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THE WEATHER AND CIRCULATION OF JUNE 1969

A Predominantly Cool and Wet Month

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1. HEMISPHERIC MEAN CIRCULATION

A vigorous 700-mb circulation with well-defined features at middle and high latitudes continued to prevail during June, as in the previous month (Green, 1969). The deep 700-mb Low remained almost stationary near Hudson Strait from May through June, with heights 110 m below normal in June (figs. 1, 2). A separate center of cyclonic activity developed between Greenland and Iceland where monthly mean heights fell 100 m between May and June. The blocking ridge that had retrograded to Greenland in May moved eastward again, and during June its axis was oriented from Denmark to Spitzbergen.

On the opposite side of the Pole, the blocking ridge over western Canada and the interior of Alaska strengthened during June with heights as much as 60 m above normal over the Beaufort Sea. A vigorous trough extended into Eurasia from a Low east of Novaya Zemlya, thereby completing a two-wave pattern at high latitudes around the Pole.

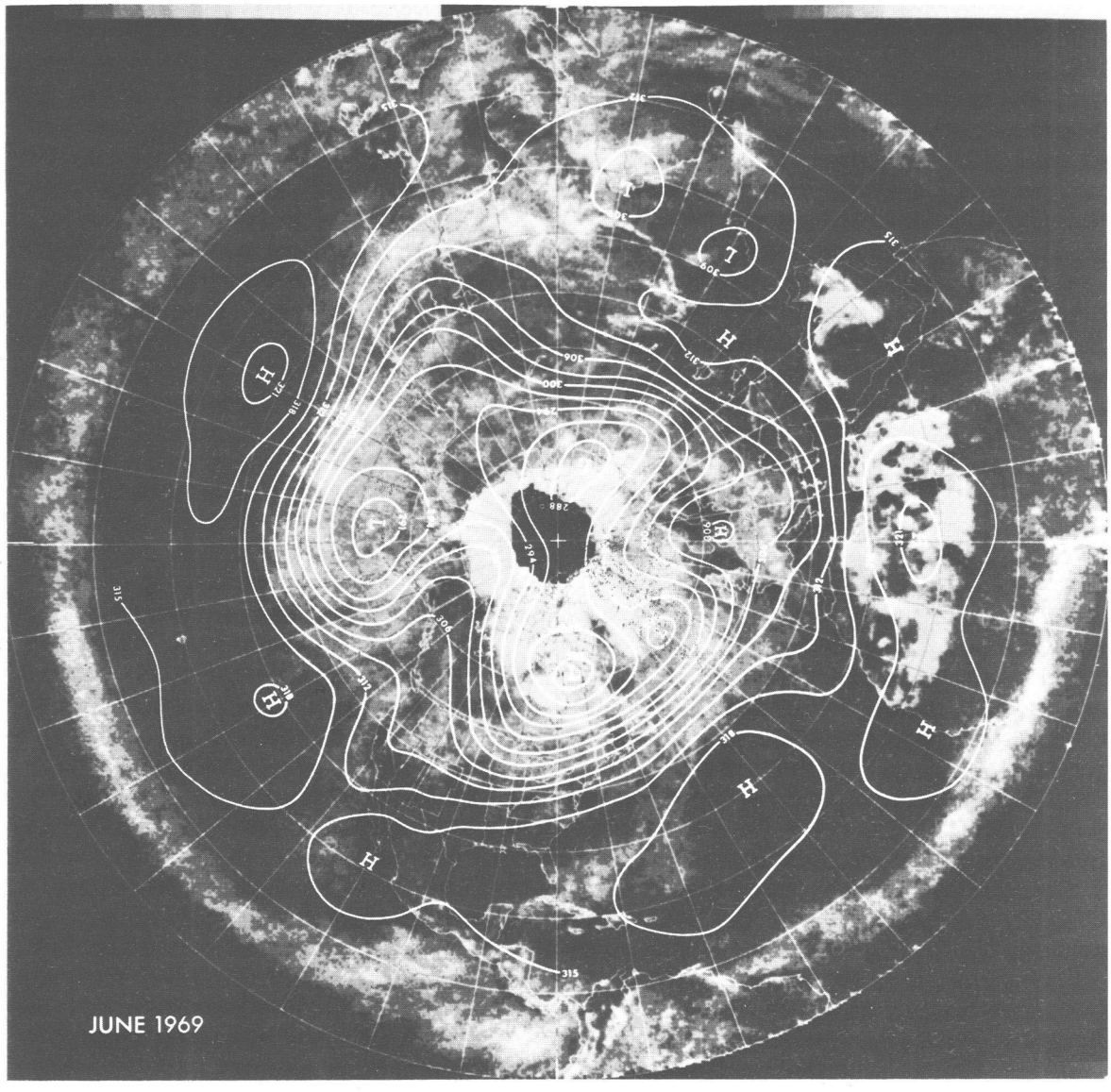


FIGURE 1.—Mean 700-mb contours (decameters) for June 1969, superimposed upon mean brightness composite of daily photographic observations from the ESSA–9 satellite for May 29–June 27, 1969.

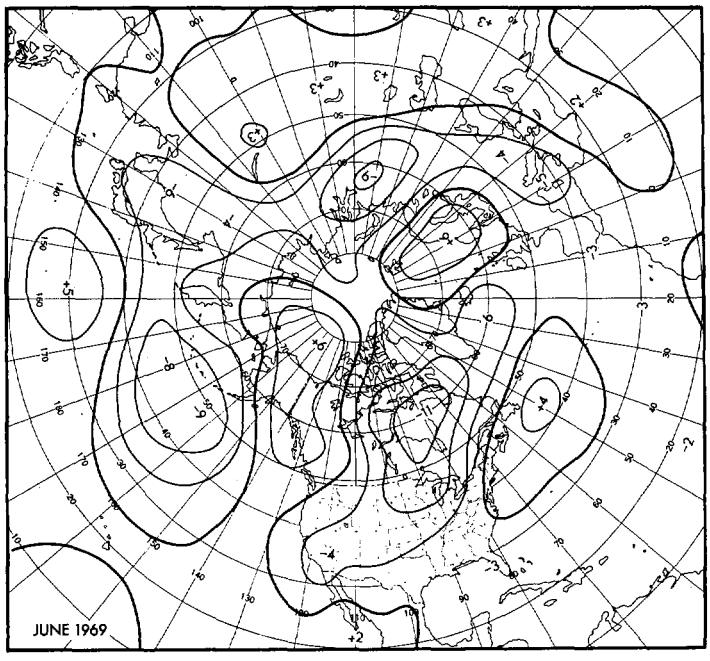


FIGURE 2.—Departure from normal of mean 700-mb height (decameters) for June 1969.

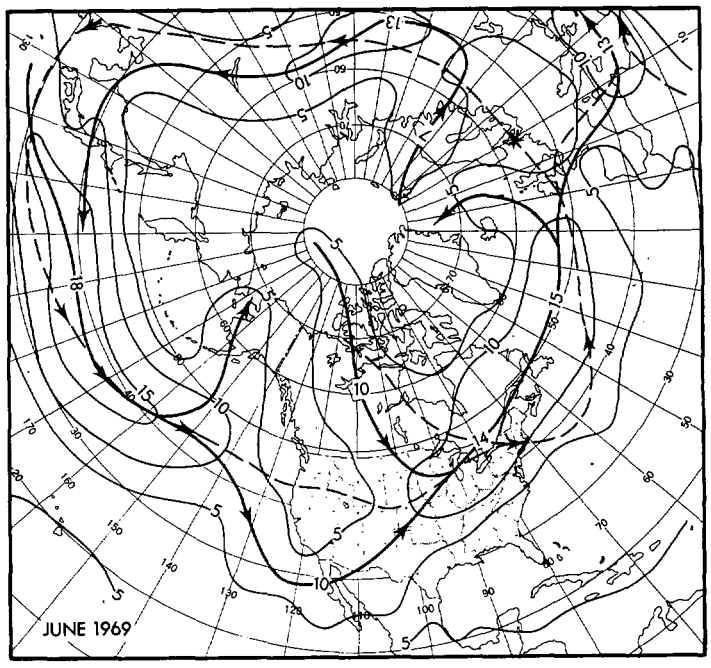


FIGURE 3.—Mean 700-mb geostrophic wind speed (meters per second) for June 1969. Solid arrows show axes of maximum wind speed during June 1969, and dashed arrows indicate normal June positions.

Abnormally strong westerlies characterized the circulation at midlatitudes over several sectors of the hemisphere. Over the Pacific, between a vigorous trough south of the Aleutians and a strong subtropical high cell, the monthly mean 700-mb winds reached a peak speed of 18 m sec^{-1}, approximately twice the normal June value (fig. 3). A band of strong westerlies also extended from the Great Lakes area to the eastern Atlantic.

The 700-mb jet-stream segment normally entering the United States through the Northern Plateau Region was displaced far south of normal over Baja California around the unusually deep trough located over California (figs. 1–3). The axis of maximum 700-mb winds then turned northeastward across the Central States and entered Canada over the Great Lakes Region. This type of jet-stream configuration is typical of severe weather situations and heavy precipitation over wide areas of the central United States, as was the case during this June.

Over the western Atlantic, the 700-mb jet was displaced north of its usual June position by an abnormally strong northwestward extension of the Atlantic High (figs. 2, 3). The blocking High over Scandinavia forced the northern branch of the European jet stream to curve northward between Iceland and Norway (figs. 1, 3).

The mean brightness as measured by the ESSA–9 satellite over the Northern Hemisphere during June 1969 also provides some interesting details in figure 1. Note the dark area over northwest Hudson Bay where strong winds circulating around intense sea-level cyclones related to the deep 700-mb center had broken the icepack and pushed it off shore. Other unusually dark areas at high latitudes showed up over the interior of Alaska and Scandinavia where subsidence under the blocking ridges suppressed cloudiness and the warm air and sunshine had melted most of the snow. A sharp demarcation between snow cover and bare ground was evident in northwest Canada, about parallel to the 700-mb height contours and between unusually warm air over Alaska and cold air centered over Baffin Island.

The Pacific storm tracks were vividly brought out by the belt of cloudiness near the region of strongest winds (figs. 1, 3). Mexico, where a severe drought was reported in many areas, remained unusually cloud free during June as the southward-displaced westerlies delayed the usual late spring onset of moisture-bearing tropical easterlies (figs. 2, 3). Tropical activity was evidenced by monsoon clouds over India and the Bay of Bengal, and also by a cloud belt extending from western Cuba northeastward. Although no tropical storms or hurricanes formed in the latter area during June, a number of weak disturbances and easterly waves gave rather heavy precipitation to southern Florida and nearby areas.

The 700-mb height change from the first to last half of June (fig. 4) shows that the portions of the Scandinavian and Alaskan blocking ridges over the Arctic Ocean became stronger during the last half of the month. Heights fell at lower midlatitudes over the Pacific Ocean, western Canada, and the northwestern third of the United States; severe weather more typical of earlier spring continued throughout the Plains and Midwest. The largest height change in June was near the British Isles, where a 700-mb height fall of 130 m heralded the onset of a wet spell after a very pleasant first half of the month.

2. TEMPERATURE AND PRECIPITATION

Strong northerly anomalous flow both at the surface and aloft (fig. 2) frequently advected Canadian air masses

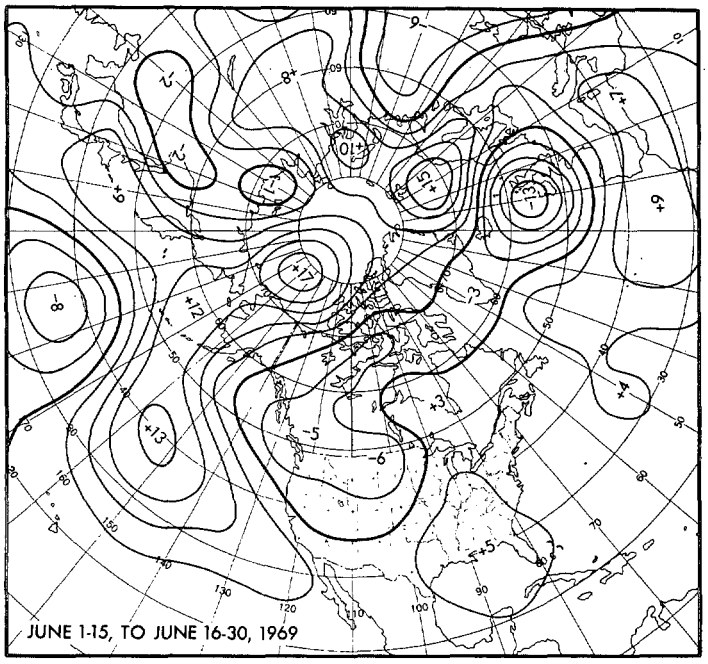


FIGURE 4.—Change in half-monthly mean 700-mb height (decameters) between June 1–15 and June 16–30, 1969.

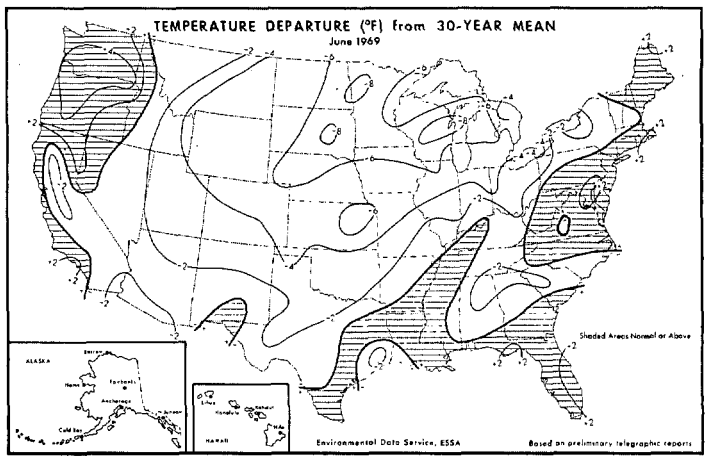


FIGURE 5.—Departure from normal of average surface temperature (°F) for June 1969 (from Environmental Data Service, 1969).

TABLE 1.—*Stations reporting record or near-record monthly mean temperatures during June 1969*

Station	Temperature anomaly (°F)	Remarks
Grand Rapids, Mich	−5.7	Coldest June since 1889 and 2d coldest of record
Sault Ste. Marie, Mich	−6.0	3d coldest June of record
Milwaukee, Wis	−4.4	Coldest June since 1889 and 2d coldest of record; 2d least June sunshine of record
Green Bay, Wis	−8.3	Coldest June of record
Madison, Wis	−6.6	Coldest June of record
Rockford, Ill	−6.1	2d coldest June of record
Dubuque, Iowa	−5.7	Coldest June of record
Waterloo, Iowa	−8.2	Coldest June of record
Sioux City, Iowa	−6.4	Tied for 2d coldest June of record
Rochester, Minn	−7.5	Coldest June of record
St. Cloud, Minn	−6.7	Coldest June of record
Duluth, Minn	−5.0	Coldest June since 1917
Minneapolis, Minn	−5.0	2d coldest June of record
Fargo, N. Dak	−7.4	Coldest June of record
Huron, S. Dak	−7.2	2d coldest June of record
Sioux Falls, S. Dak	−6.2	2d coldest June of record
North Platte, Nebr	−6.3	3d coldest June of record
Billings, Mont	−6.4	3d coldest June of record
Clayton, N. Mex	−4.6	Coldest June of record
Olympia, Wash	+4.9	Warmest June of record
Eugene, Oreg	+4.4	Warmest June since 1931

from an abnormally cold source region into the northern and central portions of the United States, where monthly mean temperatures were as much as 8°F below normal (fig. 5). Persistent cloudiness from frequent storms that traversed the area also contributed to the unusually cool weather. More than a dozen stations from Michigan to Montana and as far south as Nebraska reported record or near-record low monthly mean temperatures for June 1969 (table 1).

The Southern Plateau also had below-normal temperatures due to frequent troughs deepening and stalling in the area after moving in from the Pacific. Yuma, Ariz., reported only 9 days in which the temperature rose to at least 100°F, the fewest in June since 1894 which had 6 days. Although no monthly mean temperature records were set because of a cool first half of the month, Jackson, Miss., reported the same number of days with 100°F or higher on the last 9 days of the month, the longest June period of consecutive 100° heat since 1902 when 10 successive days with 100°F or higher were reported.

The only parts of the country to have substantially above-normal monthly mean temperatures were the Pacific Northwest and most of Alaska, where anomalies were in excess of 4°F above normal in much of the interior.

The strong confluence between the northwesterly flow from Canada and the southwesterly flow around the trough in the Western Plateau (figs. 1, 3) set the stage for heavy precipitation over much of the central part of the Nation. Many areas (fig. 6), where amounts were more than twice normal, had in excess of 8 in. Several stations reported record or near-record rainfall for June 1969 (table 2). Kansas City Municipal Airport recorded 17.21 in. between June 11 and July 10, the second wettest 30-day period in history.

Although total amounts were much less, most of the Plateau had more than twice normal rainfall, with some localities reporting in excess of 400 percent of the normal June precipitation. Instability due to several troughs and cool air aloft entering from the Pacific contributed to frequent convective showers and thunderstorms in this normally dry region, where Reno, Nev., and Salt Lake City, Utah, reported record and near-record totals of thunderstorm days, respectively (table 2).

Only in the deep South were there any reports of record dryness (table 2). Jackson, Miss., reported the driest May–June period of record, with only 2.81 in. of rainfall.

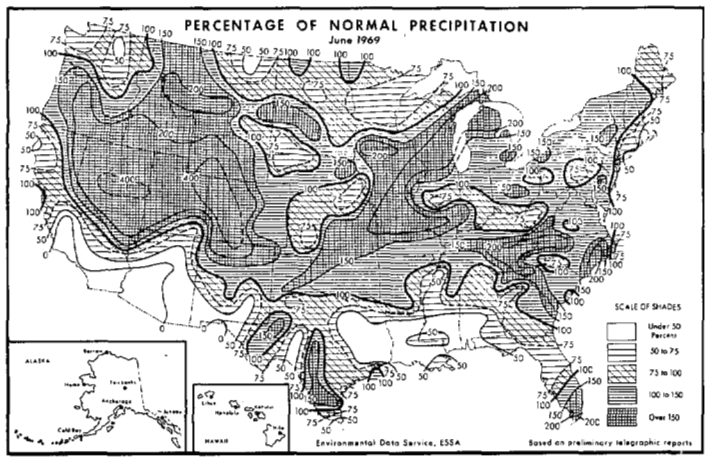


FIGURE 6.—Percentage of normal precipitation for June 1969 (from Environmental Data Service, 1969).

TABLE 2.—*Stations reporting record or near-record total monthly precipitation during June 1969*

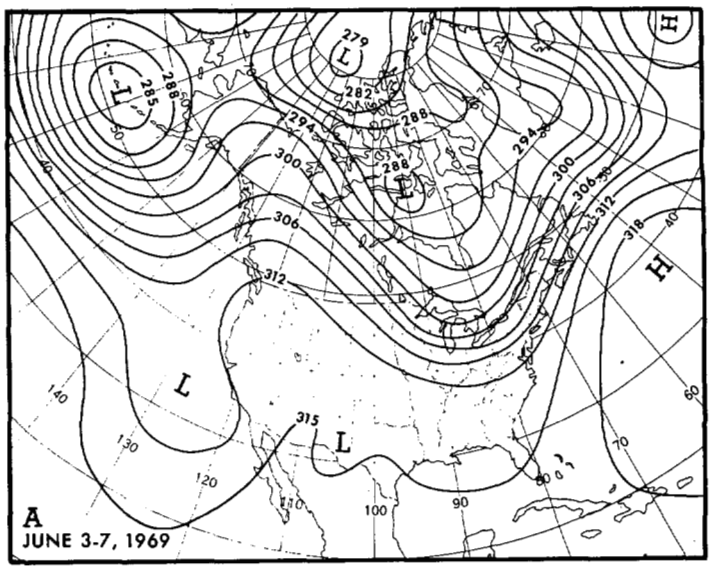
Station	Total precipitation (inches)	Remarks
Sault Ste. Marie, Mich.	7.35	Wettest June of record
Alpena, Mich.	8.37	Wettest June since 1880 and 2d wettest of record
Green Bay, Wis.	7.62	3d wettest June of record
Madison, Wis.	7.96	3d wettest June of record
Rockford, Ill.	8.90	4th wettest June of record
Dubuque, Iowa	10.49	3d wettest June of record
Columbia, Mo.	10.15	2d wettest June of record
Billings, Mont.	5.74	2d wettest June of record
Missoula, Mont.	4.18	3d wettest June of record
Grand Junction, Colo.	2.07	Wettest June of record
Salt Lake City, Utah	2.83	2d wettest June of record and 2d greatest number of thunderstorm days, 13
Reno, Nev.	1.29	4th wettest June of record and greatest number of thunderstorm days, 11
Greer, S.C.	9.59	Wettest June of record
Miami Beach, Fla.	14.09	3d wettest June of record
Appalachicola, Fla.	0.56	Driest June of record
Baton Rouge, La.	0.76	Driest June since 1936 and 4th driest of record

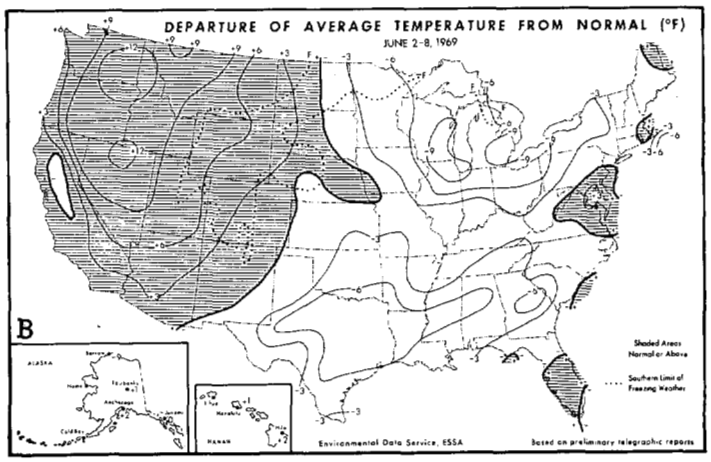
Although recording more than its average June rainfall, Williamsport, Pa., had only 12.44 in. of precipitation during the first half of 1969, the driest such period there in the 20th century.

3. WEEKLY WEATHER AND CIRCULATION

JUNE 2–8

The first week of June was the warmest, both in a relative and absolute sense, in the Pacific Northwest where temperatures soared to daily highs well up in the 90's, and the weekly mean was as much as 12°F above normal under a strong ridge (figs. 7A, B). The trough over the Great Lakes was also strongly amplified, and temperatures there and in eastern Texas and parts of the South were more than 6°F below normal. A cool spell at the beginning of the month produced some





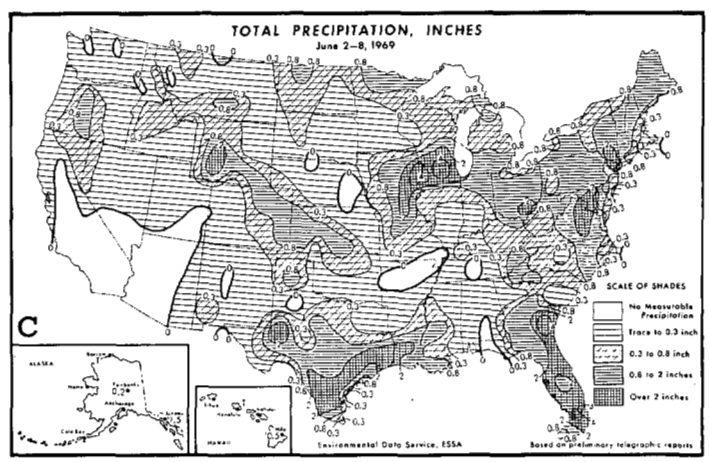


FIGURE 7.—(A) mean 700-mb contours (decameters) for June 3–7, 1969; (B) departure from normal of average surface temperature (°F); and (C) total precipitation (inches) for week of June 2–8, 1969 (from Environmental Data Service, 1969).

record low temperatures for so late in the season in the Northern Plains (table 3).

Precipitation was well distributed over most of the Nation, with only the Far Southwest and isolated small

TABLE 3.—*Stations reporting record late-season low temperatures during June 1969*

Station	Date	Temperature (°F)
Helena, Mont.	12	30
Billings, Mont.	12, 13	32, 32
Kalispell, Mont.	13	30
Casper, Wyo.	13	28
Bismarck, N. Dak.	2	30
Williston, N. Dak.	20	32
Fargo, N. Dak.	20	30
Sioux Falls, S. Dak.	13, 14	33, 34
Rapid City, S. Dak.	14	32
Scottsbluff, Nebr.	14	30
Valentine, Nebr.	2, 14	31, 30
North Platte, Nebr.	2	29
Goodland, Kans.	14	*40
Sioux City, Iowa	13	40
Minneapolis, Minn.	13	37
Sault Ste. Marie, Mich.	14	32

* Equaled lowest temperature so late in the season

areas in the middle of the country remaining dry (fig. 7C). Ordinarily the Far West might be expected to be drier under such a strong mean ridge, but cyclonic activity began working inland from the Pacific toward the end of the week.

Severe thunderstorms with hail and strong winds as well as tornadoes struck sections of the Plains and Midwest during the middle of the week, and damaging thunderstorms also occurred in New England and the Middle Atlantic States over the weekend.

JUNE 9–15

Rapid cooling occurred during the second week of June over the Rockies and Northern Plains as the western ridge strengthened and moved northwestward, while the Hudson Bay Low deepened southward (figs. 8A, B). Cyclonic disturbances aloft entered the western United States south of the ridge, contributing to unusually cool and wet weather over much of the Southwest at what is normally near the hottest and driest part of the year in that area. Only southern Arizona and the California deserts escaped with no rain at all (fig. 8C).

In the Northern and Central Plains, weekly temperatures averaged more than 12°F below normal (fig. 8B). From the 12th through the 14th, numerous new records for low temperatures so late in the season were established, some at stations which had just set new marks for June cold earlier in the month (table 3). The latest spring snowstorm of record along the eastern slopes of the Rockies and in the Black Hills area gave 2.6 in. at Helena, Mont., 4 in. at Sheridan, Wyo., and 0.5 in. at Rapid City, S. Dak., on the 12th and 13th.

On the very same day the snow was ending in the plains, Juneau, Alaska, recorded a maximum temperature of 86°F; 2 days later at McGrath and Fairbanks, the thermometer reached 90°F and 96°F, respectively (table 4).

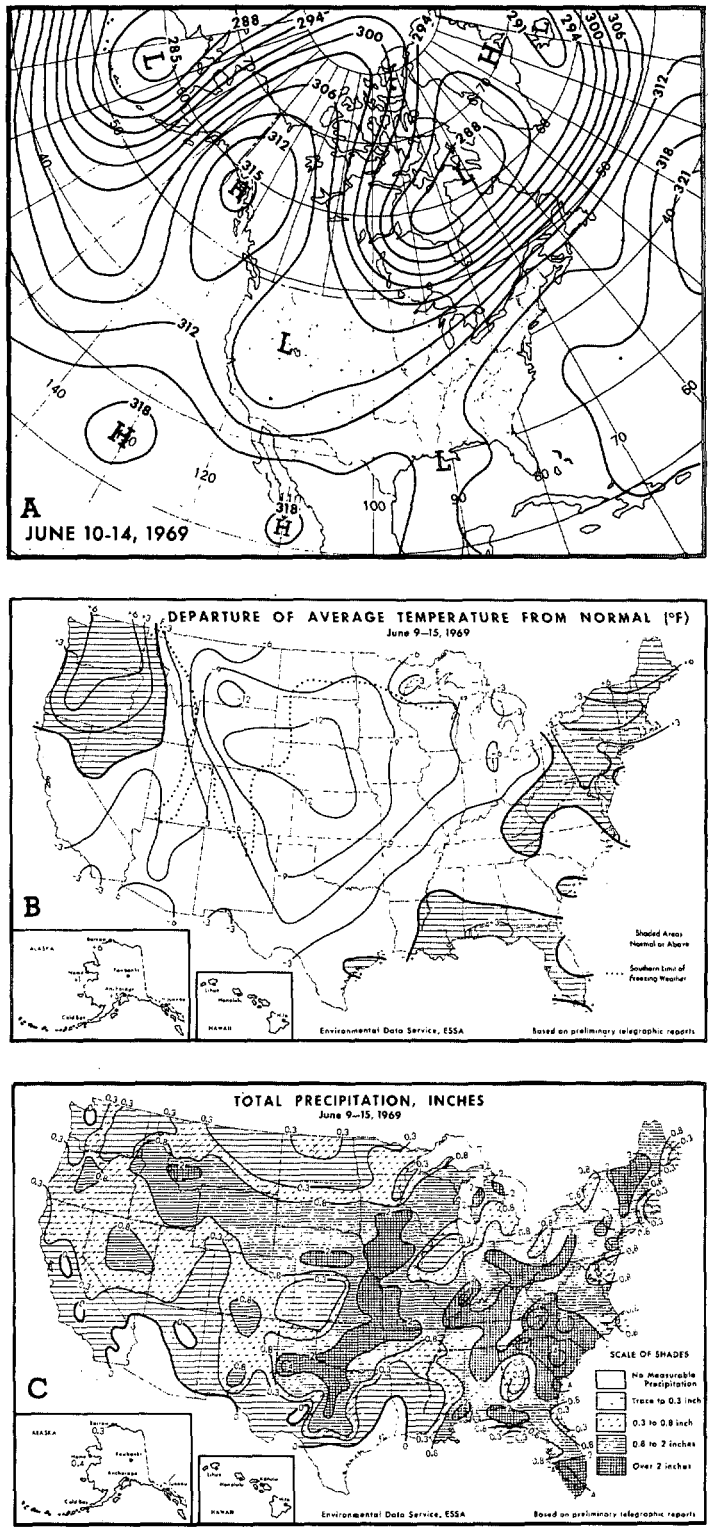


FIGURE 8.—Same as figure 7, (A) for June 10–14, 1969; (B) and (C) for June 9–15, 1969 (from Environmental Data Service, 1969).

These readings were not only the highest temperatures ever recorded in June, but the highest for all time at these Alaskan stations. (Fairbanks has an all-time record of

TABLE 4.—*Stations reporting record high temperatures for June during June 1969*

Station	Date	Temperature (°F)
Albuquerque, N. Mex.	29	102
Casper, Wyo.	5	* 92
Juneau, Alaska	13	** 86
McGrath, Alaska	15	** 90
Fairbanks, Alaska (Airport)	15	** 96

* Highest temperature so early in the season
** Highest temperature for all time in period of record

99°F recorded in July, but the 96°F was a new all-time record for the airport station.)

Heavy rainfall in excess of 2 in. fell during the week over widespread sections of the Plains, the Ohio Valley, and the Southeast (fig. 8C). Numerous thunderstorms, some accompanied by winds gusting to near-hurricane force and damaging hail, struck in parts of Texas, Kansas, Nebraska, Wisconsin, and Michigan.

JUNE 16–22

The circulation over the North American sector reverted during the third week of June to a pattern similar to that of the first week of the month. Broad cyclonic flow extended deep into the South as cool air masses circulated around the Hudson Bay vortex, which reached its maximum intensity, with 700-mb heights nearly 200 m below normal for the 5-day period June 17–21, 1969. The Pacific Northwest ridge restrengthened, although it was joined to the eastern Pacific ridge at low latitudes, rather than to the Rockies ridge as 2 weeks previously (compare figs. 7A and 9A).

Most of the country, except for the Pacific Northwest where daily maxima were as high as 109°F, and Florida and much of Texas, had below-normal temperatures (fig. 9B). However, the record-breaking readings of the previous week were not repeated, except for a couple of stations in North Dakota (table 3).

Heaviest precipitation fell across the middle and southern portions of the Nation (9C) as the mean frontal zone was displaced far south of its normal position by the expanded flow around the Hudson Bay Low. Tornadoes and hailstorms occurred in several localities from the Texas Panhandle to Virginia.

JUNE 23–29

Retrogression of the central Pacific trough during the last week of June led to strong building of the eastern Pacific High and downstream amplification of an extensive trough over the Rockies (fig. 10A). As a consequence, 700-mb heights rose rapidly over the Southeast; and while weekly temperatures were as much as 15°F below normal in the Northern Plateau, the entire southeastern third of the Nation warmed rapidly (fig. 10B). A number of cities

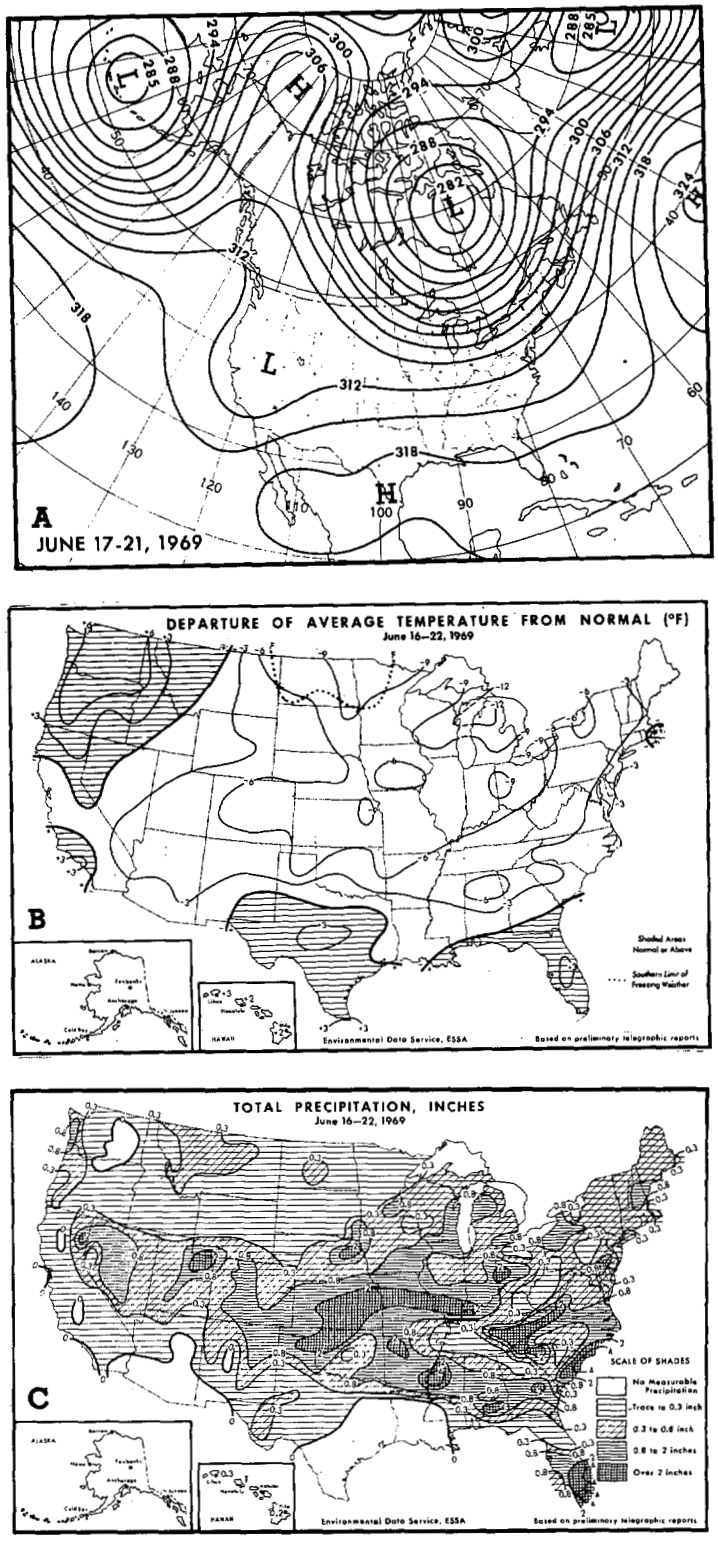


FIGURE 9.—Same as figure 7, (A) for June 17–21, 1969; (B) and (C) for June 16–22, 1969 (from Environmental Data Service, 1969).

in the Southeast reported temperatures of 100°F or higher on several days; and as the heat began expanding slowly northward and westward, Albuquerque, N. Mex., reported 102°F on the 29th, the highest June temperature ever observed there.

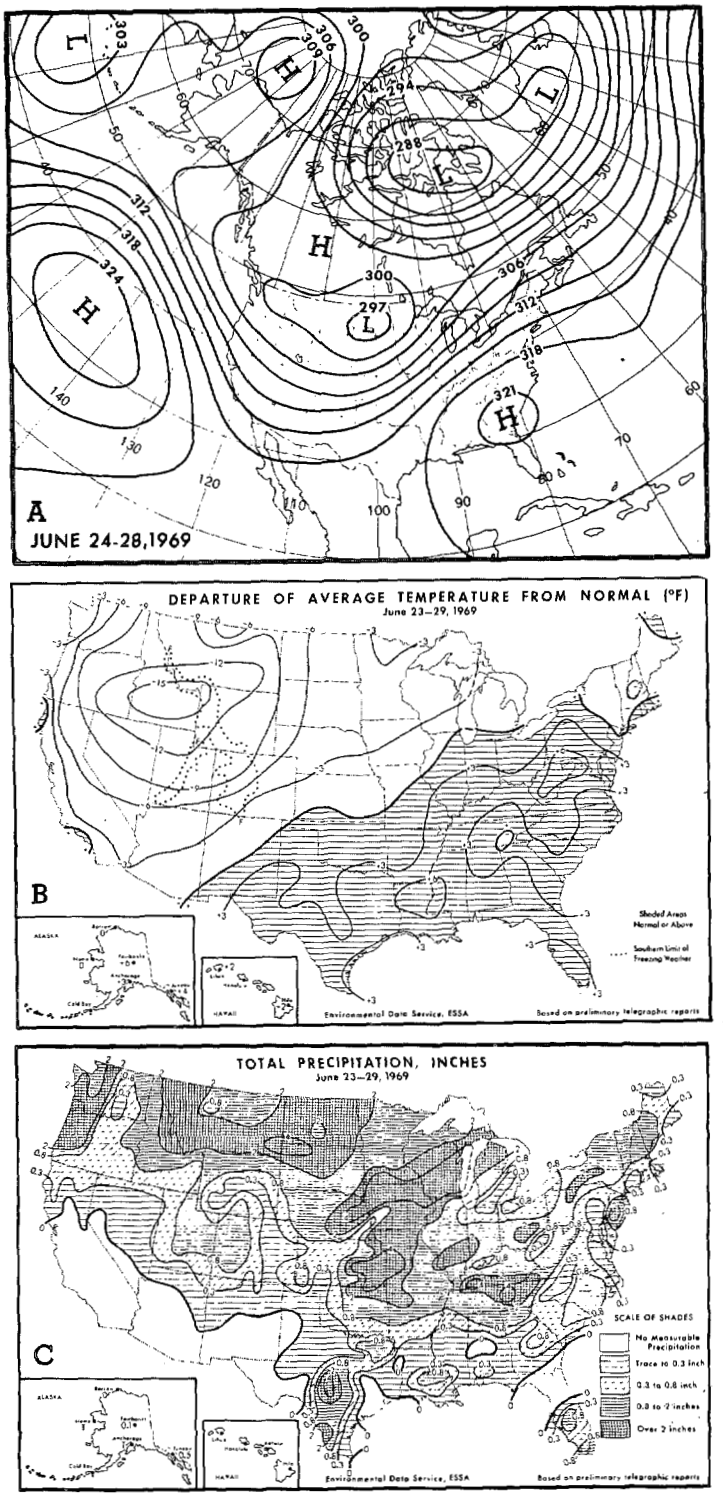


FIGURE 10.—Same as figure 7, (A) for June 24–28, 1969; (B) and (C) for June 23–29, 1969 (from Environmental Data Service, 1969).

The main band of precipitation and severe weather moved northward with the mean frontal zone and intensified as the thermal contrast across the country increased. Extensive areas of the Northern Rockies, Northern Plains, and Upper Mississippi Valley reported 2 to 4 in. of rain, with some localities in Minnesota and Wisconsin receiving more than 8 in. for the week (fig. 10C). Severe weather again affected the Central States, and damaging winds and hail accompanied thunderstorms in the Middle Atlantic States.

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