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THE WEATHER AND CIRCULATION OF NOVEMBER 1970

Unusually Warm and Wet in the West, Cool and Dry in the Southeast, With Strong Blocking in the Central Pacific

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1. MEAN CIRCULATION

Warm moist air flowed into the West this November from a trough that deepened in the eastern Pacific as blocking retrograded from Canada. The blocking helped to develop a central Pacific ridge into the most anomalous feature of the mean 700-mb circulation; associated positive height departures extended from the western Pacific to central Canada, with a center of 180 m over the eastern Aleutians (figs. 1 and 2). The mean jet axis was diverted well northward from normal by the ridge, although a branch remained south of the normal path across the eastern Pacific and most of the United States (fig. 3).

Retrogression of the major center of blocking from the October location in eastern Canada is illustrated by half-month height anomaly charts for November (figs. 4A and 4B). Shown there is the large positive center that retrograded first to northwestern Canada from the Maritime Provinces, then to the Aleutians. Another notable feature

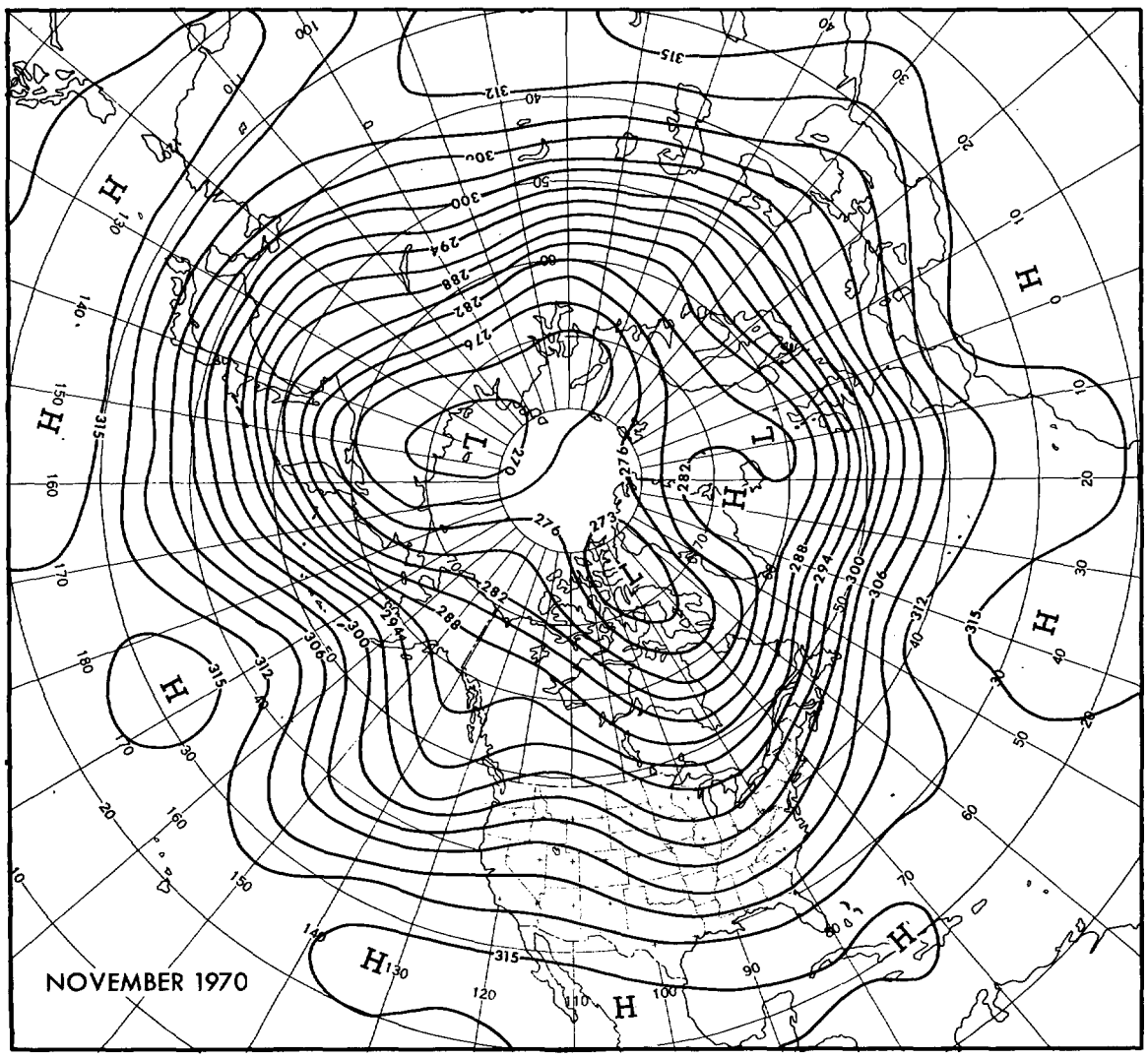

FIGURE 1.—Mean 700-mb contours (decameters) for November 1970.

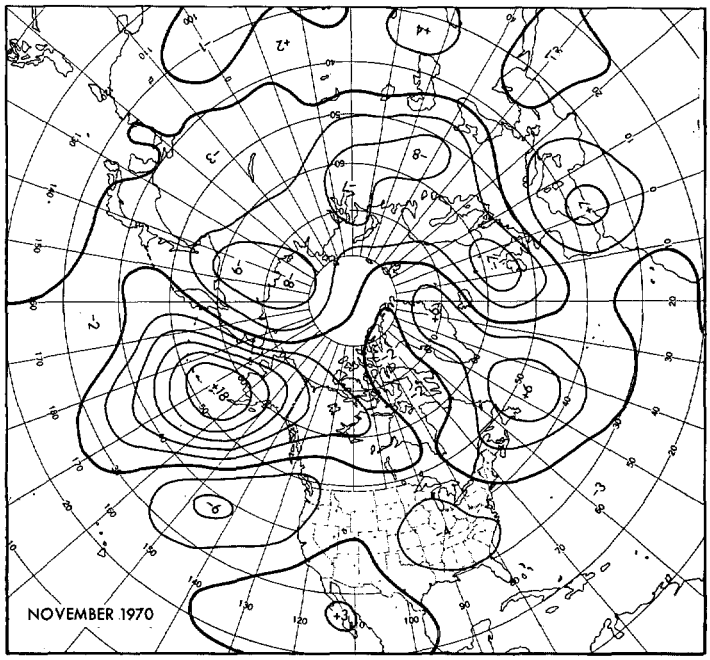

FIGURE 2.—Departure from normal of mean 700-mb height (decameters) for November 1970.

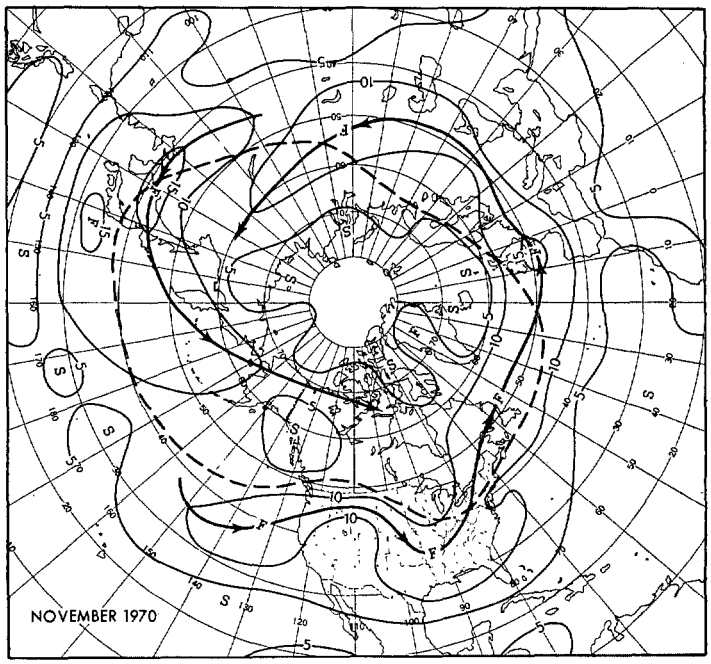

FIGURE 3.—Mean 700-mb isotachs (meters per second) for November 1970. Heavy arrows indicate principal axes of maximum wind speed; dashed lines, the normal.

is the large negative area in the eastern Pacific during the first half of November. This was produced by height falls that typically occur in the southwestern sector of retrograding blocking waves.

While retrogression took place at high latitudes, mean waves progressed at middle latitudes from October to November. Over the United States, the western ridge and eastern trough advanced to positions slightly east of normal except over the Great Lakes (fig. 1). Meanwhile, the trough formerly over the western Atlantic was replaced by a ridge, and the eastern ridge was replaced by a trough. Negative height anomalies prevailed from a center near Great Britain (across northern Eurasia) to northeastern Siberia, and the principal axis of maximum westerlies was generally south of normal from the eastern Atlantic to Korea.

2. TEMPERATURE

Average temperatures in November were higher than normal in the Far West, central and southern Rocky Mountain States, and over the northeastern quarter of the United States; but they were lower than normal over the northern Great Plains and the Southeast (fig. 5). In the West and the Southeast, this pattern was reversed from that of October (Wagner 1971). Four southwestern cities, where temperatures had averaged much below normal in October, were much above in November; and numerous western cities had anomaly rises of two or three classes (of five). Much of this relative warming came from the change of mean wind direction from northwesterly to southwesterly, accompanied by advection of warmer air. In the southern Great Plains, warming accompanied the mean ridge as it progressed (fig. 1). Anomaly decreases by two to three classes in the Southeast were associated with eastward progress of the mean trough. The average temperature of 62.6°F at Lakeland, Fla., was a record low for November. Outstanding among temperature highlights of the month was a sharp, brief cold spell that began in the northern Rockies on November 22 and produced the lowest minima of record for the month at several southeastern cities on the morning of November 25 (table 1).

3. PRECIPITATION

It was wetter than normal over much of the West and from the northern Great Plains to the Middle Atlantic coast (fig. 6). More than four times the normal precipitation fell in parts of California where abundant moisture was supplied by southwesterly flow from lower latitudes of the Pacific (figs. 1 and 2). California stations with long periods of record that reported their second wettest Novembers were Sacramento (7.44 in.) and Red Bluff (8.42 in.); both were exceeded only in 1885. Record snowfall of 41.9 in. accumulated at Mt. Shasta, but the water equivalent ranked only seventh. East of the Continental Divide, precipitation was heaviest along the zone of anomalous easterly flow during the first half of the month, when the circulation was most cyclonic (fig. 4) and daily storms were most numerous (not shown).

It was drier than normal in most Central States and Southern States. Jacksonville, Fla., with a trace had the driest November of record. It was the first November since 1945 that no rain at all fell at Tucson, Ariz.

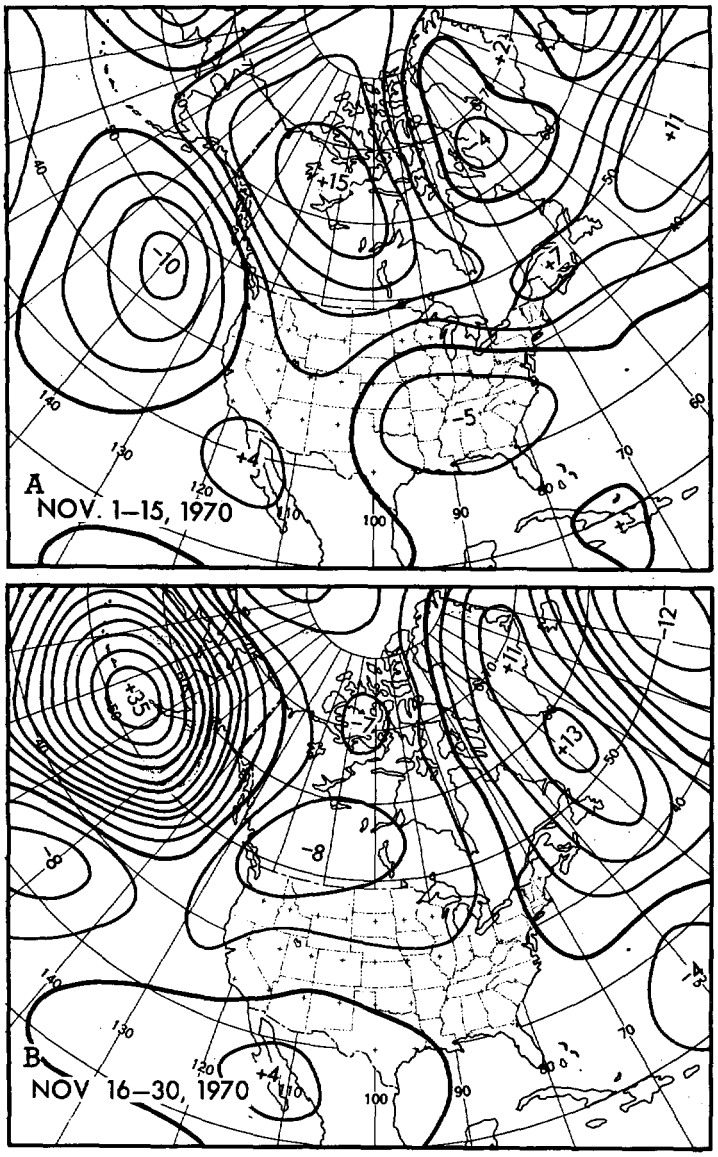

FIGURE 4.—Departure from normal of mean 700-mb height (decameters) for (A) Nov. 1–15, 1970, and (B) Nov. 16–30, 1970.

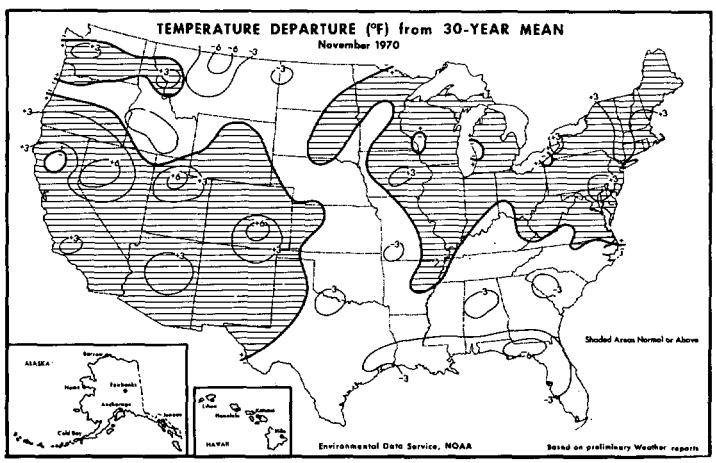

FIGURE 5.—Departure from normal of average surface temperature (°F) for November 1970 (from Environmental Data Service and Statistical Reporting Service 1970).

TABLE 1.—*Record low and high temperatures during November 1970*

Station	Temperature (°F)	Date	Remarks
Astoria, Oreg	71, 68	2, 3	Highest so late in season
Medford, Oreg	75	2	Do.
Salem, Oreg	72	2	Do.
Brownsville, Tex	35	16	Lowest so early in season
Williamsport, Pa	32	17	Latest first autumn freeze
Birmingham, Ala	13	24	Lowest so early in season
Athens, Ga	15	24	Do.
Augusta, Ga	18	24	Do.
Savannah, Ga	20	24	Do.
Reno, Nev	75	24	Highest so late in season
Charlotte, N.C	16, 13	24, 25	Lowest so early in season
Raleigh, N.C	15, 11	24, 25	Do.
Charleston, S.C	21	24	Do.
Greenville-Spartanburg, S.C	14	24	Do.
Abilene, Tex	15	24	Do.
Roanoke, Va	12	24	Do.
Jacksonville, Fla	21	25	Do.
Key West, Fla	50	25	Do.
Miami, Fla	40	25	Do.
Tallahassee, Fla	13	25	Lowest for month
Tampa, Fla	23	25	Do.
New Orleans, La	24	25	Lowest so early in season
Greensboro, N.C	10	25	Do.
Columbia, S.C	12	25	Lowest for month
Lynchburg, Va	8	25	Do.
Denver, Colo	76	25	Highest so late in season
Little Rock, Ark	79, 76	28, 30	Do.
Brownsville, Tex	86	28	Do.
Chattanooga, Tenn	74	29	Do.
Atlanta, Ga	76	30	Do.
Macon, Ga	82	30	Do.
Jackson, Miss	81	30	Do.
North Platte, Nebr	71	30	Do.

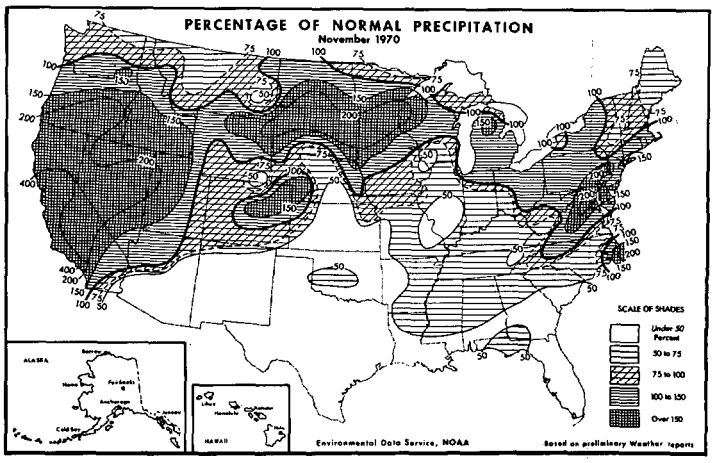

FIGURE 6.—Percentage of normal precipitation for November 1970 (from Environmental Data Service and Statistical Reporting Service 1970).

4. WEATHER BY WEEKS

Blocking was the dominant circulation feature of North America in early November. The mean ridge over western Canada was much stronger than normal, and deep troughs were located near both coasts of North America (figs. 7A and 7B). Freezing temperatures in the Deep South, where it was the coldest week of the season (fig.

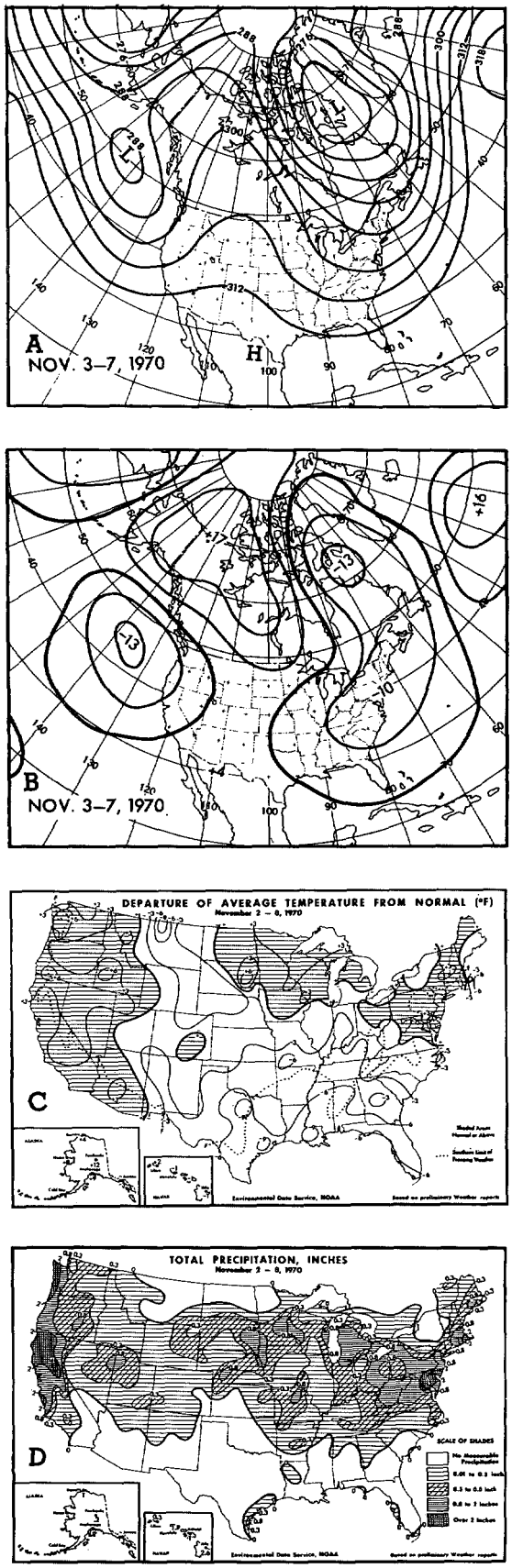

FIGURE 7.—(A) mean 700-mb contours and (B) departure from normal (both in decameters) for Nov. 3–7, 1970; (C) departure of average surface temperature (°F) and (D) total precipitation (inches) for week of Nov. 2–8, 1970 (from Environmental Data Service and Statistical Reporting Service 1970).

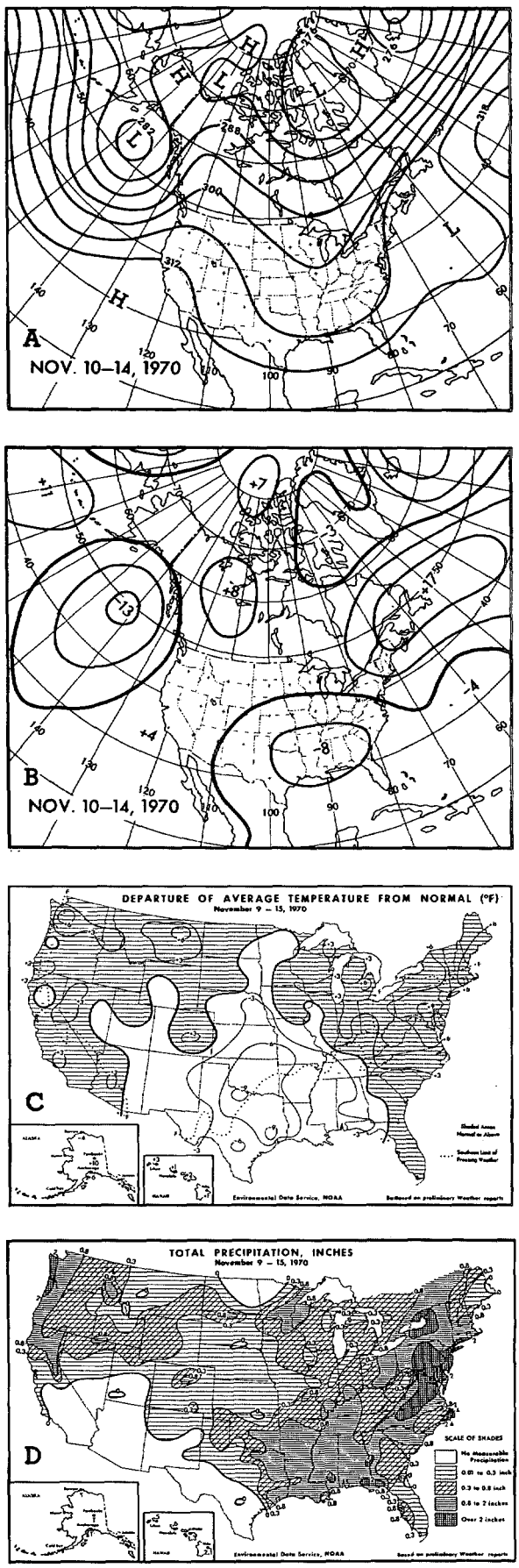

FIGURE 8.—Same as figure 7, (A) and (B) for Nov. 10–14, 1970; (C) and (D) for Nov. 9–15, 1970.

8C), followed the southward drift of a strong surface High from Saskatchewan. The first frost of the season was reported in Florida with record minima on November 5 at West Palm Beach and Miami. In South Dakota, near-blizzard conditions occurred on the night of November 2: and in Kentucky, the first snowfall of the season was reported the following night. In the Far West, where the flow aloft was southwesterly, temperatures averaged above normal, and it was wet (figs. 8C and 8D).

By the week of November 9–15, blocking had decreased in western Canada and increased over the Maritime Provinces, while mean troughs deepened in the South and the Gulf of Alaska (figs. 8A and 8B). As a consequence, temperature anomalies were higher in the northern Great Plains and the Northeast; but they continued low in the South (fig. 8C). Considerable cyclonic activity brought generous rains to most of the South (fig. 8D). The most active Low emerged from Texas late in the week, followed by a fresh outbreak of Canadian air. This cold air mass persisted over the Southeast, maintaining low temperatures there for several days.

During November 16–22, the dominant circulation feature over North America was a broad trough. Blocking had developed strongly in the north-central Pacific, while the Gulf of Alaska Low had moved southwestward and was replaced by a ridge. Heights were lower than normal in much of western Canada for the first time this month (figs. 9A and 9B). In response to these large changes in the circulation, temperature anomalies were generally higher over the West except in northern sections; and they were lower in the East (fig. 9C). The surge of cold air of the previous weekend brought record daily minima early this week in Georgia and the first killing frost to Maryland, Delaware, and the Carolinas. At the end of the week, a major arctic outbreak had begun in the northern Great Plains. Little or no precipitation fell over most of the West (fig. 9D).

While the blocking ridge in the Pacific continued to dominate the circulation of a large area through November 23–29, heights fell away over western North America, and a deep trough developed along the West Coast of the United States (figs. 10A and 10B). The mean flow over the United States became more westerly with little amplitude. The warming trend implied by this circulation was partially masked, however, by the tremendous magnitude of a cold spell as the week began. Almost every reporting station east of the divide had the lowest minimum of the month during the period November 22 to 25. Table 1 lists record low minima for the month and for so early in the season at many southeastern cities on November 24 or 25. Record daily minima were extremely numerous. The cold spell was short-lived, and temperatures in a number of States were above normal by midweek. Record maxima occurred in the Southeast late in the month (table 1). West of the Continental Divide and over the southern Great Plains, weekly temperature anomalies increased considerably (fig. 10C). Precipitation was sparse over

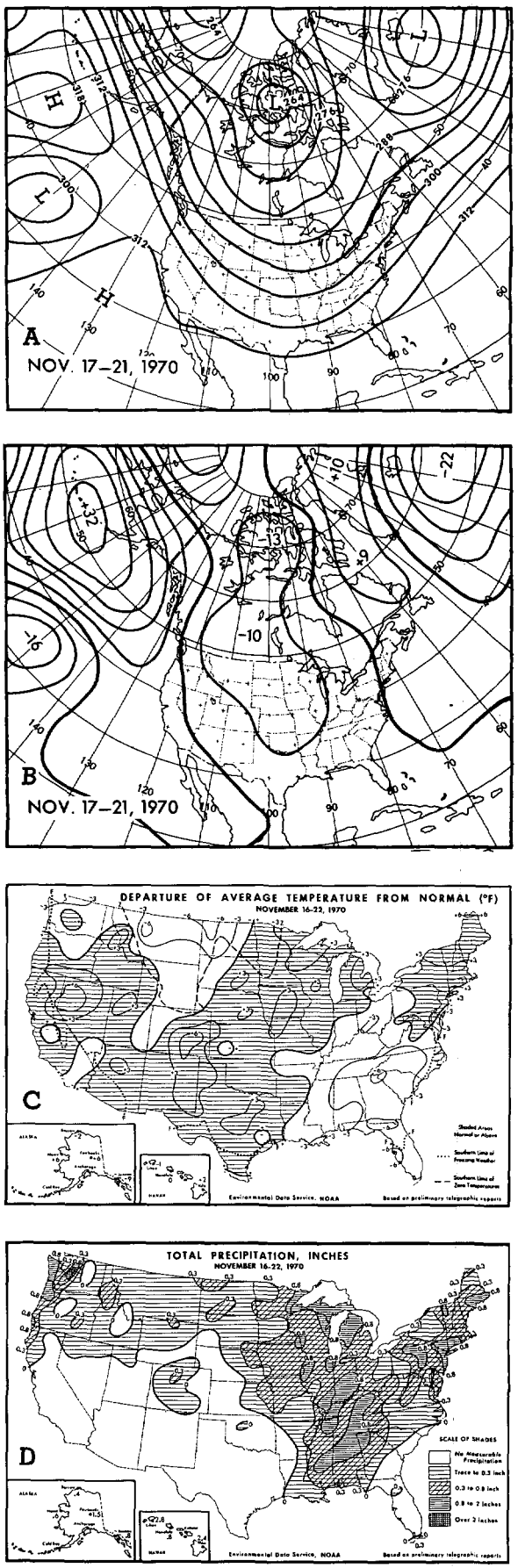

FIGURE 9.—Same as figure 7, (A) and (B) for Nov. 17–21, 1970; (C) and (D) for Nov. 16–22, 1970.

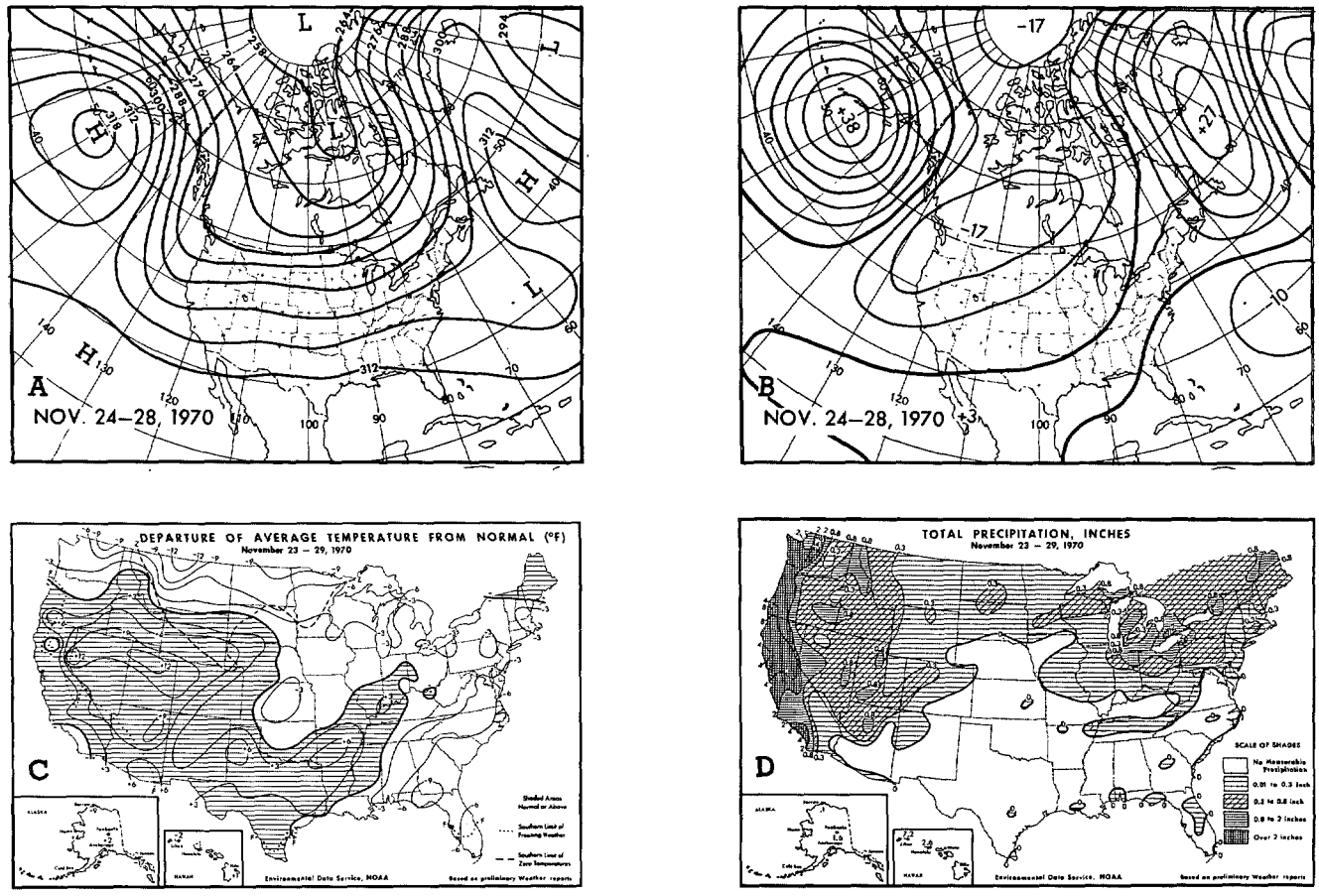

FIGURE 10.—Same as figure 7, (A) and (B) for Nov. 24–28, 1970; (C) and (D) for Nov. 23–29, 1970.

most of the Nation except in the Far West near the developing trough and leeward of the Great Lakes where the first big winter-type snowstorm occurred. Strong north winds gathered moisture from Lake Erie on November 23 and deposited so much snow along the traditional snowbelt that many roads were closed in western New York. Snow accumulated to depths of nearly 3 ft during the storm.

5. TROPICAL CYCLONES

Two very destructive storms occurred in the Tropics this month. A tropical cyclone with winds of nearly 150 mi hr^{-1} struck East Pakistan with disastrous results on November 12. The storm developed from a low-pressure area that crossed the Malay Peninsula and proceeded into the Bay of Bengal early this month. By the time the storm reached the mouth of the Ganges, it carried with it a 20-foot-high wall of water that took many lives. Late in the month, the official estimate was 153,000 deaths from the storm.

Typhoon Patsy took 172 lives as it crossed the northern Philippines on November 19. Patsy reached tropical storm intensity near Guam at midmonth, became a typhoon the next day, and followed a nearly straight westward course across Luzon and onward into the Philippine Sea.

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