. 4) separated into two branches, one that continued eastward through subarctic Europe and another around the strong mean trough that extended from Iceland to the west coast of Africa.

Height increases of about 60 m in the ridge over Scandinavia contributed to the blocking over Europe. This resulted in a mean jet across North Africa under the blocking ridge in which 700-mb heights averaged about 60 m above normal. The trough over Western Siberia deepened in May in response to the upstream ridge and trough, all of which comprised an omegaform block.

Blocking also characterized the circulation of eastern Asia. In this instance, the block formed as a cutoff Low retrograded a short distance from its position last month in the Sea of Okhotsk. Slight height increases to the north over Eastern Siberia intensified the blocking. The mean jet separated near Lake Balkhash, with the principal branch sweeping southeastward through the Sea of Japan where the average wind speed was about 6 m/s faster than normal.

In the central Pacific, the deepest center of action in the Northern Hemisphere (-100 -m anomaly) produced an extensive cyclonic circulation with the strongest wind (21 m/s) and greatest anomalous wind speed (9 m/s above normal) in the hemisphere. This deepening accompanied a strengthening ridge over western Canada and along the west coast of the United States. The main polar jet again split as blocking dominated western North America. The southern branch of the main westerlies was stronger around the cutoff Low over the Great Basin than the northern branch around the ridge. The strongest flow averaged 6–8 m/s faster than normal near Baja California. As the basin Low formed on the site of the April trough, the ridge in Canada moved westward and contributed to a reduction of the wave spacing over North America and strong deepening in the trough that extended from Davis Strait to the southeastern part of the United States.

3. MONTHLY MEAN WEATHER

Persistence from April to May of surface temperatures reflected the persistence of the mean 700-mb flow. The monthly temperature at 77 out of 100 representative stations in the conterminous United States changed by no more than one class (out of five). This high persistence is notable since this pair of months often has the lowest persistence of the year (Namias 1952). Temperatures averaged less than 3°F below normal over most of the Nation (fig. 5). The coolest area in the West lay under the deepest part of the mean trough (figs. 1 and 2). In the East, the coolest areas were associated with only slight cyclonic curvature of 700-mb contours; but mean heights were more than 30 m below normal. Above-normal temperatures were scarce this month as only a few stations reported a positive temperature anomaly of 1° or 2°F in parts of the Northwest, New England, southern Florida, and Texas. Twenty to 30 daily records of maximum and minimum occurred this month; but early reports indicate only one monthly record, an average of 69.5°F at Tallahassee, Fla., 5.4°F below normal.

Precipitation totaled 1 in. or more over most of the Nation (fig. 6) except in much of the Southwest where rainfall was less than 50 percent of normal. Heaviest precipitation relative to normal fell along the principal storm track from Nevada to the Central Great Plains. In parts of Nevada and southern California, four to eight times the normal precipitation fell; but amounts averaged less than 1 in. Elko, Nev., near the 700-mb mean Low, reported the wettest May of record with 4.09 in. (3.13 in. above normal). Normal precipitation bypassed the drought area of Texas except for a small area with 2 in. of rain in the western sector. Rainfall of 2–4 in. or more fell over most of the remainder of the United States with

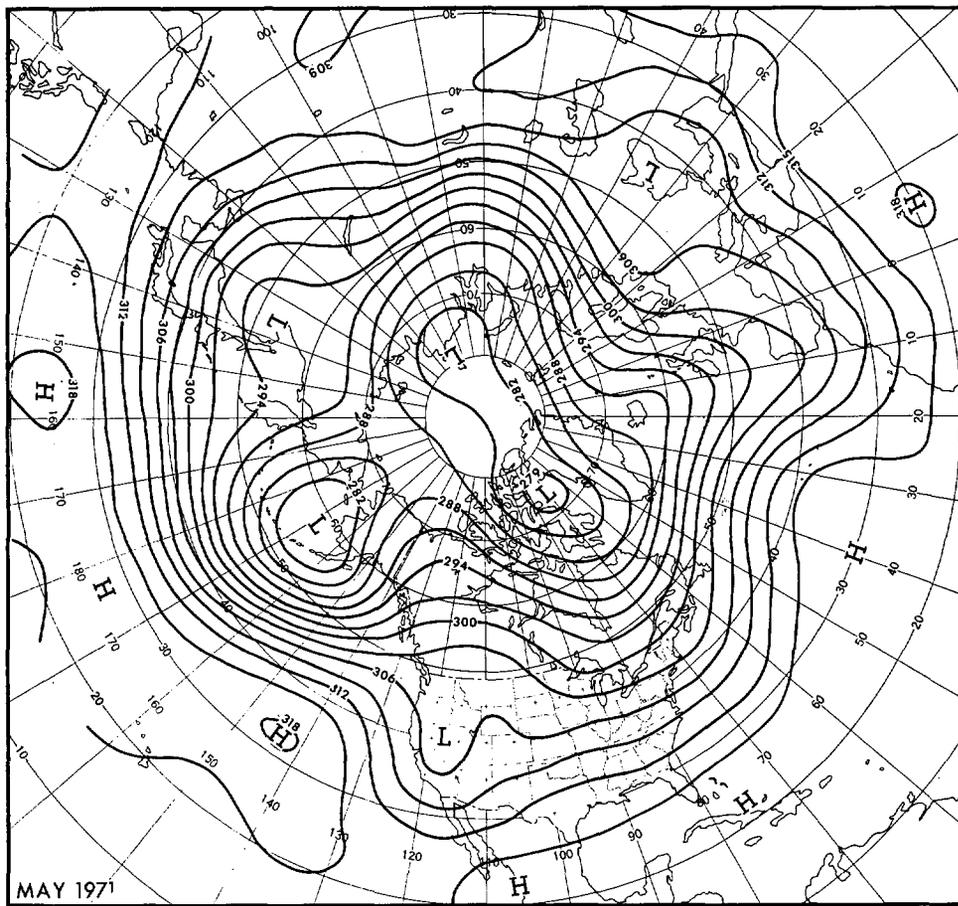


FIGURE 1.—Mean 700-mb contours [dekameters (dam)] for May 1971.

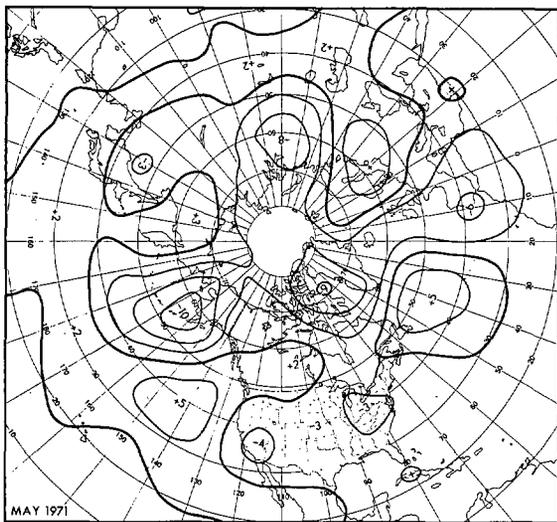


FIGURE 2.—Departure from normal of the mean 700-mb height (dam) for May 1971.

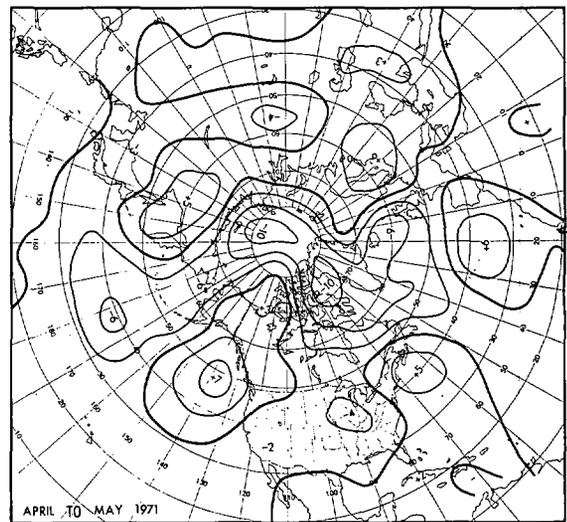


FIGURE 3.—Mean 700-mb height anomaly change (dam) from April to May 1971.

4–8 in. in the Lower Mississippi Valley. Record precipitation for May of 5.59 in. fell at Casper, Wyo., despite the proximity of a weak 700-mb ridge. Lynchburg, Va., reported 9.07 in., the heaviest May rainfall since 1898, almost 6 in. above normal. The monthly mean 700-mb contours (fig. 1) appeared to be poorly related to this and other heavy precipitation in the East, but the height

anomaly (fig. 2) suggested the passage of several deep daily troughs.

4. WEEKLY VARIABILITY

Blocking dominated the mean 700-mb circulation this first week (fig. 7A). This resulted in one branch of the westerly flow and the principal surface storm track farther south than normal. Heights averaged below normal from

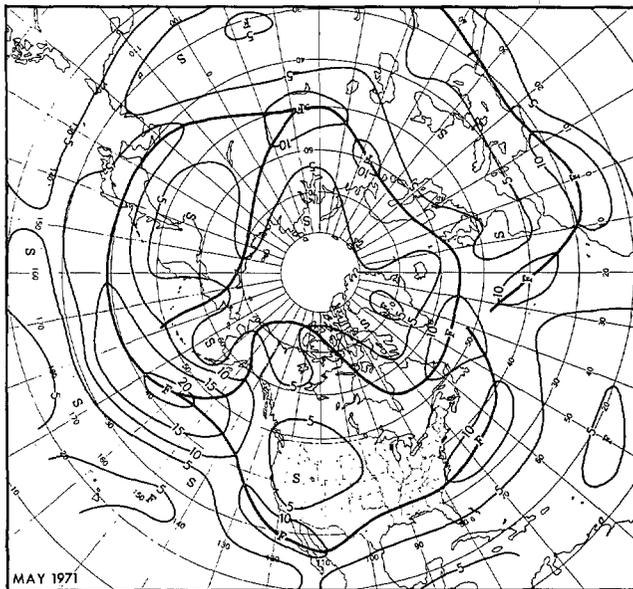


FIGURE 4.—Mean 700-mb isotachs (m/s); heavy lines indicate principal axes of maximum wind speed.

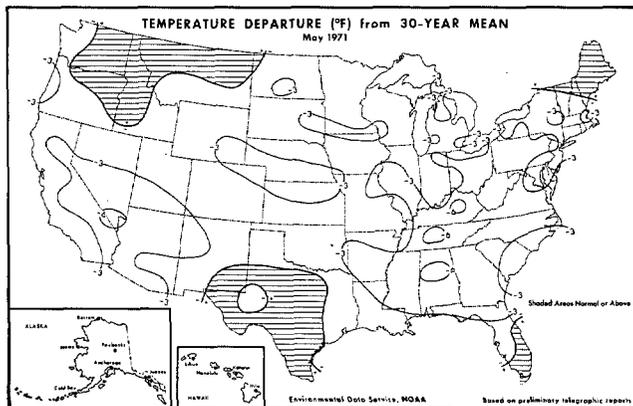


FIGURE 5.—Departure from normal of average surface temperature ($^{\circ}\text{F}$) for May 1971 (from Environmental Data Service and Statistical Reporting Service 1971).

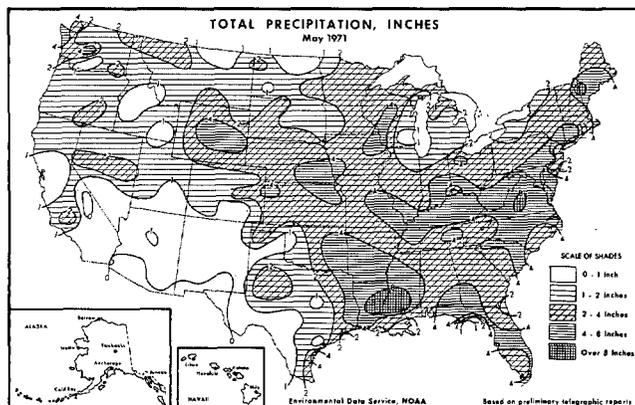


FIGURE 6.—Total precipitation (in.) for May 1971 (from Environmental Data Service and Statistical Reporting Service 1971).

the deep trough off the west coast, through the weak anticyclonic flow in the Midwest, to the trough in eastern United States. Temperatures averaged 3° – 6°F above normal in Texas (fig. 7B), where Laredo reported a daily maximum of 98°F , and from the Northern Great Plains to the Northern Rocky Mountains. East of the

Mississippi, temperatures of 3° – 6°F below normal included new monthly record minima at Montgomery, Ala. (40°F), Chattanooga, Tenn. (34°F), and Tallahassee, Fla. (34°F). In the Southwest, temperatures 3° – 9°F lower than normal occurred as a very strong daily trough entered the area. Precipitation associated with this trough (fig. 7C) extended from the West (where 1 in. or less fell) to the east coast. In parts of the Mississippi Valley and from the Tennessee Valley to New England, 1–2 in. fell. Most of the precipitation was rain that accompanied widespread thunderstorms. Some rain fell in the northern part of the Texas drought area, but none fell in the southern Florida drought area.

Heights at 700 mb increased over western North America for the second week (fig. 8A) as a strong ridge extended from western Canada to a High in the Central Rocky Mountains. The trough formerly off the west coast moved into California and weakened; the trough in the East also weakened. Blocking still existed, but the strong ridging over the Rocky Mountains dominated the weather and circulation. Temperatures remained above normal this week (fig. 8B) in the Northern Great Plains, and warmth spread to the Southwest where temperatures increased by 10° – 12°F . A mass of cool air from Canada early in the week resulted in a marked decrease of 6° – 9°F in average temperatures in the Southern Great Plains. Several new daily minima accompanied this surface ridge including 32°F at Dodge City, Kans., 30°F at Peoria, Ill., and 39°F at Midland, Tex. Then warming spread across the northern States from Washington where Olympia had a new daily maximum of 88°F and into Montana where the 90s occurred. A daily 700-mb trough moved out of the Southwest, accompanied by a deepening surface storm that spread heavy precipitation over the southeastern one-third of the Nation (fig. 8C). More than 2 in. fell over the Lower Mississippi Valley, the area from the southern Appalachians to the Chesapeake Bay, and Florida. Parts of the drought area in Texas received some rain, but the drought remained severe in the southern and western areas of the State. The rainfall in Florida (to 4 in.) relieved the drought in the Everglades and in most pastureland.

During the third week, the mean 700-mb ridge strengthened off the west coast (fig. 9A) as the portion in Canada retrograded about 15° longitude. At the same time, a full-latitude trough deepened from the Northern Great Plains to the Gulf of California. Daily components of this mean trough were accompanied by two very active surface storms, one early in the week and one late. Blocking increased in the Atlantic and created a mean 700-mb Low with heights about 100 m lower than normal south of Nova Scotia. Temperatures reacted to the 700-mb changes and averaged a few degrees above normal from southern Texas to New England (fig. 9B), parallel to the strong southwesterly mean flow. In the Southeast, temperatures were normal to a few degrees below normal, despite the mean ridge in the area, and were probably related to the strong cold advection during the last 3 days of the week. The rest of the country averaged a few degrees lower than

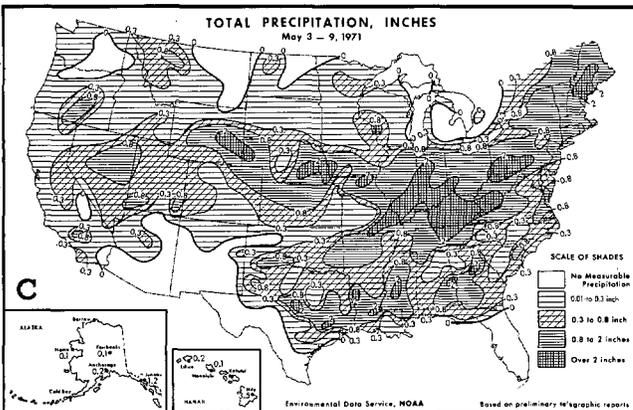
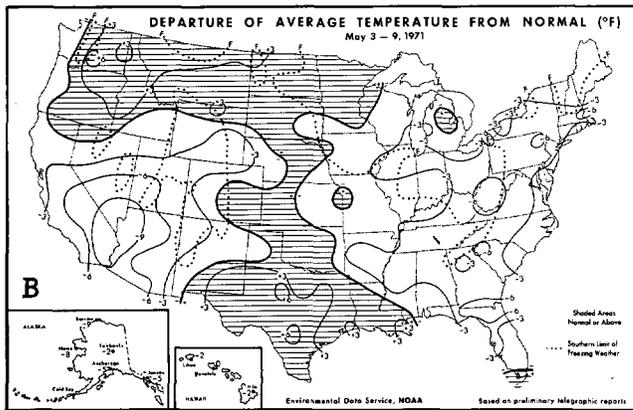
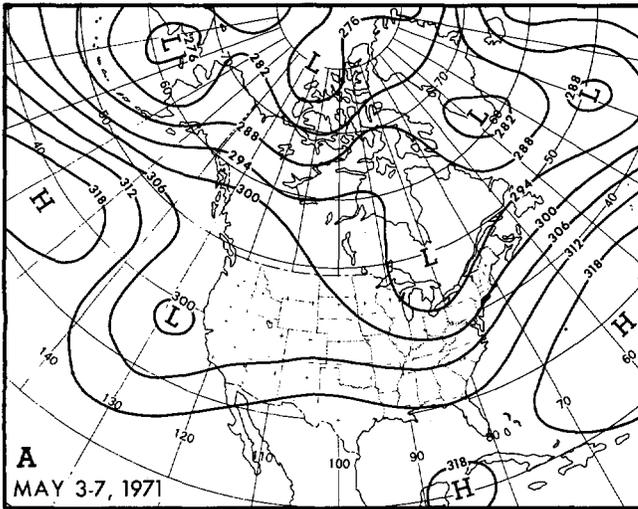


FIGURE 7.—(A) mean 700-mb contours (dam) for May 3-7, 1971; (B) departure of average surface temperature from normal (°F) and (C) total precipitation (in.) for May 3-9, 1971 (from Environmental Data Service and Statistical Reporting Service 1971).

normal under the mean trough, with departures of more than 9°F in the Northern Rocky Mountains. Daily temperature records this week included new minima at Winslow, Ariz. (27°F), Reno, Nev. (27°F), Olympia, Wash. (33°F), and Elkins, W. Va. (30°F), and a new daily maximum at Syracuse, N. Y. (92°F). Precipitation of more than 2 in. fell over the Plains States (fig. 9C) as two strong 700-mb troughs moved out of the West, accompanied by severe convective activity. With the second trough, a surface storm deepened in Nevada on Friday; and the West received rain, thunderstorms, and snow. Reno, Nev., reported 7 in. of snow, the greatest amount so late in the

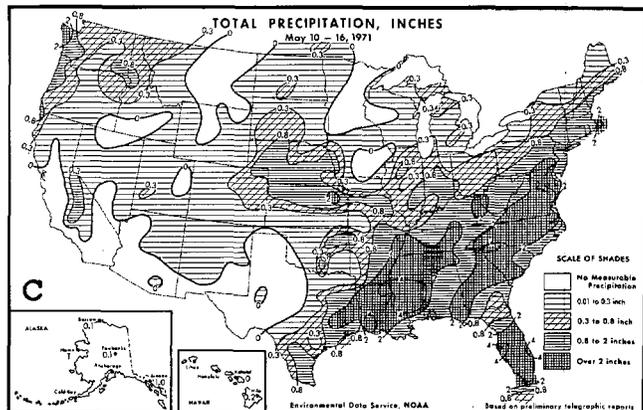
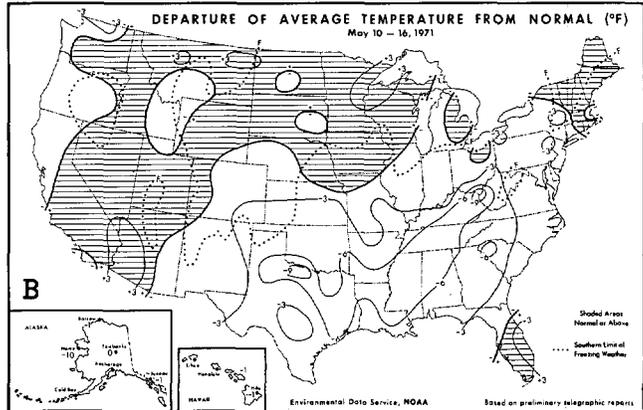
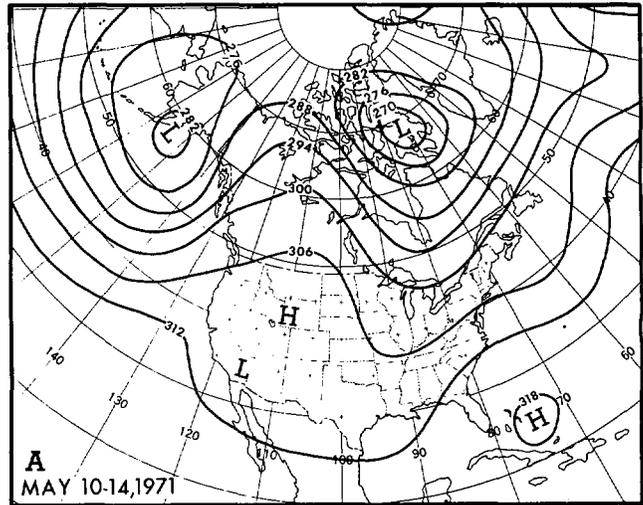


FIGURE 8.—Same as figure 7, (A) for May 10-14, 1971, and (B) and (C) for May 10-16, 1971.

season. Several inches fell in the Cascade Range, the Sierra Nevada Range, and in the Rocky Mountains. According to the *Weekly Weather and Crop Bulletin* (Environmental Data Service and Statistical Reporting Service 1971), the snow that came with this storm at the Paradise Ranger Station on Mt. Rainier, Wash., brought its seasonal total to 1,017 in., a record for any station in the United States.

Weak blocking reappeared over North America the last week of May (fig. 10A) with above-normal heights in Canada and below-normal heights over most of the United States. The portion of the trough that was over

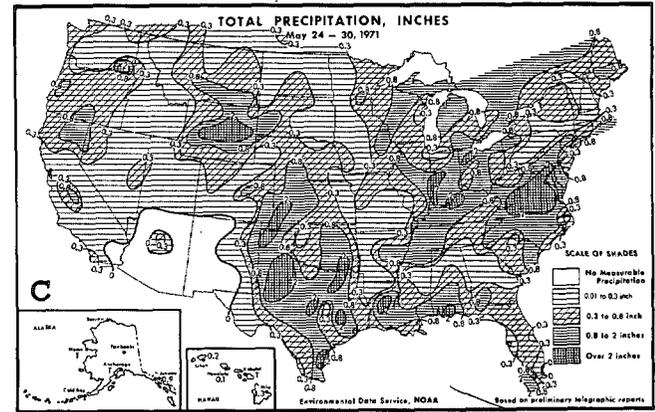
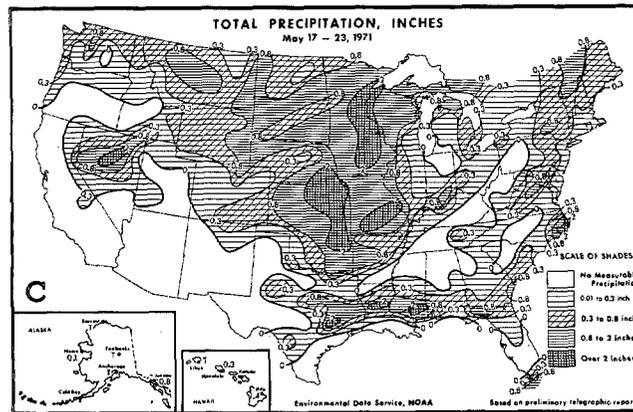
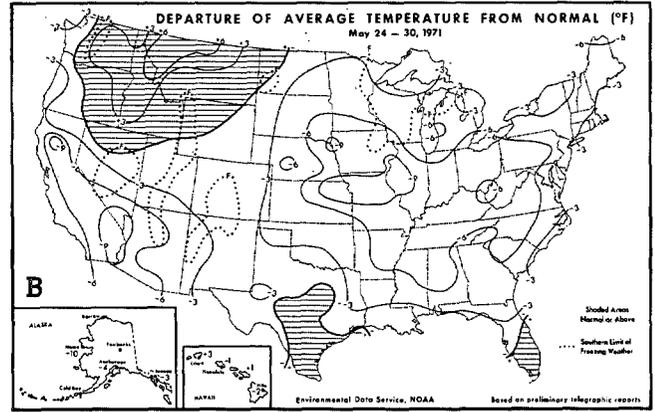
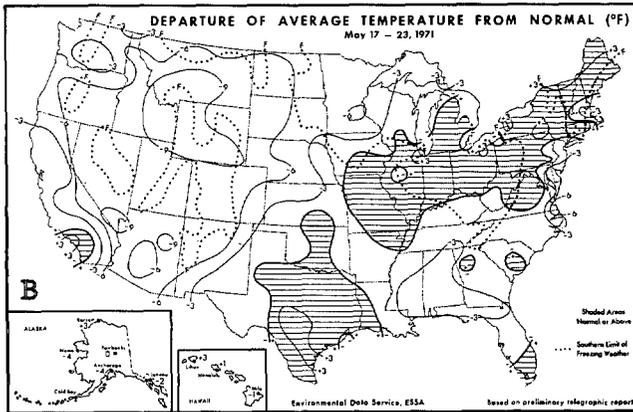
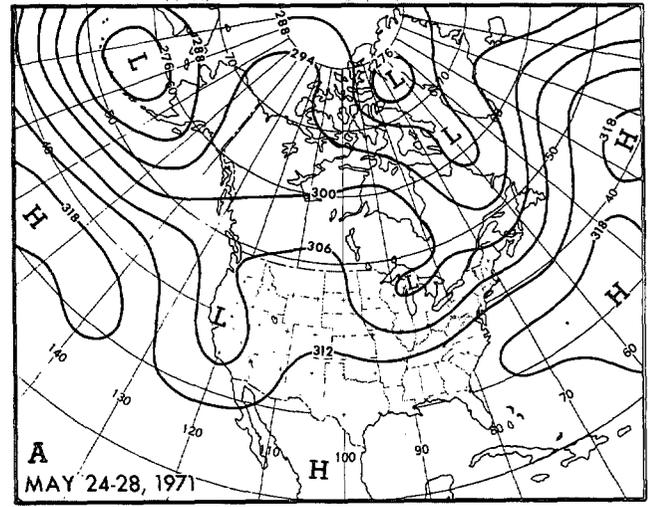
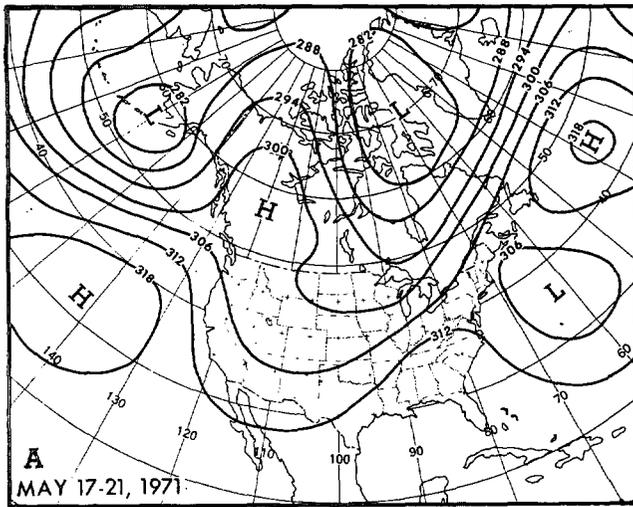


FIGURE 9.—Same as figure 7, (A) for May 17-21, 1971, and (B) and (C) for May 17-23, 1971.

FIGURE 10.—Same as figure 7, (A) for May 24-28, 1971, and (B) and (C) for May 24-30, 1971.

the central part of the United States last week moved eastward, and a ridge took its place from Texas to Montana. A new trough appeared over the West Coast States and replaced the ridge formerly there. This adjustment of major features caused mean temperatures over the Northern Rocky Mountains to increase by as much as 15°F (fig. 10B). Cooling occurred over most of the eastern two-thirds of the United States, associated with the mean trough. The Southwest remained cool with some daily maximum temperatures as much as 20°-30°F below normal. The drought was lessened as up to 2 in. of rain fell in northern Texas and western Oklahoma (fig. 10C); the drought remained serious, however, in most of southern Texas. Rainfall that accompanied the mean trough in the West generally averaged less than an inch, but some parts

of Oregon reported flash flooding following locally heavy rains of 1-3 in. as a deep shortwave trough entered the West at midweek. Precipitation of 1-2 in. in the eastern half of the Nation came principally from a storm early in the week that deepened markedly as it approached the Great Lakes. By the end of the week, a second storm spread rain into the Great Plains.

REFERENCES

Environmental Data Service, NOAA, U.S. Department of Commerce, and Statistical Reporting Service, U.S. Department of Agriculture, *Weekly Weather and Crop Bulletin*, Vol. 58, Nos. 19-23, May 3, 10, 17, 24, 31, 1971.
 Namias, J., "The Annual Course of Month-To-Month Persistence in Climatic Anomalies," *Bulletin of the American Meteorological Society*, Vol. 33, No. 7, Sept. 1952, pp. 279-285.