THE WEATHER AND CIRCULATION OF FEBRUARY 1963

A Warm Month in the West and Continued Cold in the East

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1. INTRODUCTION

In February 1963 the severe cold weather which prevailed in North America and Europe during January [1] was considerably moderated. The warming trend was especially pronounced over the western United States where the Far West had the warmest February recorded. Numerous unprecedented high temperatures for the date were reported over the western half of the country during a heat wave the first week.

The East continued cold and, though most reporting stations had experienced colder Februarys, it was the coldest winter on record at several locations. The most severe and extensive cold outbreak in the East came in the final week.

Europe retained much of its cold weather of January, though at Warsaw, Poland the average temperature rose from 9.7° F. in January to 16.4° F., and the departure from −18.5° to −11.2° F. Farther west, in Paris, however, the average rose only 2.1° F. to 28.9° F. and the departure remained unchanged at −9.9° F.

2. MONTHLY CIRCULATION

While blocking had diminished from the previous month, it was still a prominent characteristic of the average circulation (fig. 1). A large anticyclone was centered over extreme eastern Siberia near Kamchatka, where a mean Low is normally found in February, but where this year 700-mb. heights averaged up to 400 ft. above normal. The Aleutian Low was split into two cells with one located south of the western Aleutians and the other south of the Alaskan Peninsula. The extreme southward displacement from normal of the eastern cell was attended by negative 700-mb. height departures of more than 400 ft. in a center just south of the Low. The axis of maximum west winds, or jet (fig. 2), was south of the normal path from Manchuria to the eastern Pacific, with a corollary increase of winds to supernormal speeds along the jet with subnormal speeds farther north.

A strong mean ridge was observed over the Gulf of Alaska in January, but was found in western North America during February. This constituted the greatest change of the circulation from the previous month. As the ridge returned toward the more normal location some of its abnormal amplitude was retained, as indicated by positive height anomalies in the ridge from the Tropics to the Arctic. The amplification was also observed downstream with heights lower than normal in the mean trough from the Maritime Provinces to southern Mexico, but higher than normal in the ridge in the western Atlantic.

Blocking was also prevalent at higher latitudes of the Atlantic and North America. Its principal relationship to the lower latitude circulation was a southward displacement of the Low normally found over Baffin Island. An extensive area of positive height anomaly accompanied this blocking with heights as much as 440 ft. above normal in the Davis Strait. Additional components of the blocking complex included an area of moderately negative height departures over the Maritime Provinces and a much more extensive negative area over the eastern Atlantic, most of Europe, and the Mediterranean Sea. The weather in the Mediterranean area was unusually stormy with seven separate cyclone passages during the month. In this region the mean jet was shunted southward from normal (fig. 2).

An intense Polar Low near Novaya Zemlya accounted for the greatest height departures in the Northern Hemisphere, approximately −470 ft. Outside the area affected by the Low, positive height departures prevailed over Siberia. The westerlies were extremely fast in northern Siberia, especially at the confluence of two branches of the mean jet where wind speeds were as much as 11 m.p.s. above normal.

In view of the blocking and the regionally amplified character of the circulation pattern, it is not surprising to find that the zonal index, or speed of the temperate westerlies, averaged below normal for the month in the western sector of the hemisphere. However, recovery of this index from the extremely low minimum of 2.8 m.p.s. at the end of January, shown in figure 3, brought the monthly departure to −1.4 m.p.s., a substantial return toward normal from the −4.3 m.p.s. recorded in January. This completed the great prolonged index cycle which began in December [1]. The index graph shows that the transition from slow to fast westerlies was rapid but irregular, due in part to considerable variability in the shorter-period mean circulation from week to week.

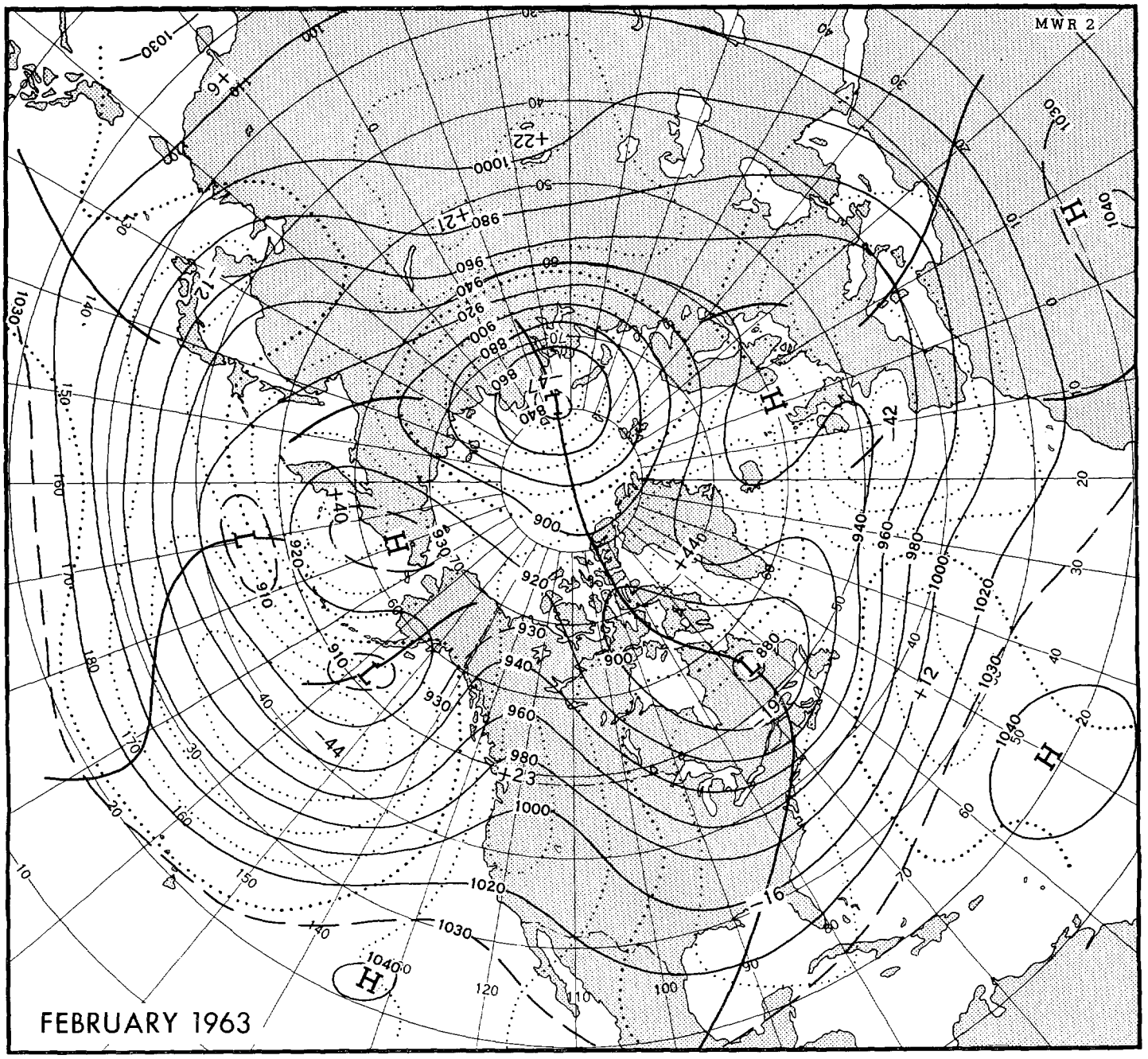


FIGURE 1.—Mean 700-mb. contours (solid) and height departures from normal (dotted), both in tens of feet, for February 1963. Positive anomaly centers near Kamchatka and Davis Strait indicate high-latitude blocking. The mean circulation over North America was of large amplitude.

3. UNITED STATES WEATHER ANOMALIES

TEMPERATURE

Average temperature departures for February (fig. 4) were well correlated with the 700-mb. height anomalies of figure 1. Over the western half of the country temperatures were considerably higher than normal, in sharp contrast to January when the entire country averaged below normal. Warming with respect to normal from the previous month occurred westward from a line joining Lake Erie and Louisiana, and in a section of Montana monthly average departures rose more than 20°F. Table 1 lists the stations in the Far West where the February mean temperatures were the highest on record.

In the East the continuing cold was generally of less than record-breaking intensity with a single new mean February low at Pittsburgh, Pa. Even so, average departures of −8° to −10° F. in the central States are indicative of a very cold month. Most of the cold air was brought in from Canada by continental anticyclones following the principal path of figure 5A. It is interesting to note that this path closely resembles the normal

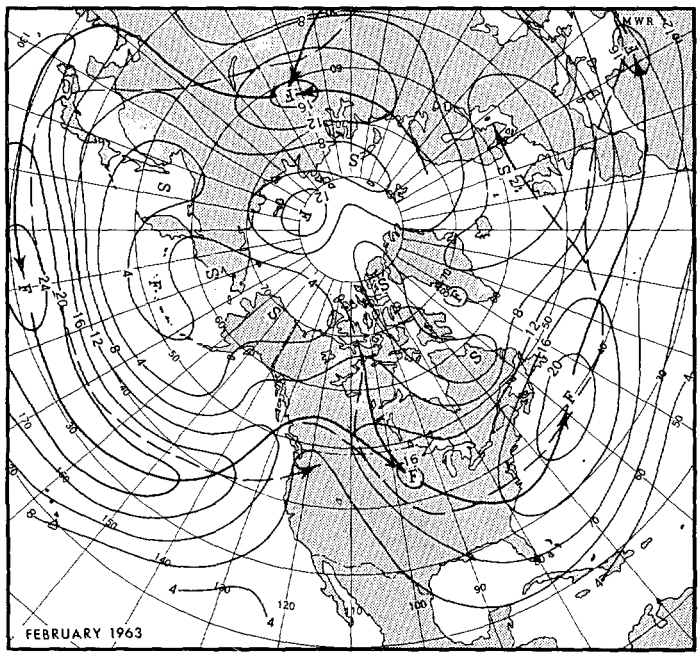


FIGURE 2.—Mean isotachs (in meters per second) of 700-mb. wind speed during February 1963. Solid arrows indicate the observed primary axis of maximum wind speed, dashed arrows the normal. Displacements of the February axis from normal reflect the presence of blocking in the Pacific and eastern Atlantic and the unusual amplitude over North America.

[2], even though the amplitude of the mean circulation was abnormally large.

This was the sixth coldest winter (Dec.–Feb.) on record for the United States, based on an average of the winter temperatures of 50 cities representing all sections of the Nation (except Alaska and Hawaii). The coldest seasons on record were the historic winters of 1898–99 and 1935–36. The winter of 1962–63 was the coldest on record at a number of stations listed in table 2.

Among the economic consequences of the persistent cold this winter were the high cost of heating and the delayed preparation of seed beds for spring crops east of the Rocky Mountains. Ice cover on the Great Lakes was both extensive and thick, leading to forecasts of late opening dates for many harbors of the region.

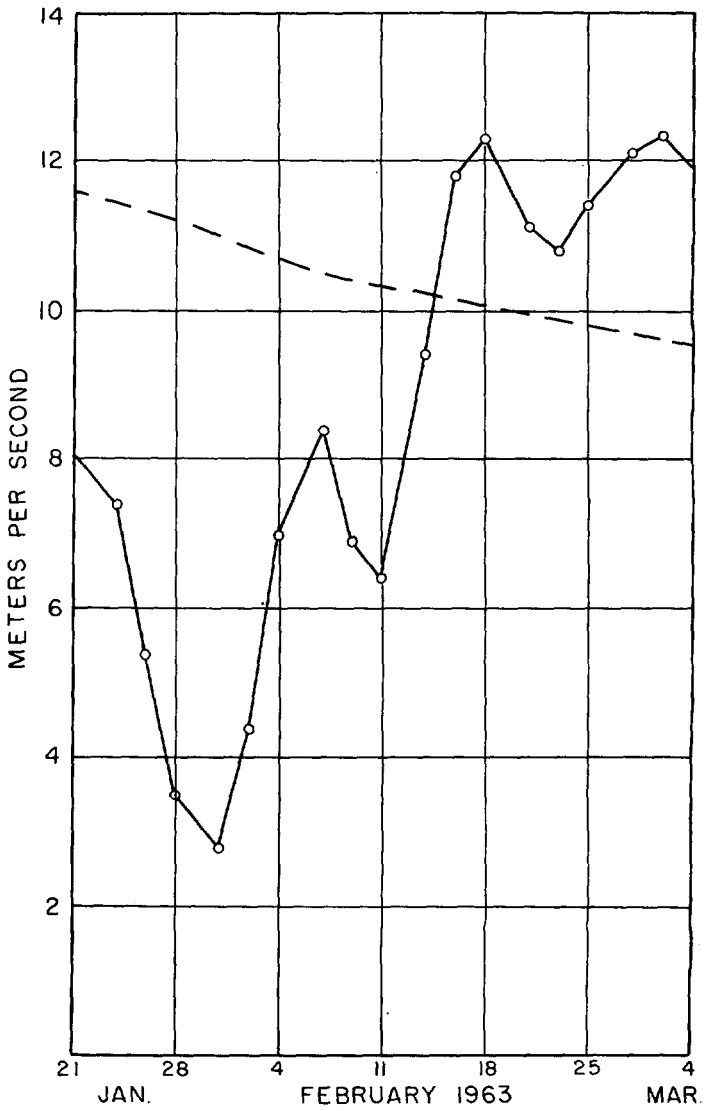


FIGURE 3.—Time variation of zonal index in meters per second (solid) and normal (dashed) for the western sector of the Northern Hemisphere (35°N. to 55°N.) for February 1963. Indices are 5-day means plotted at the middle of each period. At the end of January the index was at the lowest point in the cycle which began in December and ended in February.

TABLE 1.—*New records for highest average February temperature established in 1963*

Station	Average temperature (° F.)	Departure from normal	Year records began
Yuma, Ariz.	67.5	+7.4	1879
Bakersfield, Calif.	58.4	+6.4	1903
Fresno, Calif.	*56.4	+6.6	1888
Mount Shasta, Calif.	44.3	+7.3	1908
Red Bluff, Calif.	55.8	+6.1	1878
Sacramento, Calif.	57.6	+6.6	1877
San Diego, Calif.	*61.2	+4.5	1872
San Francisco, Calif.	58.4	+5.4	1875
Santa Maria, Calif.	58.3	+6.5	1900
Roseburg, Oreg.	50.4	+7.1	1878
Seattle, Wash.	50.3	+6.7	1891

*Equaled previous record.

TABLE 2.—*Record low average temperatures for winter (December 1962, January and February 1963)*

Station	Mean temperature (° F.)	Year records began
Birmingham, Ala.	40.4	1895
Montgomery, Ala.	43.4	1873
Atlanta, Ga.	*38.8	1879
Peoria, Ill.	18.3	1905
Cleveland, Ohio	20.5	1871
Dayton, Ohio	22.9	1912
Toledo, Ohio	18.6	1874
Pittsburgh, Pa.	21.5	1875
Chattanooga, Tenn.	34.8	1879
Nashville, Tenn.	33.4	1871

*Equaled previous record.

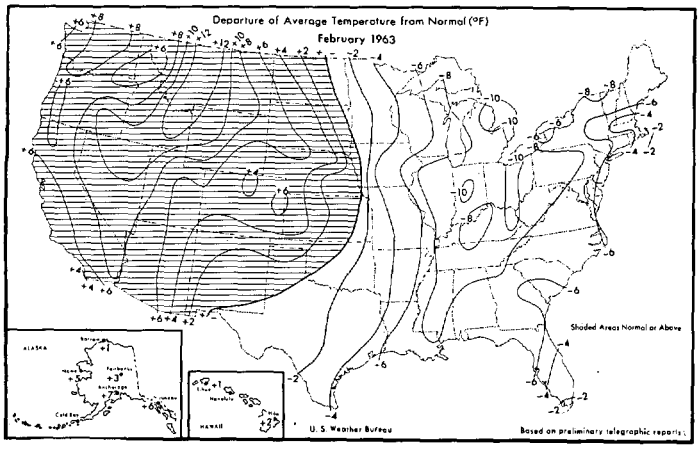


FIGURE 4.—Departure of average surface temperature from normal (°F.) for February 1963 (from [3]).

PRECIPITATION

The distribution of precipitation was quite variable with time and area. Only the Southeast, with favorable mean circulation (fig. 1) and frequent cyclone passages (fig. 5B), received amounts of more than half an inch each week. Over western North America most cyclones were diverted northward by the strong mean ridge. However, several frontal troughs penetrated the area occupied by the ridge, bringing precipitation totals up to normal for the month (fig. 6) in parts of the Northwest and up to twice normal in the Southwest. Amounts were also above normal in the Northern Plains where cyclones were frequent.

Dryness persisted from the Great Lakes region to Texas and Colorado (fig. 6), particularly in Kansas, Oklahoma, and part of northeastern Texas where accumulations of precipitation were less than a fourth of normal. St. Louis, Mo., had the driest February of station history. Waco, Tex., had the lowest January-February total, and Tulsa, Okla., the driest winter of record. Blowing soil and the threat of its continuation required preventive measures in Kansas. Dry weather continued locally in the western mountains, and along with higher than normal temperatures accounted for a scant supply of snow. In the Sierra Nevada Range the snowpack was the lowest yet recorded. In the Cascades, Sexton Summit, Oreg. reported no snow at all in February for the first time, and at Stampede Pass, Wash. the snow depth was the lowest of record.

4. WEEKLY CIRCULATION AND WEATHER

FEBRUARY 1-7

The circulation (fig. 7A) this week favored extremely high temperatures in the West accompanied by Alberta wave activity which typically spreads warmth eastward from chinook regions of the Northern Plains (fig. 7B). The zonal westerlies were increasing rapidly this week even though strong blocking persisted in the Atlantic.

After one storm which crossed Washington on the 1st, a succession of Pacific storms was diverted northward

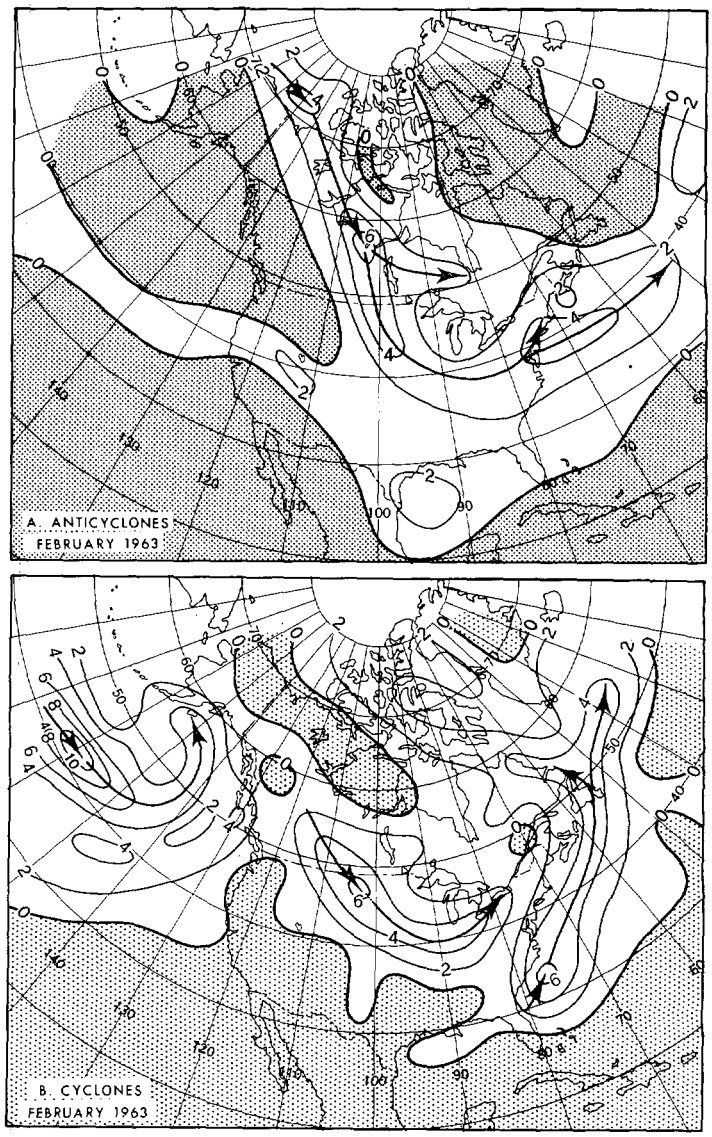


FIGURE 5.—Frequency of (A) anticyclone and (B) cyclone passages (within 5° squares at 45°) during February 1963. Arrows indicate principal tracks.

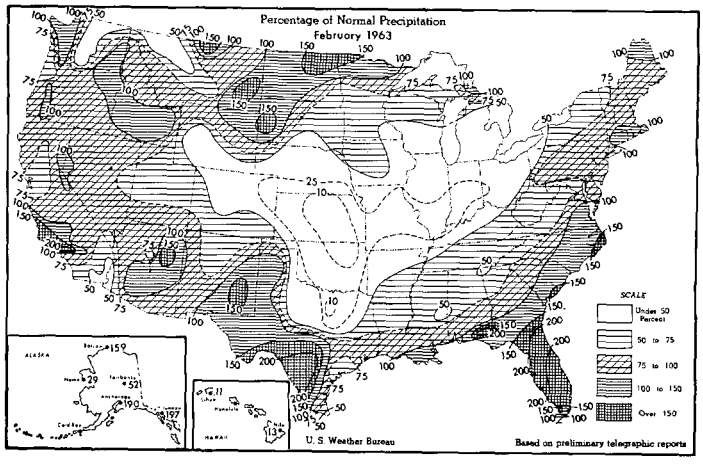
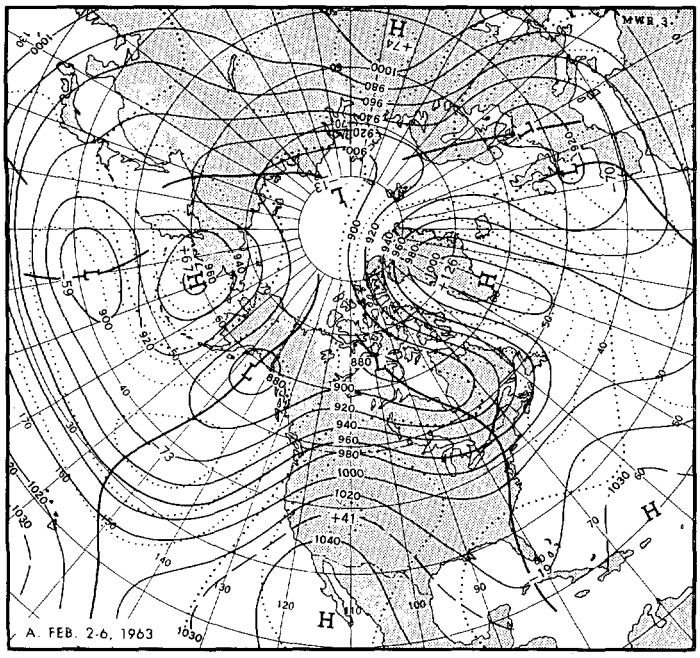


FIGURE 6.—Percentage of normal precipitation for February 1963 (from [3]).



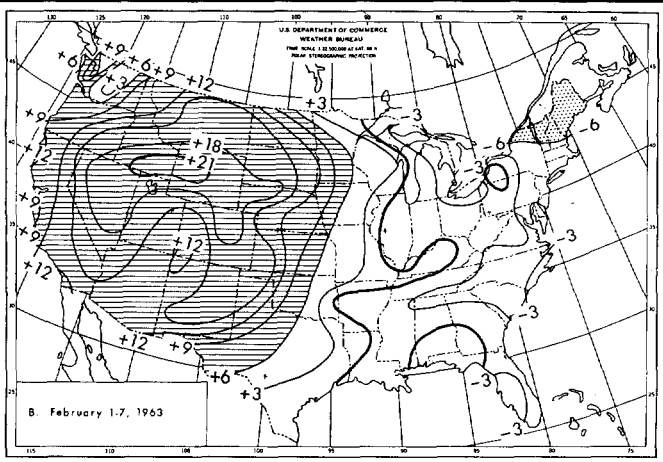
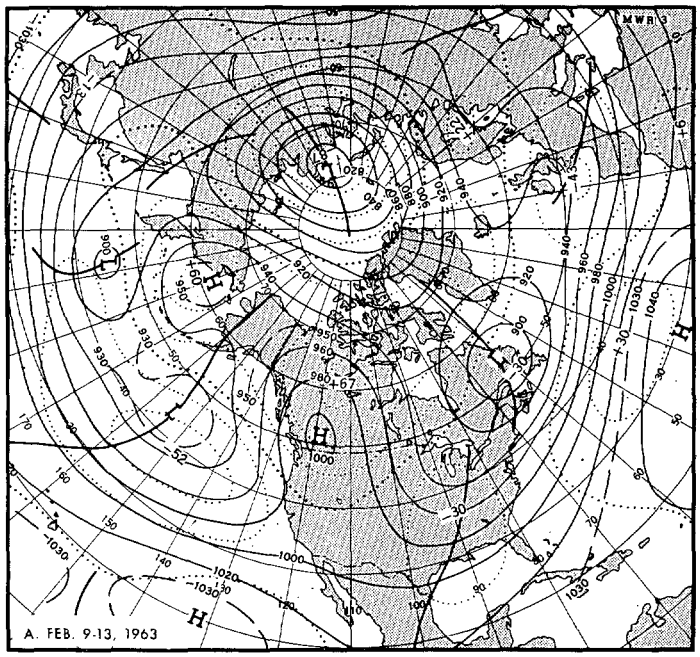


FIGURE 7.—(A) Five-day mean 700-mb. height and departure from normal for February 2–6, and (B) departure of average surface temperature from normal for February 1–7, 1963.



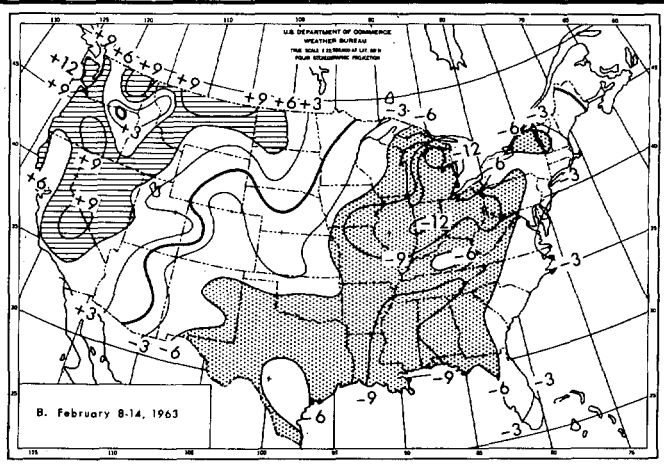


FIGURE 8.—(A) Five-day mean 700-mb. height and departure from normal for February 9–13, and (B) departure of average surface temperature from normal for February 8–14, 1963.

into Canada, as a ridge built steadily in the West. Impulses from the Pacific storms set off Alberta waves which weakened on leaving the region just east of the Divide.

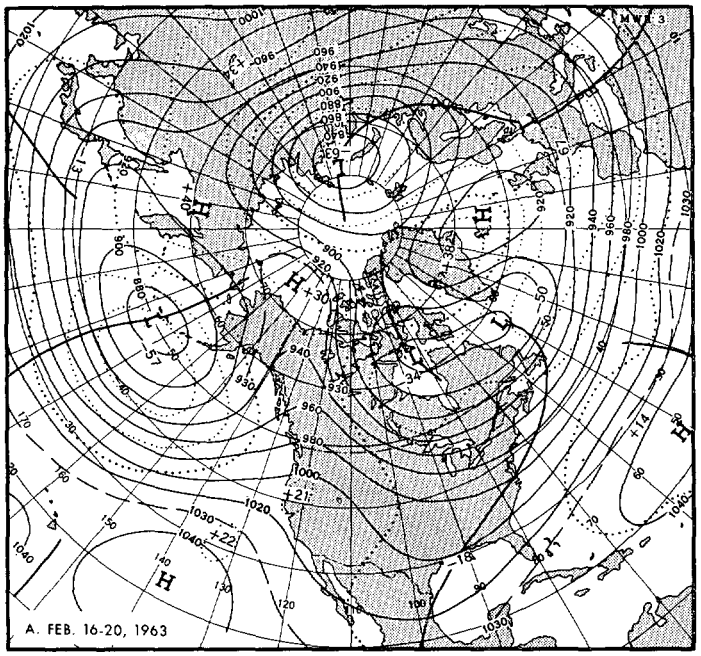
The warm spell, already extensive on the 1st, reached its peak on the 5th when new record temperature maxima were established for the date in nearly every State west of the Mississippi River. On that day Williston and Bismarck, N. Dak. recorded average daily temperatures 34° F. above normal, due in part to foehn warming with strong westerlies across the Divide.

East of the Rocky Mountains the weekly average (fig. 7B) was tempered by a strong surge of Arctic air following an intense cyclone, which brought the lowest sea level pressures on record at Helena and Billings, Mont., on the 1st. Behind this rapidly moving storm the Arctic front pushed southward to the Gulf of Tehuantepec on the 4th, when a wave began to develop on the front just east of Florida. This new storm was trapped by high pressure to the north and generated easterly winds of 35 to 40 kt. as it moved slowly and erratically northward to Cape Hatteras by the end of the week. Wind-generated swells from the storm eroded beaches from Florida to North Carolina and widened the nearly repaired channel through Hatteras Island cut by the March storm of 1962.

Precipitation was heavy this week in the northern Great Lakes, the Appalachians, New England, in the Pacific Northwest where frequent storms approached the coast, and in the Southeast.

FEBRUARY 8–14

As the western ridge of the previous week became affiliated with the zonally-oriented ridges across Alaska and Greenland, the mid-latitude westerlies cut through the southern portion of the ridge and isolated a mean High over southwestern Canada (fig. 8A), forming a typical omega-shaped blocking pattern. Amplification



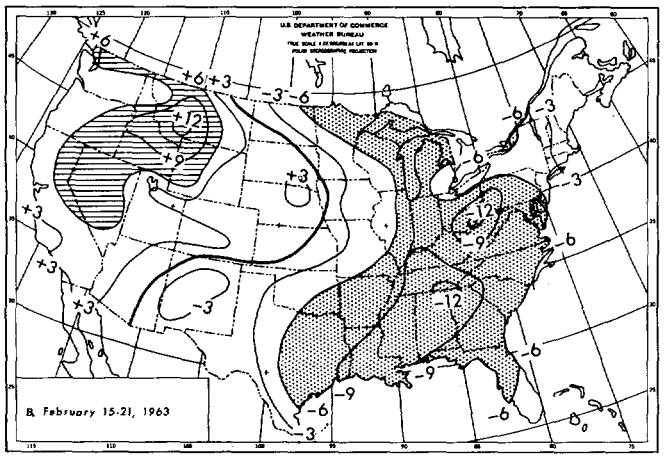
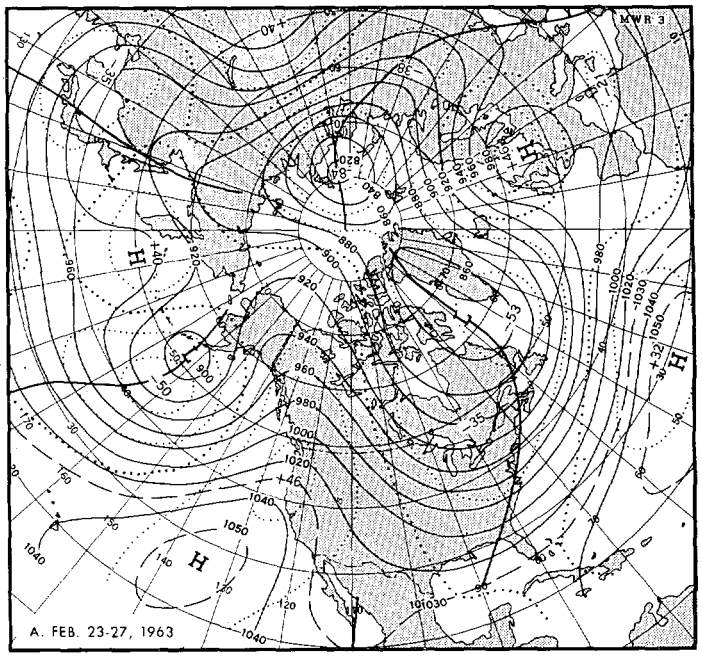


FIGURE 9.—(A) Five-day mean 700-mb. height and departure from normal for February 16–20, and (B) departure of average surface temperature from normal for February 15–21, 1963.



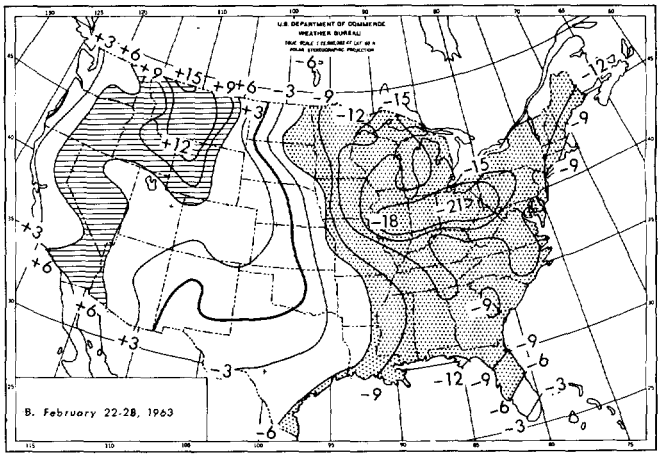


FIGURE 10.—(A) Five-day mean 700-mb. height and departure from normal for February 23–27, and (B) departure of average surface temperature from normal for February 22–28, 1963.

of the circulation thus interrupted the sharp rise of the zonal index (fig. 3).

With this circulation regime the warm spell of the previous week was curtailed, and temperatures over almost the whole country were considerably lower (fig. 8B). Arctic air was transported into all but far western sections by strong northerly flow east of the blocking ridge. Cyclone activity and precipitation increased in the Southwest where the westerlies penetrated the ridge. Sea level pressure was relatively low in this region and cold air spilled over the southern Rockies into Arizona and western New Mexico from the east.

Two waves traveling northeastward from the eastern Gulf of Mexico along a slow-moving front spread precipitation generously along their paths, then combined into a rather intense storm off the New England coast. Significant amounts of precipitation were produced by weak cyclonic activity in Arkansas, Tennessee, and the Great Lakes region, east of the mean trough (fig. 8A).

FEBRUARY 15–21

Blocking relaxed over North America and wind speeds again rose sharply from the second week to the third (figs. 9A and 3). In the eastern Pacific the subtropical ridge was rebuilding, and its combination with remnants of the blocking ridge in Canada helped maintain strong northerly flow aloft and repeated surges of Arctic air into the United States.

While changes in the pattern of temperature anomaly (fig. 9B) from the previous week were small, the daily sea level activity was much different. With the growth of the subtropical ridge in the eastern Pacific, the cyclonic channel aloft and paths of storms simultaneously moved northward, and the precipitation band shifted from the

Southwest to the Pacific Northwest. The northern part of the mean trough moved eastward from the Great Lakes to the Atlantic coast, while the southern end remained in the western Gulf of Mexico. One vigorous wave cyclone moved up along the sharply tilted trough, spreading a streak of heavy precipitation from southern Texas to Cape Hatteras.

FEBRUARY 22–28

By the middle of the final week blocking had diminished further as the subtropical Highs grew, and the amplitude of the mean wave over North America (fig. 10A) was large. Also the trough over North America had sheared as it deepened in the north and filled in the south.

Strong northerly flow transporting cold air from the Canadian Arctic made this the coldest week in the East (fig. 10B). Three separate cold anticyclones followed nearly identical paths from northwestern Canada through the Northern Plains. The first of these brought the most severe cold on the 22d, when many stations reported their lowest daily temperatures of the month and new record minima for the date. At Norfolk and Richmond, Va., on the 22d and at Wilmington, N.C., on the 27th, temperatures were lower than at any time during the extremely cold month of January.

The sea level troughs which preceded and followed successive outbreaks of cold air brought widespread but generally light precipitation from the Northern Plains to the Atlantic coast. Two of the troughs set off waves along the quasi-stationary front in the Gulf of Mexico, both of which brought heavy precipitation to the Southeast as they intensified along the south Atlantic coast.

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