

THE WEATHER AND CIRCULATION OF DECEMBER 1970

Cold and Wet in the North and Far West With Mild, Relatively Dry Conditions Elsewhere

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1. MONTHLY MEAN CIRCULATION

Principal monthly mean circulation features continued to move eastward this month in middle latitudes while the retrogression of the two previous months in higher latitudes seemed to be over. Some blocking remained in eastern Siberia and weakened appreciably, but the most dominant feature of the Northern Hemisphere this month (figs. 1 and 2) was the blocking regime that became established over the eastern Atlantic. This blocking expanded from an area of weak high pressure near Greenland in November to an impressive ridge with

700-mb heights in December as much as 140 m above normal.

The trough off the east coast of North America contributed to this blocking and widespread amplification in the North Atlantic. This deep system averaged 100 m below normal near Newfoundland and was a notable change from November. As westerlies increased over the United States, the weak trough formerly over the Central States deepened by 150 m, relative to normal. Meanwhile, 700-mb heights increased by as much as 200 m near Scotland (fig. 3). This pattern produced a split in the

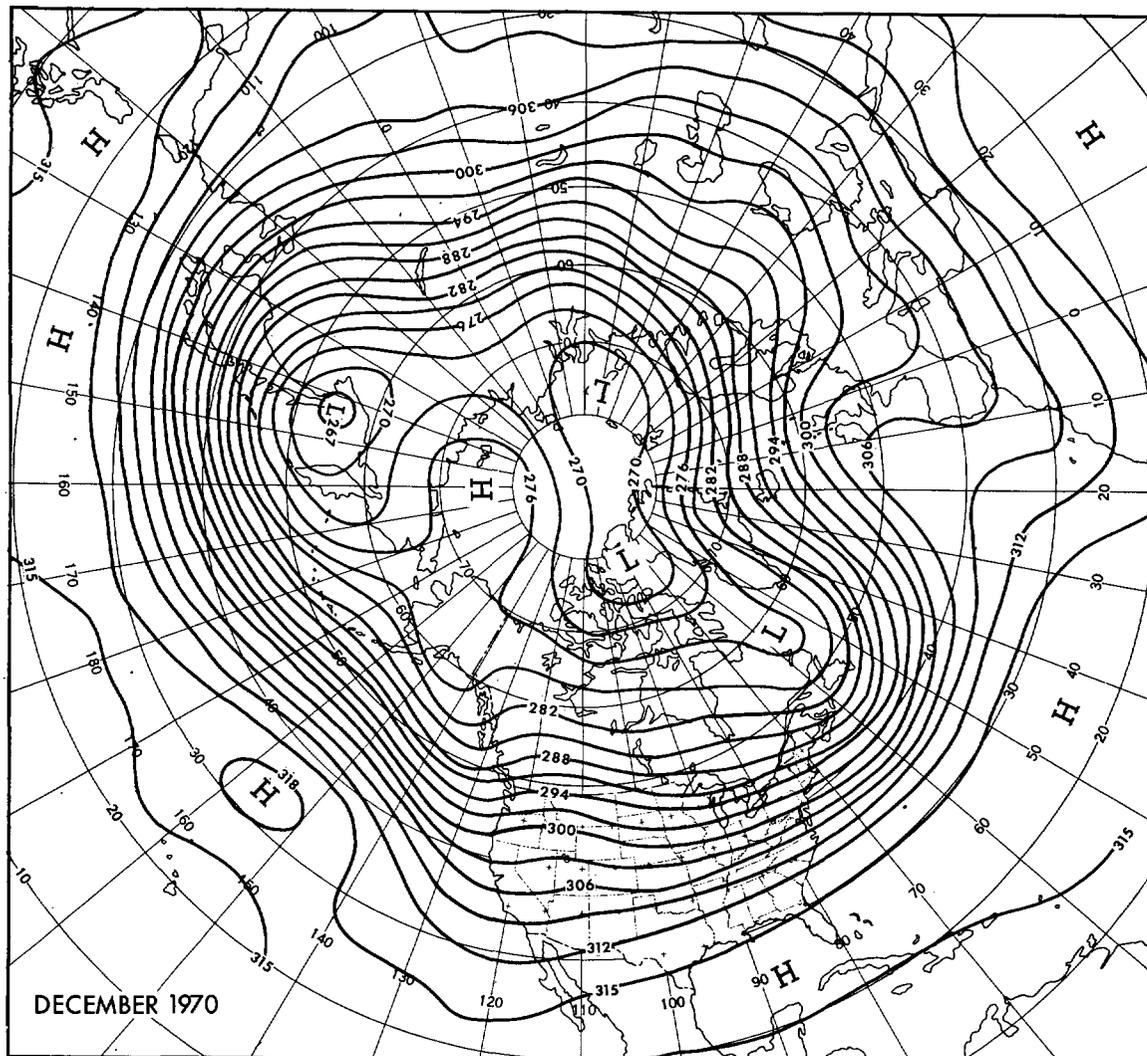


FIGURE 1.—Mean 700-mb contours (dekameters) for December 1970.

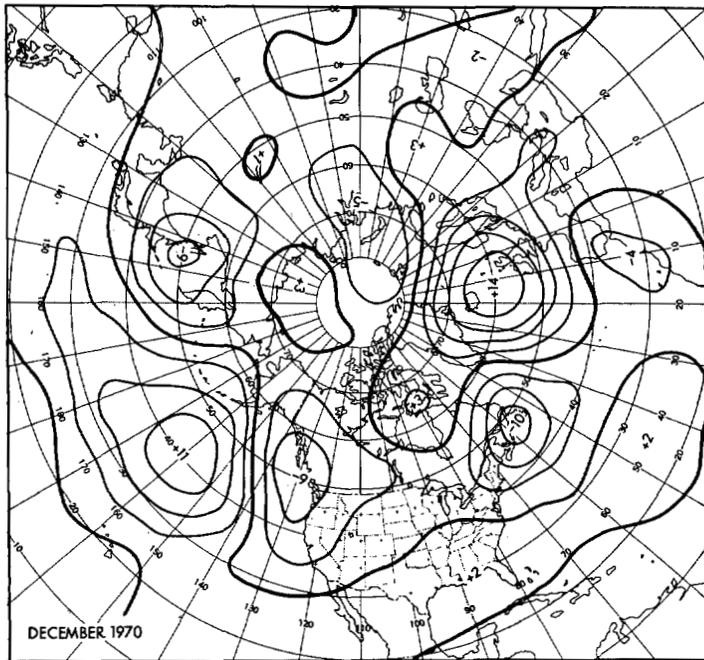


FIGURE 2.—Departure from normal of the mean 700-mb height (dekameters) for December 1970.

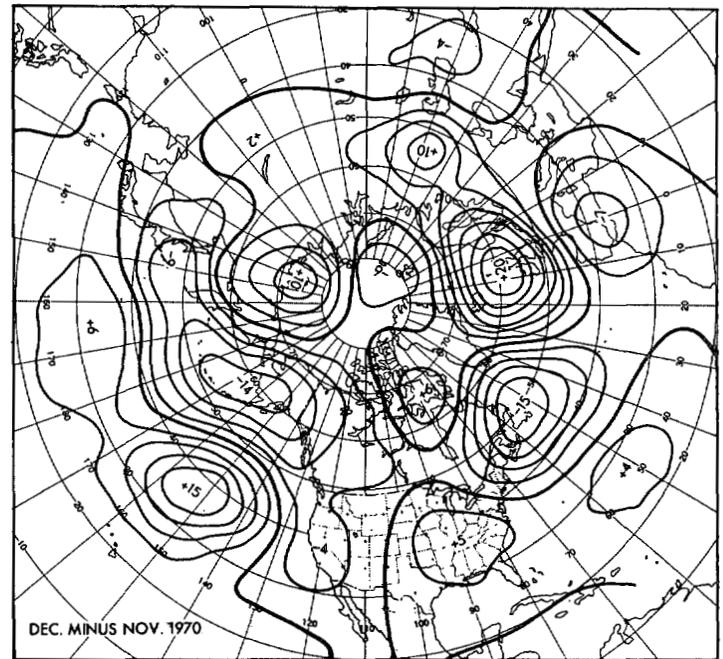


FIGURE 3.—Mean 700-mb height anomaly change (dekameters) from November to December 1970.

700-mb jet stream (fig. 4). The main branch, and also the principal track of storminess, extended from south of Nova Scotia northeastward and passed over Iceland to northern Scandinavia. The southern branch reached south of 25°N into North Africa, with some severe storms in the Mediterranean during the last half of the month. This southern track is also shown by the axis of negative height anomaly (fig. 2) and by figure 3 that shows the 70-m decrease of heights in the western Mediterranean.

Downstream from the blocking ridge, 700-mb heights averaged only a few meters below normal in the trough that extended from the Arctic to the Black Sea. Instead of deepening in response to amplification upstream, heights increased from November to December by 60–100 m at 50° – 60°N .

In eastern Asia, the coastal trough deepened to about 90 m below normal in the Sea of Okhotsk. This intense circulation produced a strong 700-mb jet stream at its normal latitude with average maximum wind speeds of more than 25 m s^{-1} just east of Japan, about 5–10 m s^{-1} faster than normal.

The ridge in the central Pacific in November lost some of its amplitude in December as 700-mb heights fell by 120–140 m in the eastern Bering Sea. Height decreases extended from Hokkaido through the Aleutians and into western Canada. This along with height increases in middle latitudes in the central Pacific made a much flatter and faster westerly flow with average speeds more than 5 m s^{-1} above normal in the eastern Pacific. The ridge remained 90–100 m above normal in the central Pacific but moved

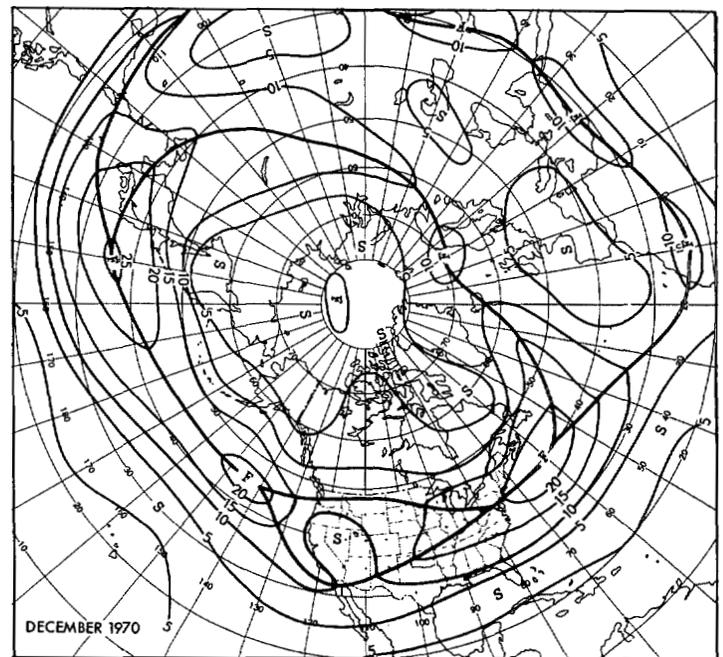


FIGURE 4.—Mean 700-mb isotachs (m/s); heavy lines indicate principal axes of maximum wind speed.

10° farther east this month.

The trough that formerly extended from Hawaii to southeastern Alaska deepened slightly and moved to the Alaska-British Columbia coast in the north and into California in the south. This caused a very short half-wave length to the ridge over western North America that re-

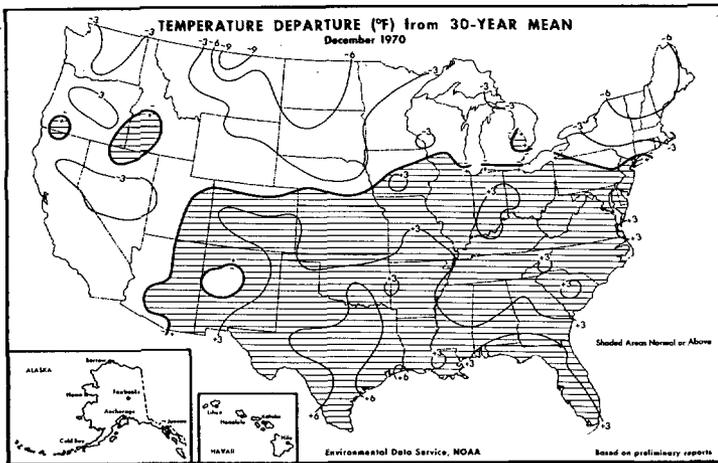


FIGURE 5.—Departure from normal of average surface temperature (°F) for December 1970 (from Environmental Data Service and Statistical Reporting Service 1971).

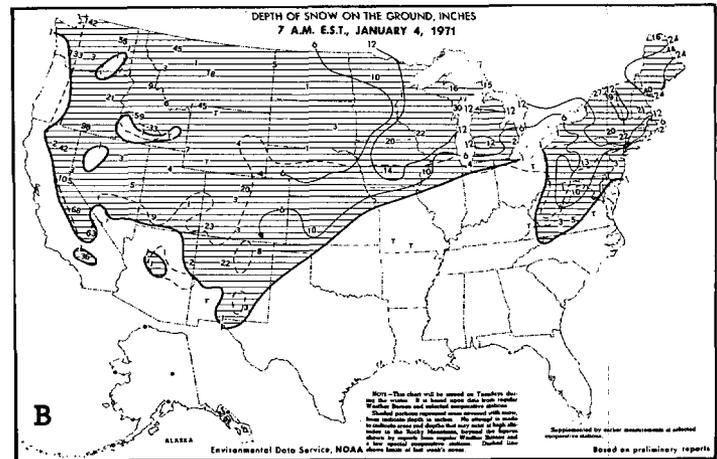
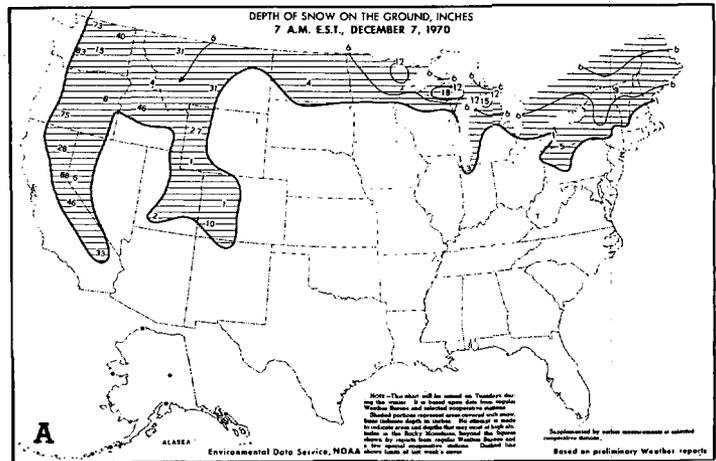


FIGURE 7.—(A) depth of snow on the ground (inches) at 7 a.m. EST on Dec. 7, 1970, and (B) the same for Jan. 4, 1971 (both from Environmental Data Service and Statistical Reporting Service 1970-1971).

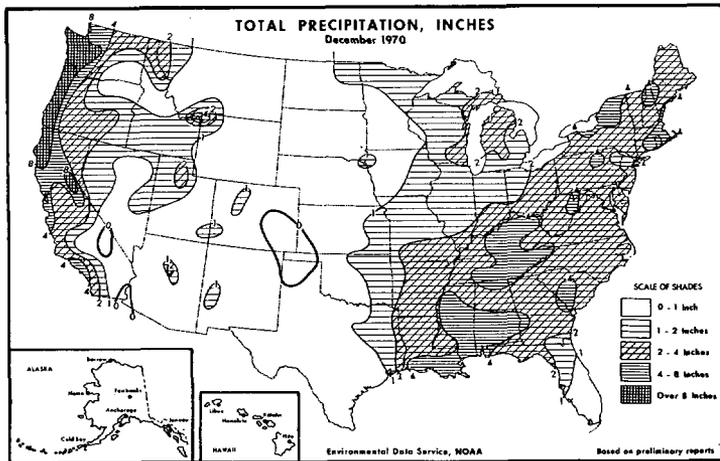


FIGURE 6.—Total precipitation (inches) for December 1970 (from Environmental Data Service and Statistical Reporting Service 1971).

remained stationary but weaker than last month with heights lower than normal. This is a favorite longitude for ridges in winter and, in the average westerly flow, creates a long half-wave length to the next trough to its east.

The split in the 700-mb jet over the western United States also occurs frequently, almost a climatological feature in December. From the Southwest, this branch accompanied by many surface storms moved eastward and met the northern branch again. The greatest speed was found in the trough that became anchored over the western Atlantic.

2. MONTHLY MEAN WEATHER

Temperatures averaged a few degrees below normal over the Far West (fig. 5) and in the northern Plains States, with the greatest departures in parts of Montana and North Dakota (-6° to -9° F). From the Great Lakes to

New England, temperatures were 3° – 6° F below normal and were lowest where 700-mb heights were lowest. The remaining portions of the United States had temperatures that averaged a few degrees above normal with greatest departures of 6° – 7° F in Texas. No new monthly records were reported in December.

Precipitation was heavy along the Pacific Coast (fig. 6) where amounts totaled 4–8 in. This precipitation accompanied a very active mean trough along the West Coast from which came more than a dozen upper air troughs and almost as many major surface storms. This great activity left a large increase in the snow cover in the West and in the Great Lakes. In the Northeast, the snow cover increased when these storms gained additional moisture from the Gulf of Mexico and Atlantic sources. Figures 7A and 7B show the snow cover at the beginning and end of December. Sizable increases occurred in the West (Stampede Pass, Wash., increased by 50 in.), the upper Mississippi Valley, and the Northeast. Record snowfall is listed in table 1.

TABLE 1.—Snowfall records established in December 1970

City	Amount (Inches)	Remarks
Burlington, Vt.	56.7	All time record
Alpena, Mich.	46.3	December record
Rochester, N. Y.	44.2	December record
Boston, Mass.	27.9	December record for 100 yr
Madison, Wis.	16.0	All time 24-hr record
Lansing, Mich.	15.1	All time 24-hr record
Fairbanks, Alaska	----	Heaviest Sept.-Dec.

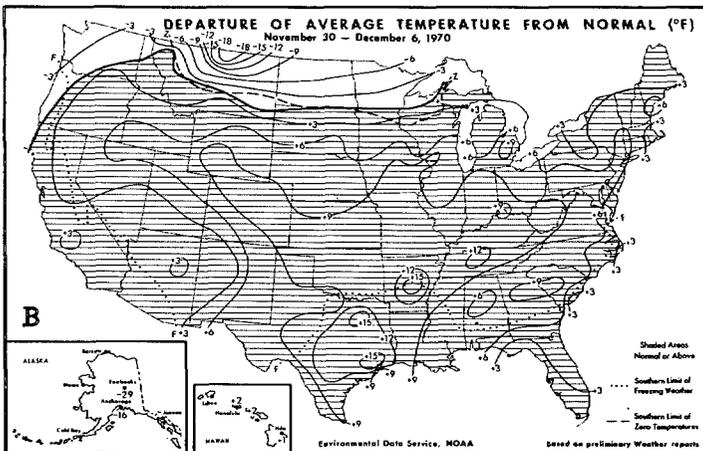
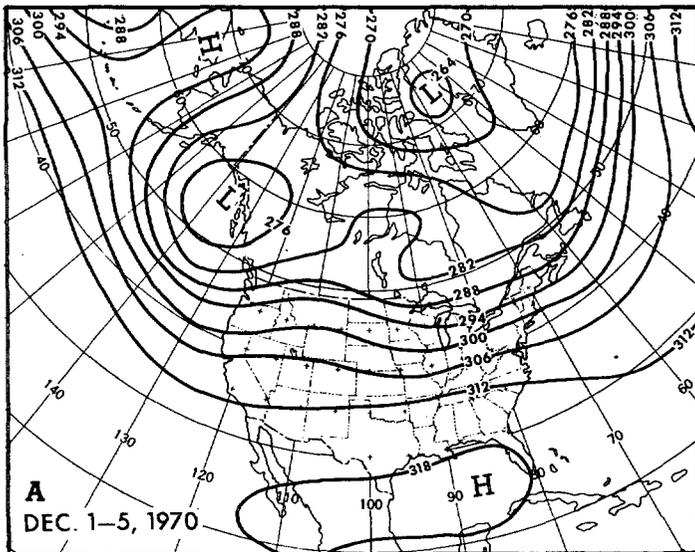


FIGURE 8.—(A) mean 700-mb contours (dekameters) for Dec. 1-5, 1970, and (B) departure of average surface temperature from normal (°F) for Nov. 30-Dec. 6, 1970 (from Environmental Data Service and Statistical Reporting Service 1970).

Precipitation in the East of 2-5 in. was about normal or slightly less. Precipitation records were few this month. They include a 24-hr rainfall record for December at Louisville, Ky. (1.96 in.), and Long Beach, Calif. (2.36 in.). Amarillo, Tex., reported a trace this month to end the driest year of record.

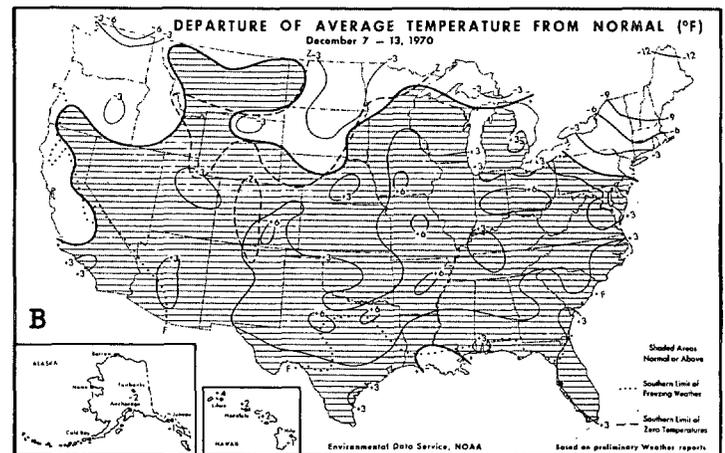
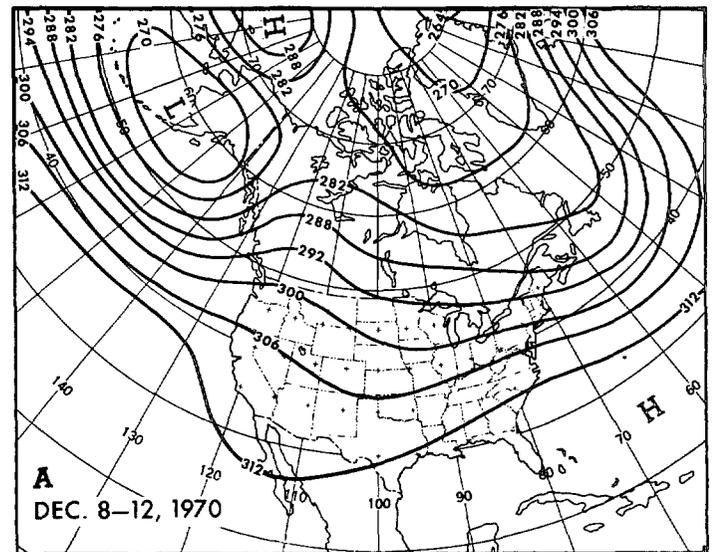


FIGURE 9.—Same as figure 8, (A) for Dec. 8-12, 1970, and (B) for Dec. 7-13, 1970.

3. WEEKLY VARIABILITY

A deep cyclonic center of action in the Gulf of Alaska this first week of December (fig. 8A) resulted in a strong flow of Pacific air over the United States. The 5-day mean 700-mb chart also showed a small-amplitude trough from Hudson Bay to Illinois. In this area, three vigorous shortwave troughs, which originated in the longwave trough off the west coast, produced very active surface storms. Mild weather prevailed over most of the Nation (fig. 8B) as maritime air brought temperatures of 6°-9°F above normal from the central Rockies to the east coast. Temperatures reached record daily highs in 21 States in the eastern half of the Nation. In contrast, temperatures averaged as much as 8°F below normal in western Montana. Precipitation along the West Coast totaled 2-4 in. from Washington to central California, associated with the mean trough in the eastern Pacific. The storms that came out of this trough after leaving the West produced generally less than an inch of precipi-

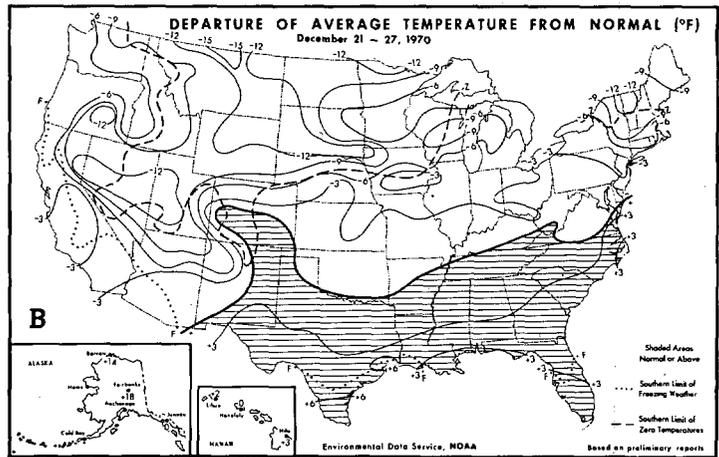
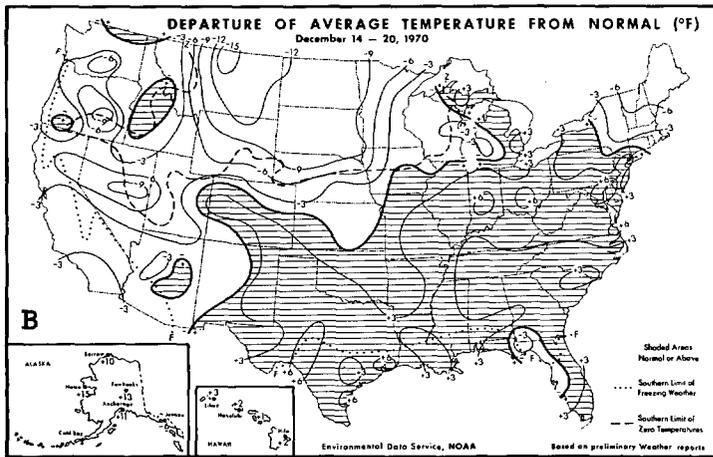
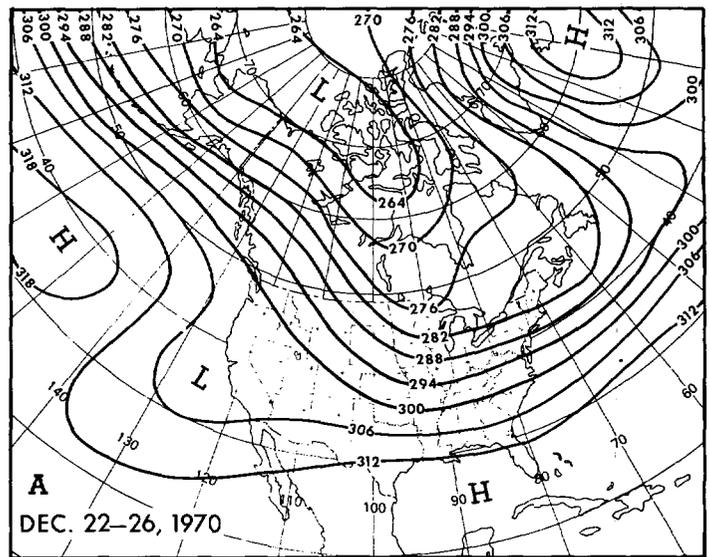
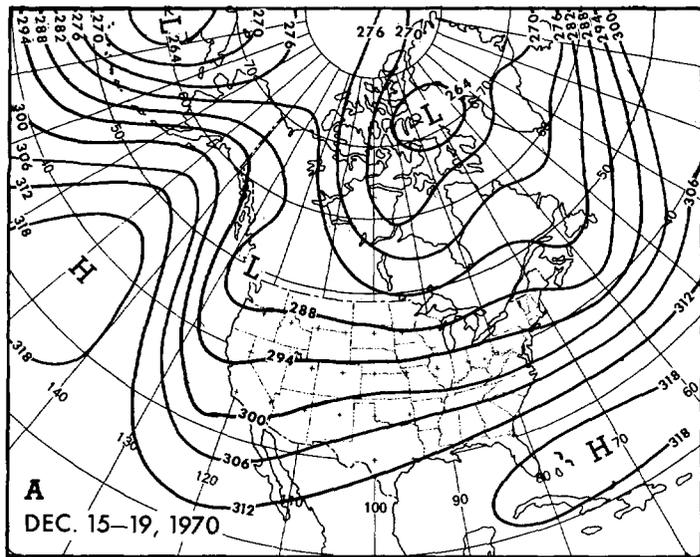


FIGURE 10.—Same as figure 8, (A) for Dec. 15-19, 1970, and (B) for Dec. 14-20, 1970.

FIGURE 11.—Same as figure 8, (A) for Dec. 22-26, 1970, and (B) for Dec. 21-27, 1970.

tation in the States from Minnesota through the Great Lakes to New England, including 6-12 in. of snow in parts of Minnesota and Michigan.

Five-day mean 700-mb flow remained generally westerly during the second week of December (fig. 9A) as most of the trough formerly along the West Coast moved eastward and weakened. The Gulf of Alaska Low appeared about 25° west of last week's position as high-latitude blocking receded farther into Siberia. The ridge in western North America was only slightly higher than normal, so conditions favored continued domination by maritime air masses with little chance of prolonged cold over a large area. Temperatures were lower than last week over most of the Nation (fig. 9B) with some averages lower than normal in New England, the northern Plains States, and in the Pacific Northwest. Otherwise, temperatures averaged 3°-6°F above normal east of the Rockies where mild weather was interrupted by only one cold outbreak early in the week. In the lee of the Rockies and under strong westerly flow, temperatures reached 77°F at Pueblo,

Colo., and 73°F at Grand Island, Nebr., both new daily records, as chinook warming prevailed. As most of the West Coast trough moved eastward, precipitation of less than an inch spread across the Rockies. Principal surface storminess appeared in the central Plains States and spread about an inch of precipitation from Louisiana to the Ohio Valley and from Iowa to southern New England. In northern areas, several inches of snow fell with record 24-hr amounts at Madison, Wis., and Lansing, Mich.

The circulation underwent a major change by the third week of December (fig. 10A) as 700-mb heights increased by more than 300 m in the Gulf of Alaska. The Aleutian Low of last week was transferred to southern British Columbia as heights fell a maximum of 150 m over the Great Basin. This flow produced a trajectory from Alaska to the subtropics of the eastern Pacific and transported cold air into the Far West and northern Plains States (fig. 10B). Southwesterly flow across the country prevented any sustained advection of cold air into most of the eastern half of the Nation where temperatures averaged a few

degrees above normal. The lowest reported temperature was -36°F in northwestern Minnesota. Fairbanks (under the strong 700-mb ridge) averaged 42°F higher than last week when the mean temperature was -29°F with a Low in the Gulf of Alaska. Precipitation was heavy along the West Coast, and most areas received 2-4 in. as three more storms came out of the major trough along the West Coast. Another area of rain of an inch or more, and to 4 in. in Georgia and Alabama, included the lower Mississippi Valley and the Middle Atlantic States. As a storm of Pacific origin crossed the South, it picked up Gulf of Mexico moisture, then deepened as it moved toward Nova Scotia. This severe storm created thunderstorms in the South, heavy snow in the Northeast (Portland, Maine, had 20 in. in 12 hr), and very strong winds in the eastern Atlantic.

Mean 700-mb flow during the fourth week of December in the eastern Pacific returned to a much less amplified pattern (fig. 11A) as the strong ridge formerly over Alaska weakened and moved into an area west of Canada. Some of the trough remained off California, but the major vorticity moved into central United States. Meanwhile, blocking became very strong over the North Atlantic, with above-normal heights appearing in eastern Canada. Temperatures remained above normal from Texas to the

South Atlantic States but averaged below normal elsewhere (fig. 11B). Greatest departures occurred in the Great Basin and in the northern Plains States, both of which reported temperatures more than 14°F below normal. Parts of the Northeast also were 9° - 12°F below normal. Some extremes included -36°F in Minnesota and 82°F at Macon, Ga. Temperatures reached 0°F or lower over parts of the Great Basin, the northern Rockies, and the Plains States as far south as Nebraska. Precipitation amounted to less than an inch except in the Tennessee and Ohio Valleys, parts of the Gulf Coast, and New England. Heaviest snow fell over northern Arizona (21 in. in 48 hr at Flagstaff) and at Portland, Maine (17 in.). On the last day of December, a new storm formed along the gulf coast and moved northeastward, accompanied by heavy snow from the southern Appalachians to New England, with amounts to 2 ft in mountain areas of Maryland and Virginia.

REFERENCE

Environmental Data Service, NOAA, U.S. Department of Commerce, and Statistical Reporting Service, U.S. Department of Agriculture, *Weekly Weather and Crop Bulletin*, Vol. 57, Nos. 49-52, Vol. 58, Nos. 1-2, Dec. 7, 14, 21, 28, 1970, and Jan. 4 and 11, 1971.