

WEATHER AND CIRCULATION OF FEBRUARY 1971

A Stormy Month With a Marked Mid-Month Reversal in the Temperature Regime

A. JAMES WAGNER

National Meteorological Center, National Weather Service, NOAA, Suitland, Md.

1. MEAN CIRCULATION

The mean 700-mb circulation during February was characterized by an amplified planetary wave train from the central Pacific to eastern North America, with troughs and ridges near their normal positions but stronger than normal (figs. 1 and 2). The amplification may have been initiated by continued retrogression of the blocking ridge that had moved into the Bering Sea in January (fig. 1 of Posey 1971). This block was centered over the Tamyr Peninsula in February, where 700-mb heights

were 230 m above normal. This was an increase of 350 m with respect to normal compared to the previous month (fig. 3), when the expanding, retrograding block displaced a deep Low that had been near Novaya Zemlya (Posey 1971).

Heights fell south of the block over Asia and also downstream by as much as 180 m over the Bering Sea, where it had been the previous month (fig. 3). Another area of falls centered over the Davis Strait was associated with northward movement of the westerlies over the Atlantic, which was dominated by above-normal heights (fig. 2).

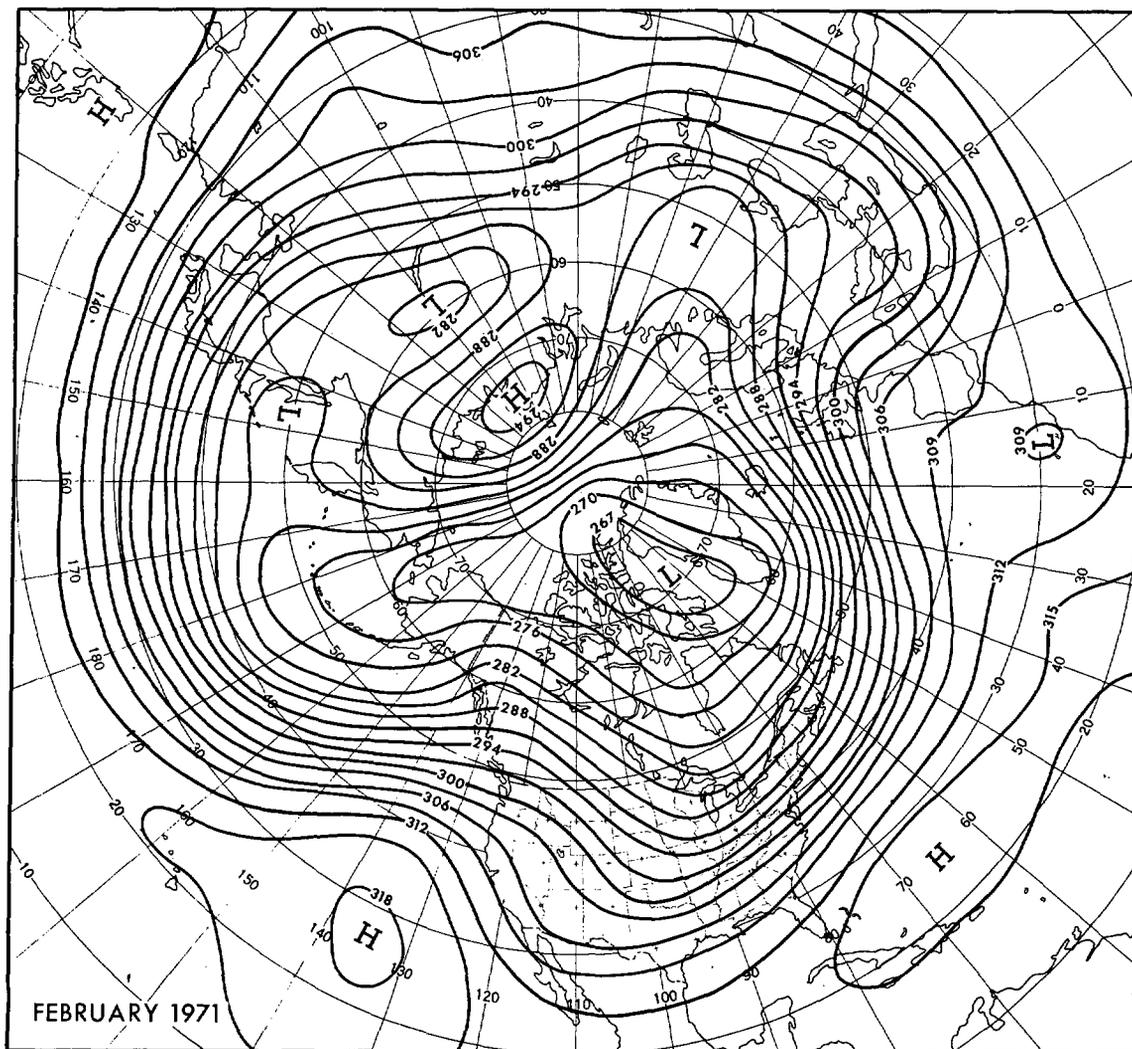


FIGURE 1.—Mean 700-mb contours (dekameters) for February 1971.

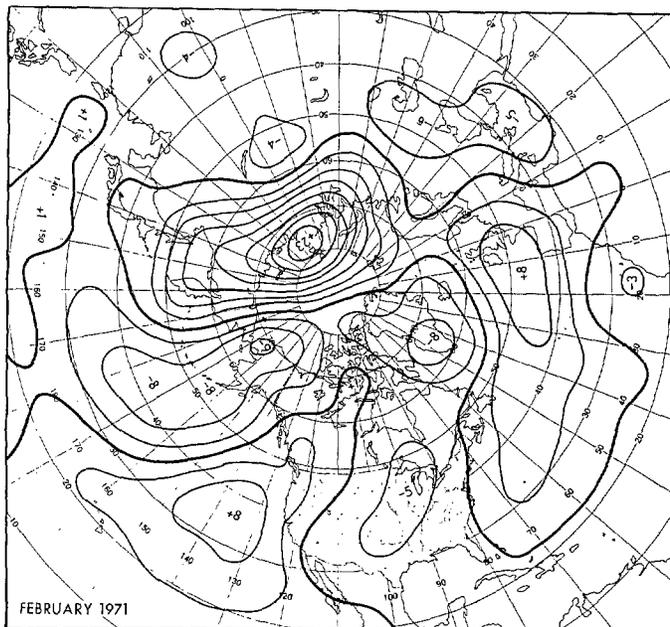


FIGURE 2.—Departure from normal of mean 700-mb height (dekameters) for February 1971.

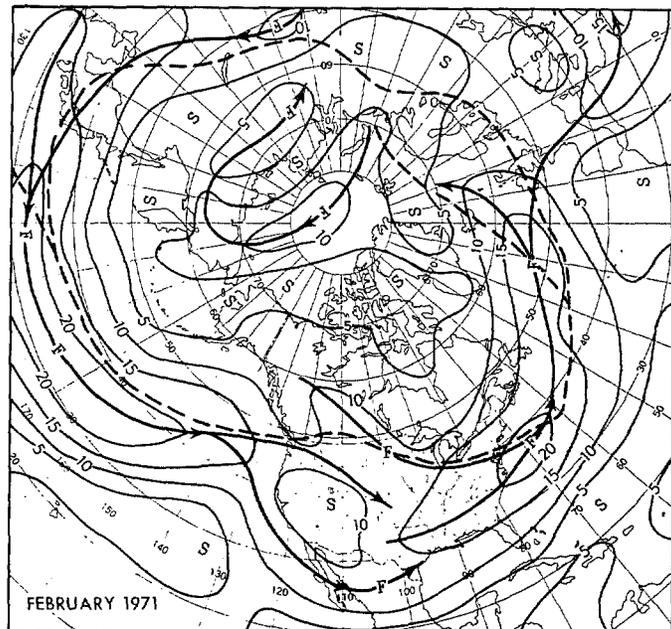


FIGURE 4.—Mean 700-mb geostrophic wind speed (meters per second) for February 1971. Solid arrows show principal axes of maximum wind speed, and dashed lines show the normal February positions.

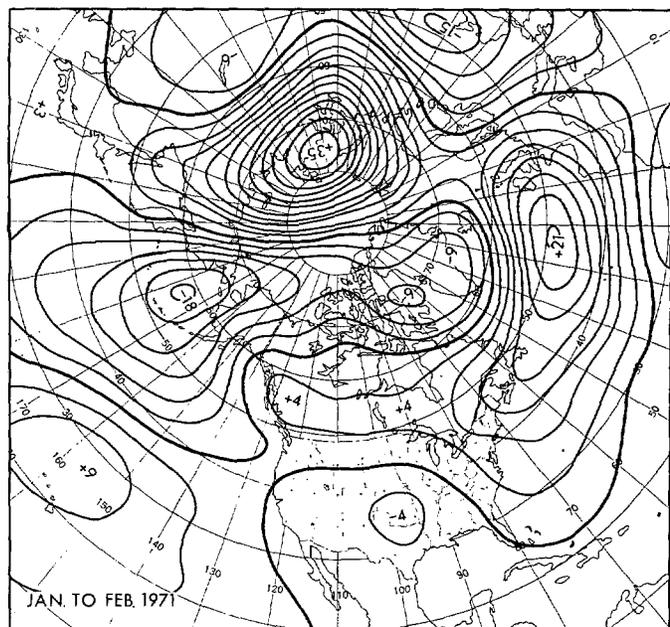


FIGURE 3.—Mean 700-mb height anomaly change (dekameters) from January to February 1971.

Heights rose strongly over the eastern Atlantic and the British Isles, where anticyclonic conditions again became established (figs. 1 and 3).

The 700-mb jet stream was strongest over both oceans, being somewhat south of normal over the Pacific and north of normal over the Atlantic (fig. 4). Speeds were above normal by as much as 11 m/s over the Pacific and 8 m/s over the Atlantic. The jet axis split into two branches as it approached the continents of North America and Europe.

The pattern was quite complex over North America, with no well-defined continuous jet across the continent. Most of the cyclones affecting the United States appeared to be related to the northern branch of the jet from the eastern Pacific and the southern branch of the Atlantic jet beginning over Texas. Only weak storms were associated with the branch beginning in western Canada. Noteworthy because of its unusual configuration was a small loop of wind maxima surrounding the strong block over the Siberian coast (fig. 4). A wind-speed maximum of almost 10 m/s from the east was defined south of the block.

2. MONTHLY TEMPERATURE

The monthly mean temperature anomaly pattern over the United States changed little from January to February, remaining generally warm in the West and cold in the East (fig. 5). Areas of greatest change were the marked cooling in the Central Plains, where a severe blizzard laid down a heavy snow cover, and the Northeast where temperatures moderated considerably after a bitter cold January (Posey 1971). Over the country as a whole, the temperature at 86 out of 100 stations remained within one class (*much above, above, near, below, or much below*) of the January value.

Due to a marked mid-month change in circulation (discussed later in the text), there were few extreme or record monthly mean temperature anomalies. Nome, Alaska, recorded its coldest February as bitter Arctic cold kept its grip on the northernmost State. Not until the end of the month did milder air intrude with sufficient

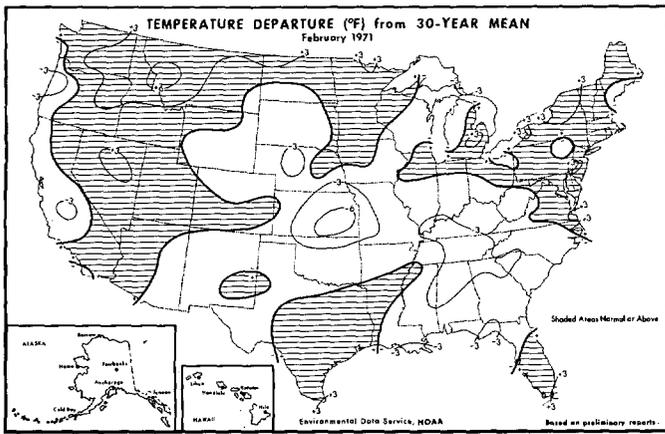


FIGURE 5.—Departure from normal of average surface temperature (°F) for February 1971 (from Environmental Data Service and Statistical Reporting Service 1971).

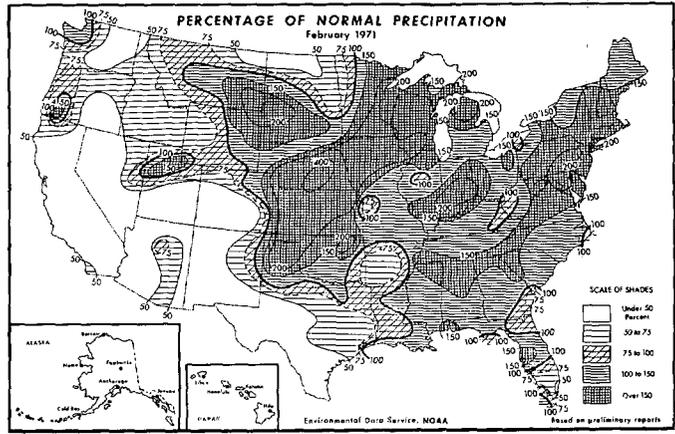


FIGURE 6.—Percentage of normal precipitation for February 1971 (from Environmental Data Service and Statistical Reporting Service 1971).

TABLE 1.—Monthly and seasonal temperature records established during February 1971

Station	Temperature (°F)	Date	Remarks
Raleigh, N.C.	6	2	Lowest Feb. min. on record
Tallahassee, Fla.	14	10	Do.
Red Bluff, Calif.	81	11	Highest so early in season
Long Beach, Calif.	91	12	Highest Feb. max. on record
Winnemucca, Nev.	69	12	Tied highest Feb. max.
Cape Hatteras, N.C.	76	22	Highest Feb. max. on record
St. Paul Island, Alaska	-13, -15	16, 22	Lowest Feb. mins. on record
Nome, Alaska	-42	25, 28	Tied lowest Feb. min.
	-11.6	---	Coldest Feb. on record
Boston, Mass.	---	26	Ended 85 consecutive days with mins. 32° F or below, longest string on record
Santa Maria, Calif.	22	27	Lowest Feb. min. on record

strength into New England to keep minimum temperatures above freezing at Boston, where a record 85-day stretch of subfreezing minima finally came to an end (table 1).

3. MONTHLY PRECIPITATION

In contrast to the relatively dry conditions prevailing over the country during January (Posey 1971), large portions of the central and eastern United States had unusually heavy precipitation during February (fig. 6). Several major storms gave extensive precipitation as the mean 500-mb trough retrograded from its January position near the east coast to the Great Plains during February (figs. 2 and 3). Due to generally low temperatures in the Ohio Valley and Great Plains, a large part of the precipitation in these areas was in the form of snow.

A large number of stations from the Great Plains through the Great Lakes and Ohio Valley eastward to the Middle Atlantic States reported record and near-record precipitation and snowfall totals during February 1971 (table 2). Only in the Far Southwest were conditions appreciably drier than normal. The dryness was most

TABLE 2.—Record and near-record monthly precipitation and snowfall during February 1971

Station	Amount (inches)	Anomaly (inches)	Remarks
Milford, Utah	18.8	-----	2d snowiest Feb. on record
Tulsa, Okla.	4.18	+2.41	4th wettest Feb. on record
Topeka, Kans.	3.49	+2.44	2d wettest Feb. on record
	22.4	-----	2d snowiest Feb. on record
Grand Island, Nebr.	3.39	+2.65	Wettest Feb. on record
Rapid City, S. Dak.	1.00	+0.52	2d wettest Feb. on record
	15.7	-----	2d snowiest Feb. on record
Sioux City, Iowa	2.66	+1.77	3d wettest Feb. on record
Waterloo, Iowa	3.54	+2.66	2d wettest Feb. on record
Rochester, Minn.	2.21	+1.41	Do.
St. Cloud, Minn.	21.6	-----	Snowiest Feb. on record
Duluth, Minn.	2.37	+1.41	4th wettest Feb. on record
Sault Ste. Marie, Mich.	3.74	+2.24	Wettest Feb. on record
	32.6	-----	2d snowiest Feb. on record
Houghton Lake, Mich.	3.36	+2.07	Wettest Feb. on record
Alpena, Mich.	3.17	+1.56	Greatest Feb. precip. since 1887
Columbus, Ohio	15.4	-----	3d snowiest Feb. on record
Cincinnati, Ohio (Abbe Observatory)	5.75	+2.95	2d wettest Feb. on record
	14.6	-----	3d snowiest Feb. on record
Providence, R.I.	5.36	+2.26	3d wettest Feb. on record
Allentown, Pa.	5.44	+2.80	2d wettest Feb. on record
Williamsport, Pa.	6.50	+3.99	Wettest Feb. on record
Wilmington, Del.	6.29	+3.34	2d wettest Feb. on record
Mount Shasta, Calif.	0.71	-5.70	Tied with Feb. 1896 for driest on record

anomalous in California, where less than an inch of precipitation fell at normally wet Mount Shasta and only 0.01 in. of rain fell during the first half of the month at Red Bluff. The unusually strong ridge just off the coast (figs. 1 and 2) deflected the Pacific storms, which normally affect this area in late winter, far to the north into the Gulf of Alaska.

4. WEEKLY WEATHER

FEBRUARY 1-7

The 700-mb circulation over North America during the first week of February featured an amplified full-latitude trough extending from Hudson Bay southwestward

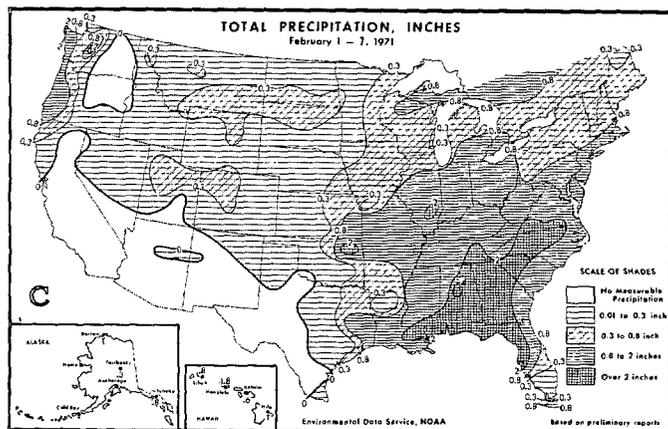
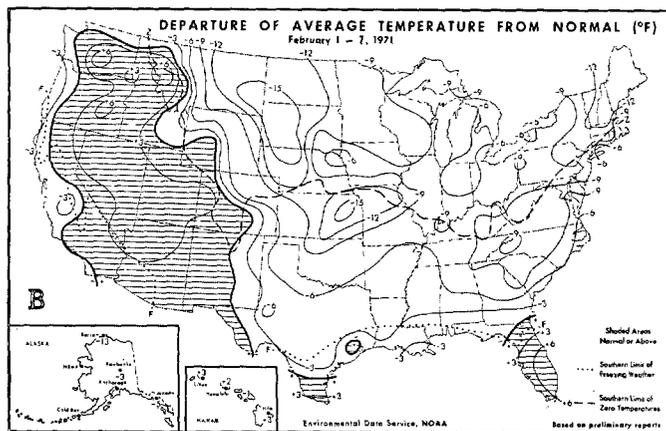
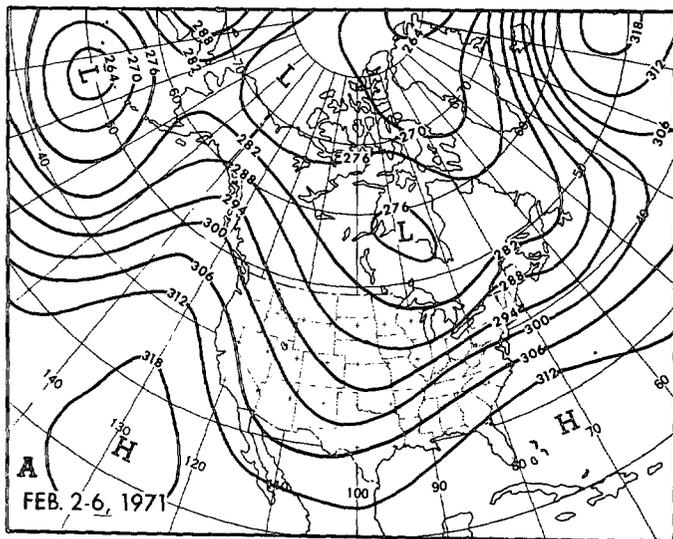


FIGURE 7.—(A) the mean 700-mb contours (dekameters) for Feb. 2-6, 1971; (B) departure from normal of average surface temperature ($^{\circ}\text{F}$) and (C) total precipitation (inches) for the week of Feb. 1-7, 1971 (from Environmental Data Service and Statistical Reporting Service 1971).

through the Great Plains to Mexico (fig. 7A). This trough was associated with much storminess over the eastern half of the Nation. The strong ridge off the west coast and the trough advected large quantities of Arctic air into the eastern two-thirds of the country (fig. 7B) where weekly

mean temperatures averaged as much as 15°F below normal over the Northern and Central Plains. Several stations in the Northeast reported record low daily minimum temperatures on the first few days of the month. Readings were as low as -26°F at Green Bay, Wis., on the 2d, -27°F at Concord, N.H., on the 3d, and -25°F at Portland, Maine, on the 3d.

Heaviest precipitation for the week, as much as 4 in. in Alabama (fig. 7C), fell in connection with a vigorous storm that swept from the Rockies to the Great Lakes around the middle of the week. Severe thunderstorms with flash floods and a few tornadoes occurred over the Southeastern States, and blizzard conditions developed from Kansas to Minnesota. As the storm center deepened to 973 mb over Wisconsin, giving the lowest sea-level pressure since 1902 at Green Bay, Wis., the Great Lakes area experienced gale-force winds with gusts reaching 50 to 60 mi/hr.

Two storms in quick succession moved rapidly north-eastward up the Atlantic Coast States from the Gulf of Mexico on Sunday and Monday. They produced tornadoes at several locations in Florida and a snowstorm locally of near-blizzard intensity over the Ohio Valley and northern Appalachians. Lakeland, Fla., reported rainfall of 3.92 in. on the 7th and 8th, the greatest February 24-hr total on record.

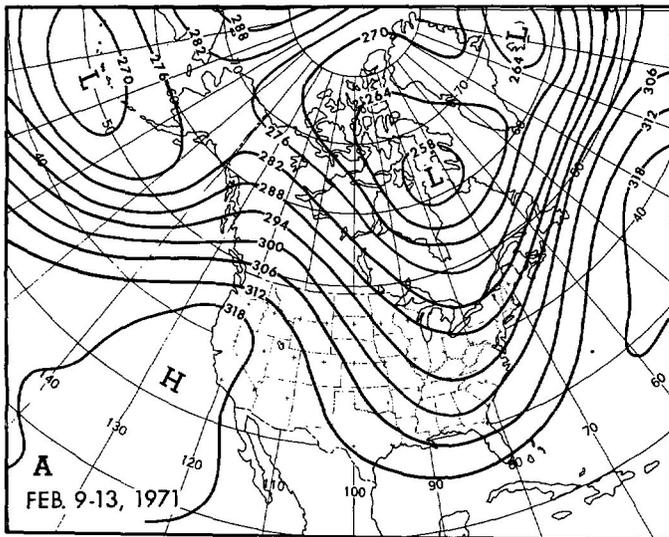
FEBRUARY 8-14

The 700-mb flow pattern flattened somewhat over the Pacific during the second week of February, and the ridge that had been off the west coast progressed inland to the Northern Plateau (fig. 8A). The trough that had been in the Great Plains progressed to a position just west of the Appalachian Mountains, with some amplification from the previous week.

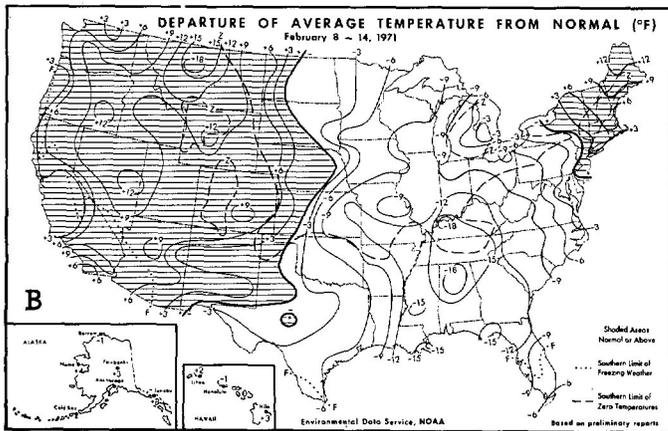
The temperature anomaly pattern reached its maximum amplitude also, with weekly averages ranging from 18°F above normal in Montana to 18°F below normal in the Ohio and Tennessee Valleys, where some subzero readings occurred (fig. 8B). Temperatures moderated in New England where it was the mildest week in over 2 mo.

In response to the amplified flow pattern, temperatures reached record levels on both the high and low sides. An unusually cold air mass from Canada gave record daily lows in the Northern Plains early in the week and continued to set daily records over the Ohio Valley and as far south as Florida as it moved to the Atlantic Seaboard. The 14°F reading at Tallahassee, Fla., on the 10th was the lowest February temperature ever recorded there.

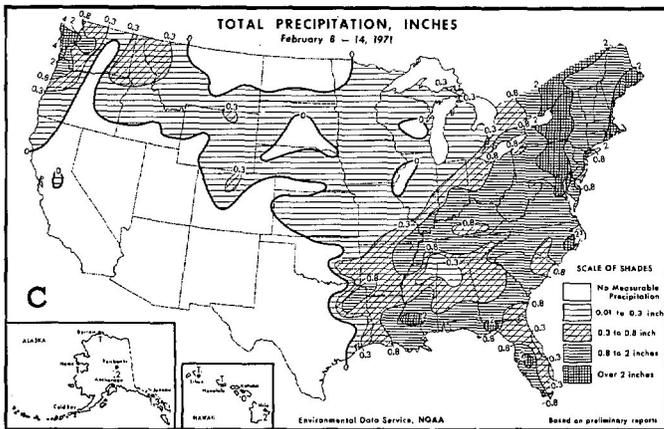
Under the strong advancing ridge in the West, temperatures soared to levels more typical of late spring. On the 11th and 12th, new records for February and early-season warmth were established at several stations in California and Nevada (table 1). Continuing on the 13th and 14th, daily maximum temperatures in the upper 50s over the Pacific Northwest and even as high as 68°F at Walla Walla, Wash., with 70s in Nevada and 80s in southern California, set many daily records for high temperatures.



A
FEB. 9-13, 1971



B



C

FIGURE 8.—Same as figure 7, (A) for Feb. 9-13, 1971; (B) and (C) for Feb. 8-14, 1971.

With the weekly mean trough near the Appalachians, the only precipitation of consequence occurred over the eastern third of the country, except for along the Pacific Northwest coast (figs. 8A and 8C). A rather intense storm toward the end of the week produced more heavy snow from eastern Tennessee to New England, with heaviest amounts exceeding 1 ft in Pennsylvania and New York. Parts of Ohio that had several inches of snow the previous weekend also were affected by the new storm.

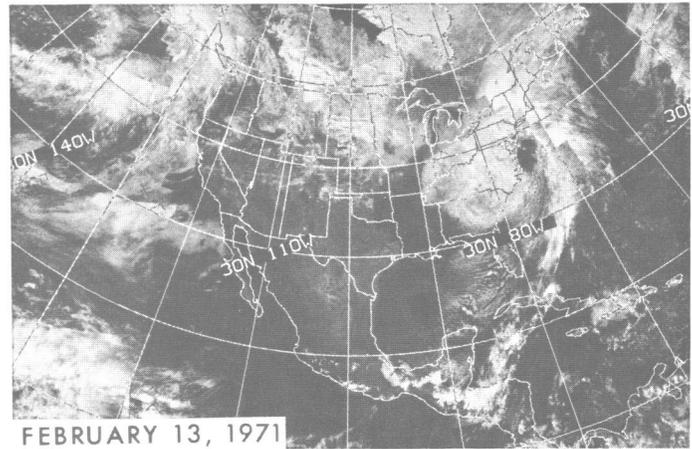


FIGURE 9.—Cloud distribution over the North American sector as photographed by ITOS 1 (improved TIROS operational satellite) on Feb. 13, 1971.

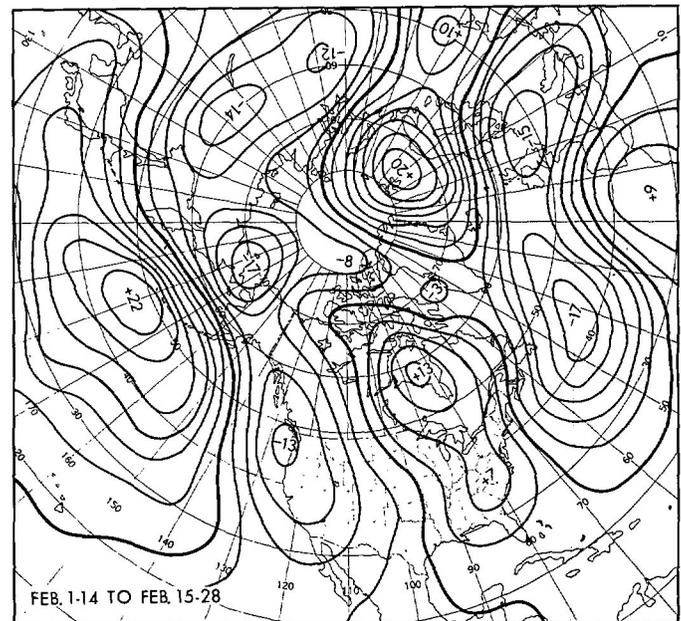


FIGURE 10.—Change in half-monthly mean 700-mb height (dekameters) between Feb. 1-14 and Feb. 15-28, 1971.

The ITOS 1 view of this storm on Saturday, February 13, is shown in figure 9. It was already in the occluding stage over the mid-Atlantic area with a small cutoff Low aloft over the southern Appalachians. The precipitation over New England was mostly rain.

FEBRUARY 15-21

The principal change in circulation during February 1971 occurred close to the middle of the month, with the result that the weather in the second half was quite different from that in the first half. Half-monthly mean 700-mb heights rose by 220 m just south of the Aleutians and fell by 130 m over the Pacific Northwest coast (fig. 10).

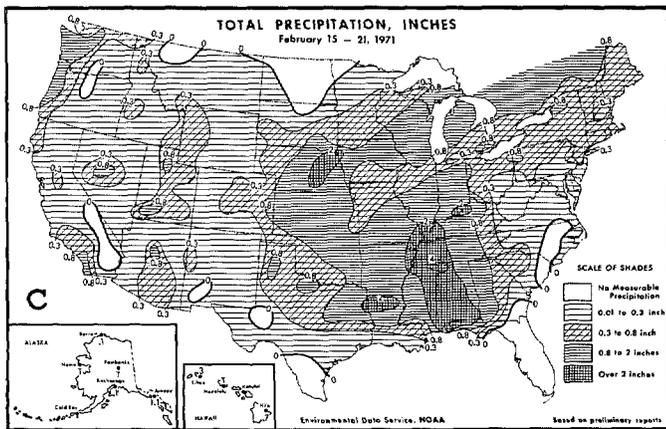
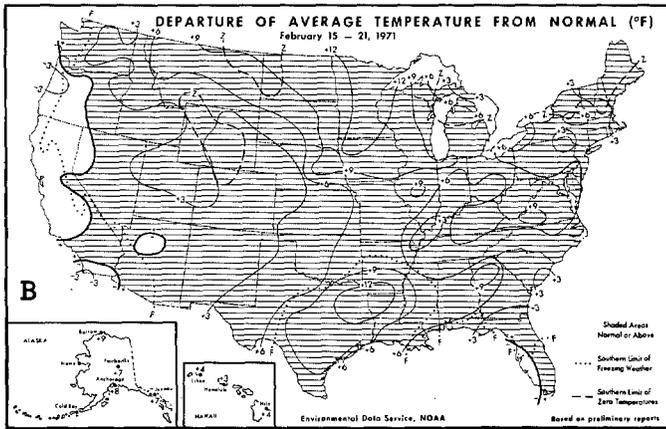
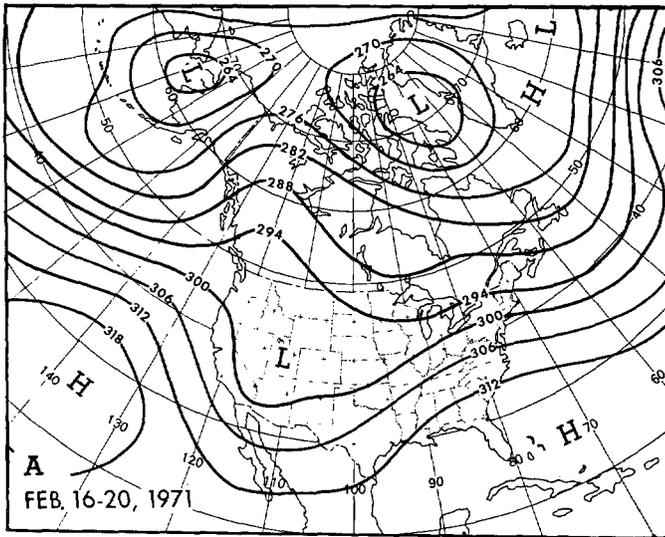


FIGURE 11.—Same as figure 7, (A) for Feb. 16-20, 1971; (B) and (C) for Feb. 15-21, 1971.

Another area of height rises extended from Hudson Bay to the southern Appalachians. Many stations in the eastern half of the country reported a very cold first half of the month and an unusually mild second half, with the reverse true in some Southwestern States. The circulation over the Pacific resulted in an almost rainless first half at

normally moist Hilo, Hawaii; but the height rises to the north re-established the trades so that more normal rainfall occurred in the second half of the month.

Most of the unusual and extreme weather occurred in the central part of the country as a low-latitude trough became established over the Southern Plateau during the third week of the month, while the ridge remained over northwestern Canada, thereby setting up a confluence zone with rather heavy precipitation over the Great Plains and Mississippi Valley (figs. 11A and 11C). Two deep storms affected that area. The first, accompanied by unusually mild temperatures which set daily records in the 70s and even 80s at several stations from the eastern slopes of the Rockies to the Mississippi River, produced heavy rainfall of up to 3 in. within 48 hr in eastern Nebraska. Even though there was little snow on the ground, severe flooding resulted as the ground was still frozen from the earlier cold; and almost all the rainfall ran off immediately.

While flooding from this storm was still in progress, a blizzard struck the area from the Texas Panhandle to eastern Nebraska. Gage, Okla., had over 2 ft of snow; and the 15.2 in. that fell on the 21st and 22d at Topeka, Kans., was the heaviest 24-hr total during February since 1900. The cold front from this storm triggered a devastating series of tornadoes as it swept eastward through Louisiana and Mississippi.

Despite the severe and violent weather, temperatures averaged on the mild side over most of the country (fig. 11B). Only portions of California and Oregon averaged below normal, and weekly temperatures were more than 12°F above normal over Minnesota and Texas.

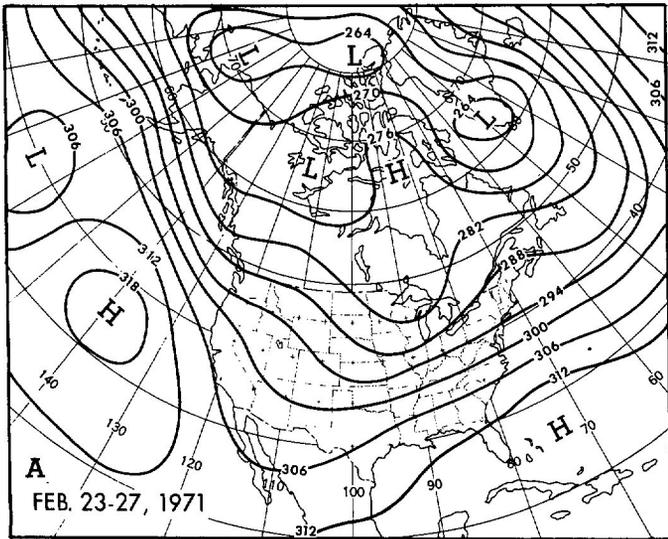
FEBRUARY 22-28

During the last week of the month, 700-mb heights rose strongly over the eastern Pacific, and a full-latitude trough became established over the West, with two segments at mid-latitudes, one along the Pacific coast and the other over the Mississippi Valley (fig. 12A).

As a consequence, cold air became established over the western half of the Nation (fig. 12B), with many localities in the Southwest reporting record daily minima and their coldest weather of the month within a few days of the end of the month.

Precipitation was fairly widespread but not excessive as two rapidly moving storms crossed the country during the week (fig. 12C). Heaviest totals were along the Pacific Northwest coast and in areas affected by convective activity through the Southeast.

An unusually vigorous storm system crossed the Nation from the 25th to the 28th, producing record mild temperatures in the 70s over much of the east in its warm sector but damaging winds behind its cold front all the way from southern California to Michigan. In the Great Lakes region, gusts of 60 to 70 mi/hr occurred over a wide area on the 27th as the storm reached its greatest depth of 968 mb over Lake Superior. Sault Ste. Marie, Mich.,



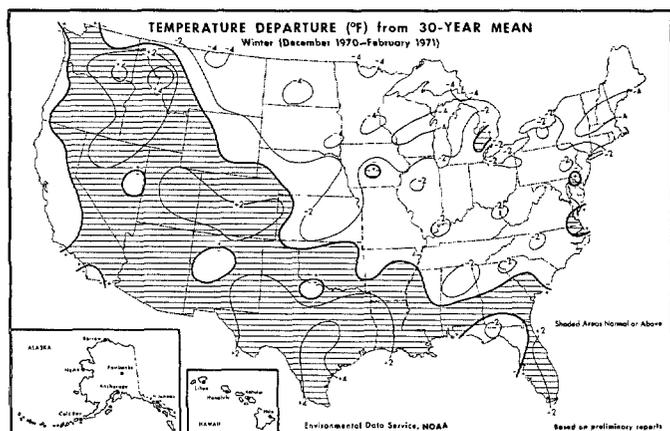


FIGURE 15.—Departure from normal of average surface temperature ($^{\circ}$ F) for winter 1970–1971 (from Environmental Data Service and Statistical Reporting Service 1971).

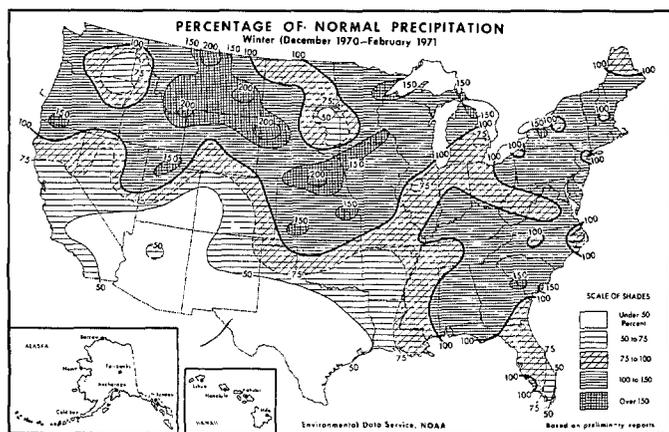


FIGURE 16.—Percentage of normal precipitation for winter 1970–1971 (from Environmental Data Service and Statistical Reporting Service 1971).

Along the gulf coast, over the Southern Plains, and westward from the Continental Divide, generally mild Pacific air masses were the rule as the mean seasonal height pattern had a component of stronger than normal westerly flow.

Precipitation was quite deficient over the Southwest, averaging less than half the seasonal normal over a rather wide area (fig. 16). The heaviest amounts relative to normal occurred over the Northern and Central Plains, where frequent, vigorous storms generated along the zone of contrast between the Arctic and Pacific air masses. Precipitation along the Atlantic Seaboard averaged near or slightly above normal, where the frequent occurrence of storms was counterbalanced by the westerly anomalous flow, giving a downslope effect across the Appalachians.

Due to the general and persistent cold coupled with slightly above-normal precipitation over the Northeast, record and near-record seasonal snowfall totals were reported by several stations. A large part of this fell in December when several monthly snowfall records were set (Stark 1971). Persistent cold and cyclonic activity over Alaska (fig. 14) contributed to a record-breaking seasonal snowfall of 137.1 in. at Fairbanks through the end of February.

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- Posey, Julian W., "The Weather and Circulation of January 1971—Amplification Over the United States With a Change in the Temperature Regime," *Monthly Weather Review*, Vol. 99, No. 4, Apr. 1971, pp. 328–334.
- Stark, L. P., "The Weather and Circulation of December 1970—Cold and Wet in the North and Far West With Mild, Relatively Dry Conditions Elsewhere," *Monthly Weather Review*, Vol. 99, No. 3, Mar. 1971, pp. 250–254.