

THE WEATHER AND CIRCULATION OF JUNE 1970

A Month With Sharp Temperature Variations, Warm in the Northwest and Cool in the Southeast

A. JAMES WAGNER

National Meteorological Center, Weather Bureau, ESSA, Suitland, Md.

1. MEAN CIRCULATION

The 700-mb mean circulation for June 1970 featured a deep vortex centered over the North Pole where heights averaged 130 m below normal (figs. 1 and 2). Other Lows were located near the eastern shore of Baffin Island and just north of the central Aleutians. The Baffin Low moved little from the previous month's position, but the Aleutian Low represented a northwestward displacement of the 700-mb system found in the Gulf of Alaska during May (Posey 1970). Nevertheless, the Aleutian Low was still south of the normal position in June, as implied by the height anomaly field (fig. 2).

Relative to normal, the largest height anomaly changes from May to June were falls of 150 m near the Pole and 100 m over the western Pacific (fig. 3). Heights also fell by as much as 50 m over the northeastern portion of the United States as the ridge that had extended from the Southeast to the Great Lakes in May weakened. The height anomaly field itself was very weak over the United States and southern Canada during June, with heights 20 m above normal over central and southwest Canada and 10 m below normal over the south-central United States (fig. 2).

Positive height anomaly centers over northeast Siberia and Scandinavia (fig. 2) were associated with blocking ridges that produced unusually clear, fine early summer weather in those areas. This can be seen rather well in figure 1, where Scandinavia and northeast Siberia were among the darkest (most cloud-free) land areas over the Northern Hemisphere during June. Other dark areas were found, as might be expected, along the major subtropical high-pressure belts of the Atlantic and Pacific Oceans. The Great Plains of the United States also appeared to be relatively cloud-free.

The cloud areas associated with storms over the oceans had rather well-defined southern boundaries located just south of the axes of maximum wind (figs. 1 and 4). Note the relatively bright area east of Newfoundland in the confluence zone where two branches of the jet stream apparently merged. Blocking over Siberia and Scandinavia was associated with splitting of the maximum wind axis (figs. 1 and 4). The 700-mb wind speed maxima near 40° N., 170° W., and 50° N., 45° W., were nearly twice the normal values at those locations.

Areas of ice and snow over Greenland and the Arctic Basin show up as the brightest in figure 1. Some snow was apparently lingering over northern Siberia in the vicinity of the Taymyr Peninsula, and the ice in Hudson Bay had cleared or broken away from the northwestern shore and

the James Bay area, while remaining over most of the central part of the bay.

The intertropical convergence zone was rather even and well-defined over both oceans, extending nearly unbroken all the way from the coast of West Africa to the Philippines. It was, for the most part, located between 5° and 10° N., as seen by the mean brightness.

2. TEMPERATURE

The temperature anomaly pattern for June (fig. 5) was related in its broadest aspects to the height anomaly pattern, with generally cool weather in the southeastern half of the Nation and warm weather in the northwestern portion, with greatest positive departures along the Canadian border from Minnesota to Washington. As might be expected during a month without strong mean height anomalies, temperature anomalies were also generally small. No new record monthly mean temperatures were established, and the largest departure was 6.6°F above normal at Great Falls, Mont.

There were sharp variations of temperature during the month, however; in some areas, marked hot and cold spells tended to alternate. In the West, record high temperatures for the month and for so early in the season were set at several stations on the first day of June and again toward the end of the month (table 1). Even though there were intervening periods of cool weather, Medford, Oreg., had a record 6 days this June with maxima of 100°F or higher; Walla Walla, Wash., and Missoula, Mont., established new June records with 90°F or higher for 14 and 11 days, respectively.

3. PRECIPITATION

As is typical of summer, the precipitation distribution over the United States was rather irregular (fig. 6). Wettest areas relative to normal were in a band extending from northern California across the Great Basin to the central Rockies and in the Tennessee and lower Ohio Valleys. Thunderstorms were frequent from the Ohio Valley to the mid-Atlantic coast. Due to the changeable nature of the circulation during the month, the precipitation pattern was not well related to the monthly mean height or to its anomaly.

Abnormally dry areas were in the Pacific Northwest and northern Mississippi Valley where 700-mb heights were above normal and anticyclonic flow prevailed most of the month. Rapid City, S. Dak., had its sunniest June since 1940. Other dry areas were in parts of the Southeast, the lower Mississippi Valley, and the South-

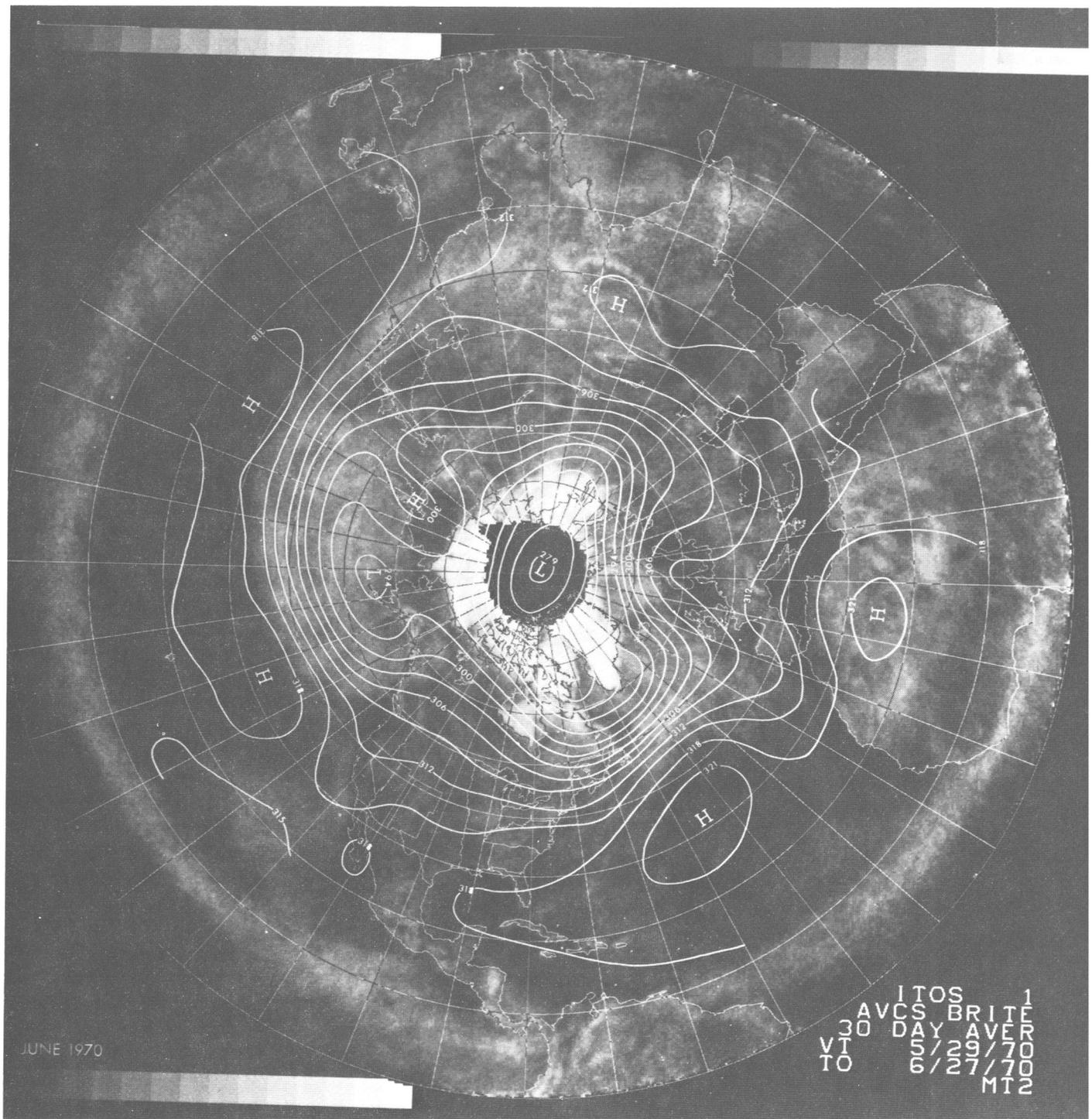


FIGURE 1.—Mean 700-mb contours (decameters) for June 1970, superimposed on 30-day average brightness for May 29–June 27, 1970, as measured by the ITOS 1 satellite.

west. Jackson, Miss., reported its third driest first half-year of record.

Only one station reported a new monthly precipitation record. Port Arthur, Tex., had its driest June with only 0.96 in. of rainfall, which was 3.33 in. below normal. The spatial variability of the precipitation pattern was highlighted by the fact that Corpus Christi, Tex., had its second rainiest June of record with 9.16 in., which was 6.77 in. above normal. Funnel clouds and tornadoes were observed in the area on 5 days. An even more spectacular

contrast in precipitation over a relatively short distance in Texas can be seen from the 5.14 in. of rain recorded at Galveston while only 0.26 in. was observed at Houston less than 60 mi away.

4. WEEKLY WEATHER AND CIRCULATION

JUNE 1–7

The month began with a spectacular early-summer heat wave in the West as an abnormally strong ridge built

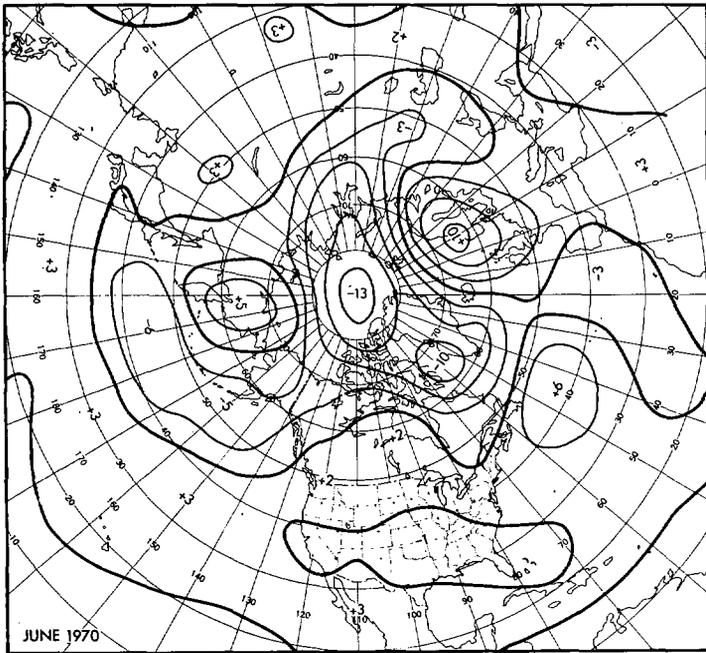


FIGURE 2.—Departure from normal of mean 700-mb height (decameters) for June 1970.

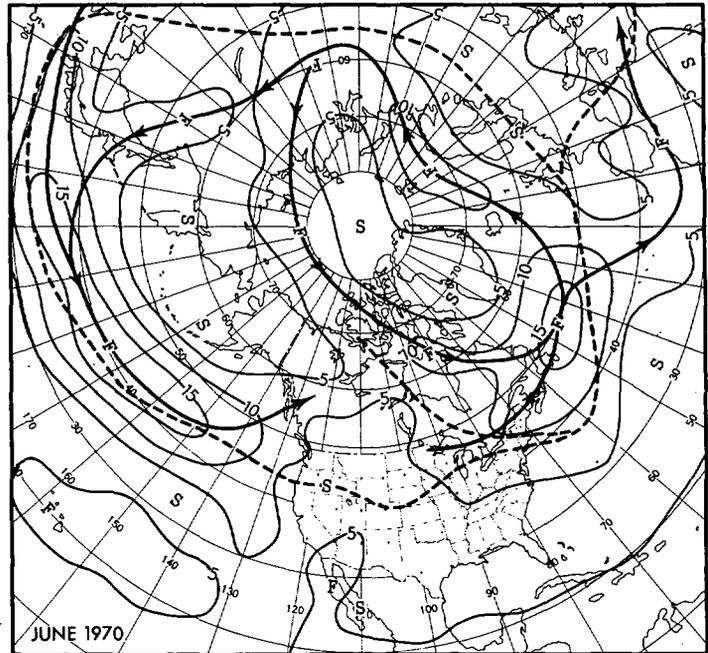


FIGURE 4.—Mean 700-mb isotachs (meters per second) for June 1970. Heavy arrows indicate principal axes of maximum wind speed, dashed lines the normal.

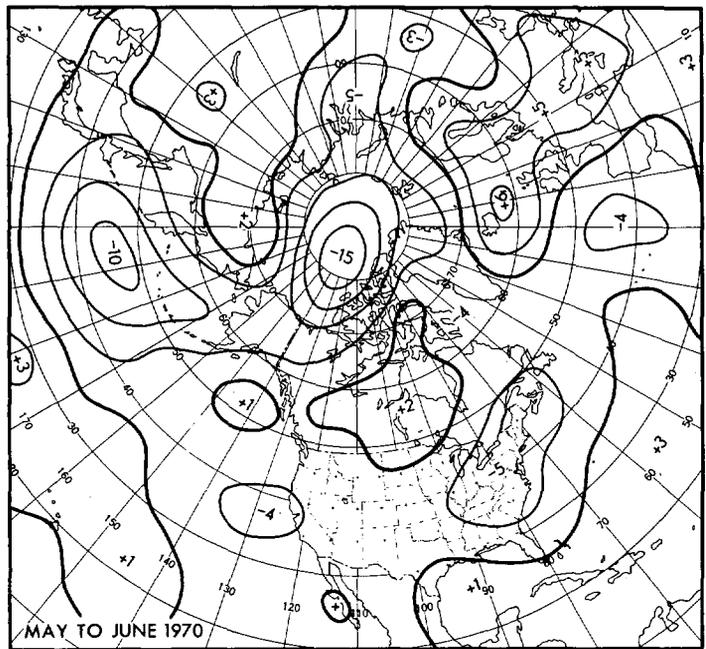


FIGURE 3.—Mean 700-mb height anomaly change (decameters) from May to June 1970.

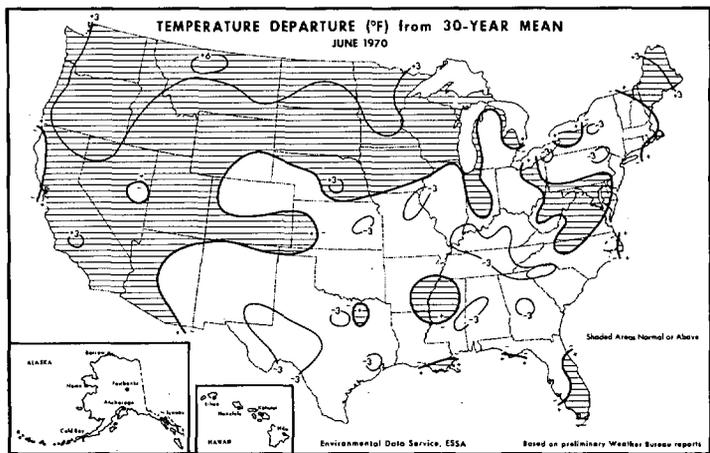


FIGURE 5.—Departure from normal of average surface temperature (°F) for June 1970 (from Environmental Data Service 1970).

over southwestern Canada where 700-mb heights averaged 110 m above normal near Lake Winnipeg (figs. 7A and 7B). Temperatures averaged as much as 15°F above normal for the week in the northern basin, and several records for early-season warmth were set (table 1). The temperature also soared to 100°F at the Portland, Oreg., Custom House observation site, and new daily heat records were established at several localities in Montana, Washington, and Oregon. Toward the end of the week, the core of the warm air moved to the northern plains where Williston,

TABLE 1.—Record temperatures established during June 1970

Location	Temperature (°F)	Date	Remarks
Olympia, Wash.....	94	1	Highest so early in the season
Bakersfield, Calif.....	110	1	Highest so early in the season
Roswell, N. Mex.....	40	2	Lowest for month of June
Shreveport, La.....	54	3	Lowest so late in the season
Austin, Tex.....	53	3	Lowest for month of June
Tucson, Ariz.....	111	25	Equaled alltime record high
Flagstaff, Ariz.....	96	26	New alltime record high
Winslow, Ariz.....	106	26	Highest for month of June and equaled alltime record high
Milford, Utah.....	105	26	Highest for month of June
Phoenix, Ariz.....	89	27	Highest daily minimum in June
Casper, Wyo.....	101	27	Equaled June record high
Grand Island, Nebr.....	107	28	Highest for month of June
Bridgeport, Conn.....	50	28	Lowest so late in the season

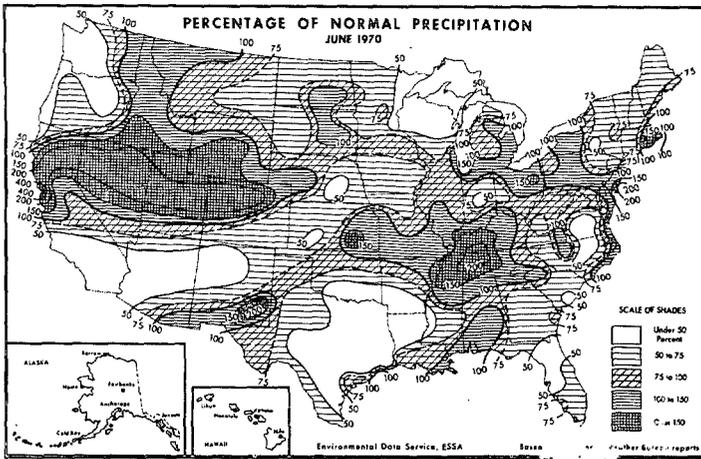


FIGURE 6.—Percentage of normal precipitation for June 1970 (from Environmental Data Service 1970).

N. Dak., and St. Cloud and Minneapolis, Minn., established new daily high marks on the 7th, all with 92°F.

A slowly moving cut-off Low to the south of the warm Canadian blocking ridge was reflected in a weak mean Low centered over southern Illinois (fig. 7A) where the 5-day mean height was 90 m below normal. Heavy convective rains with weekly totals over 2 in. occurred from eastern Kansas to Ohio (fig. 7C), and several tornadoes and funnel clouds were sighted. Another area of excessive rainfall extended inland from the eastern gulf coast, where some places recorded over 8 in. of precipitation for the week.

Unusually cool weather prevailed throughout the South in connection with the widespread cloudy skies and precipitation ahead of an anomalous northerly flow behind the trough. Weekly temperatures averaged more than 12°F below normal in the Texas Panhandle (fig. 7B). Roswell, N. Mex., set a new June low-temperature record on the 2d with 40°F; and Shreveport, La., and Austin, Tex., set new late-season June cold records on the 3d, with 54° and 53°F, respectively (table 1).

JUNE 8-14

Amplification of a trough in the central Pacific and the downstream ridge led to a rapid change of circulation and accompanying weather over the western United States. A deep mean trough with a closed low center over Idaho and 5-day mean heights 100 m below normal was associated with much cooler weather in the Far West and Great Basin and widespread precipitation across most of the Nation (figs. 8A, 8B, and 8C). The blocking ridge that had been over southwest Canada the previous week amplified and moved eastward to extend from the Great Lakes to central Canada where 5-day mean heights averaged 110 m above normal.

Relative to normal, lowest temperatures of more than 6°F below normal were observed in the Great Basin where they had averaged as much as 15°F above normal the previous week (compare figs. 7B and 8B). Rapid warming occurred over the plains and Mississippi Valley in the southerly flow ahead of the western trough, with

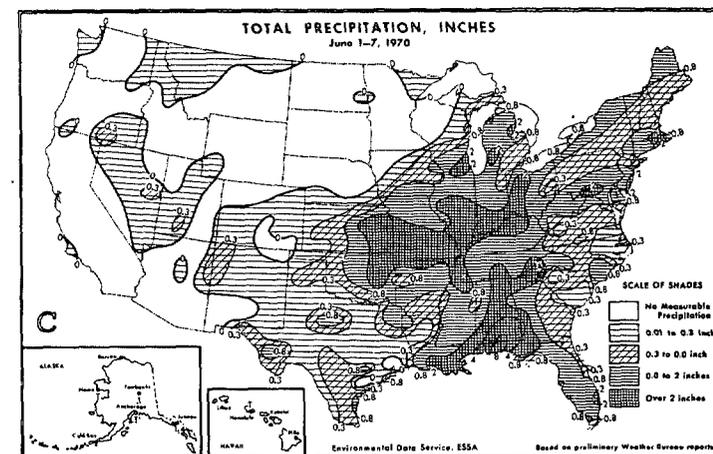
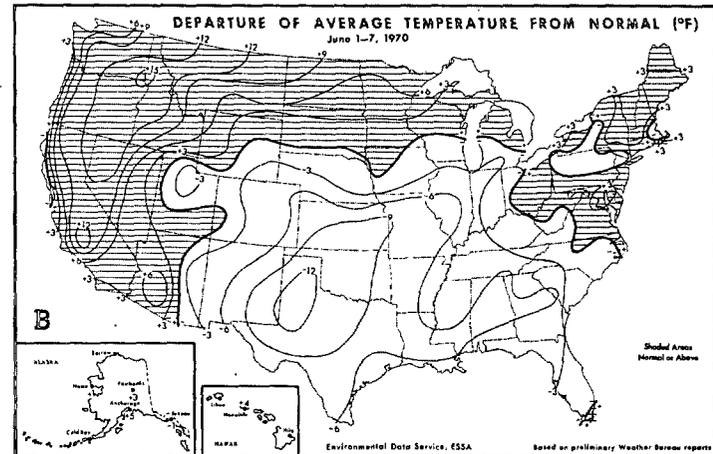
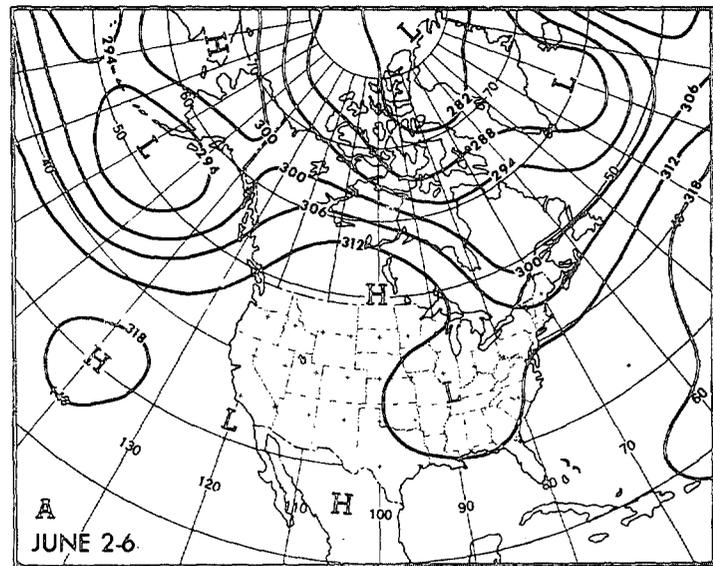
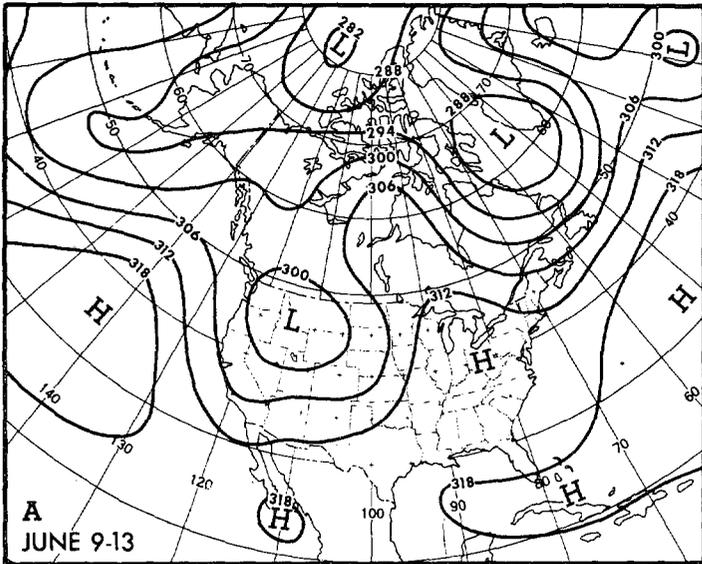


FIGURE 7.—(A) mean 700-mb contours (decimeters) for June 2-6, 1970; (B) departure from normal of average surface temperature (°F) and (C) total precipitation (inches) for week of June 1-7, 1970 (from Environmental Data Service 1970).

greatest positive anomalies of 9°F over Minnesota. The Southeast remained a few degrees lower than normal as heights were slightly below normal and the flow had a weak anomalous component from the northeast, due to the highly amplified Canadian blocking ridge.

Heavy precipitation fell in the central plains where portions of Kansas received more than 8 in. and flash

JUNE 15-21



During the third week of June, the blocking in central Canada was replaced by negative 700-mb heights and cyclonic flow. The trough and associated cool air that had been in the West moved eastward and later southward, in response to height rises over western Canada and the Pacific Northwest, where temperatures as much as 6°F above normal were again observed (figs. 9A and 9B). In general, the northern half of the country east of the Rockies had temperatures averaging a few degrees lower than normal; while to the south, average readings were a few degrees above normal.

Just prior to the advent of cooler air, temperatures at several stations in the Southeast set record daily highs, with 104°F at Columbia, S.C., on the 19th being the highest reading east of the Mississippi River so far this summer. A 100°F maximum was observed as far north as Richmond, Va., on the 18th. In sharp contrast, the cool airmass behind the front established new daily record low temperatures at several stations across the Midwest from South Dakota to New York State on the 19th, 20th, and 21st.

Weak wave cyclones that developed along the slowly southward-moving boundary of the cold air produced rather extensive precipitation in a confluence zone extending through the central and eastern parts of the Nation (figs. 9A and 9C). Several tornadoes were again observed in the central plains, and severe hailstorms occurred in such widely separated locations as Iowa and Maryland.

JUNE 22-28

The weather and circulation patterns near the end of June reverted to ones similar to those prevailing at the beginning of the month. A ridge built over the Rockies, and a trough deepened near the east coast (fig. 10A), while temperatures were above normal in the western half of the Nation and below in the East (fig. 10B). The heat in the West was rather extreme, with several stations reporting record June highs (table 1). The hottest weather in many years was observed over southwest deserts with 122°F at Blythe, Calif., and 121°F at Needles, Calif. Toward the end of the week, maxima of 100°F or higher were recorded as far north as Wyoming where Sheridan reported its first June maximum of 100°F or higher since 1940 on the 27th. Temperatures soared to as high as 107°F in the western plains area.

Two unusually cool surface Highs produced dozens of daily low temperature records in an area from the northern plains to the Middle Atlantic States and New England. Most minima were in the upper 40s and low 50s, but some minima in the 30s were recorded in northern New England on the 28th.

Most of the country except the far Southwest and central plains had precipitation, with heaviest amounts near the gulf coast where excessive totals and flash floods were observed in some localities. The cold front that broke

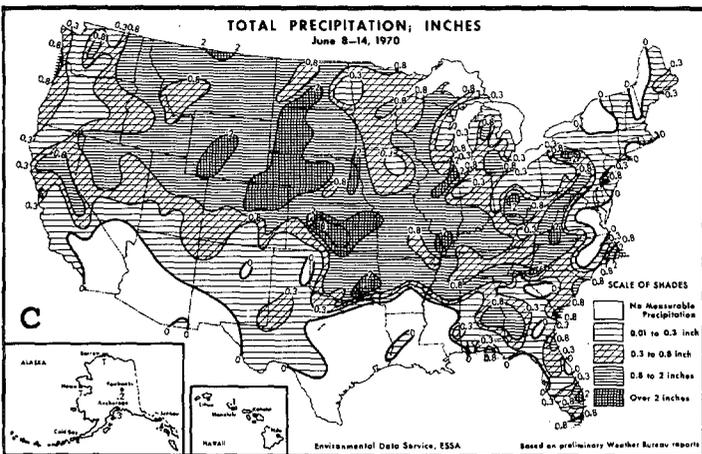
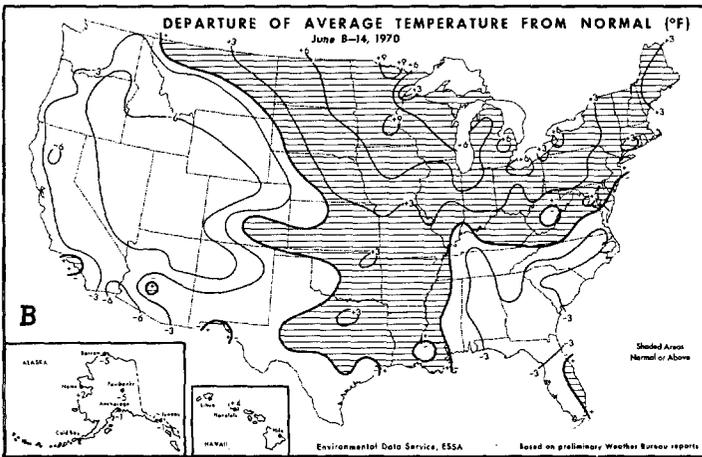


FIGURE 8.—Same as figure 7, (A) for June 9-13, 1970; (B) and (C) for June 8-14, 1970 (from Environmental Data Service 1970).

floods occurred on small streams (fig. 8C). Denver, Colo., set a new 24-hr June rainfall record with 3.16 in. on the 11th. Tornadoes occurred in several States, but none did major damage. Huron, S. Dak., reported 3-in.-diameter hail on the 14th. Some of the precipitation fell as snow in the higher elevations of the Rockies where Fraser, Colo., had 7 in., and a trace was observed at Cheyenne, Wyo.

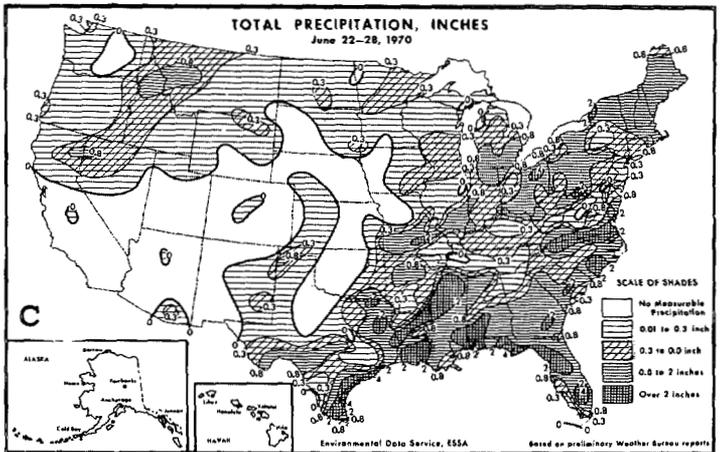
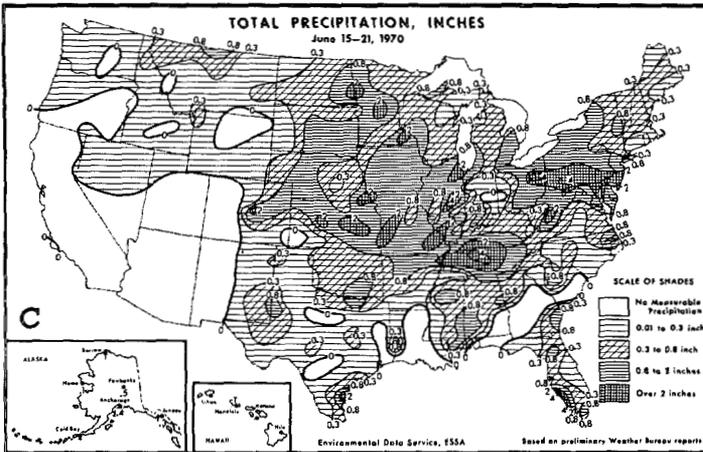
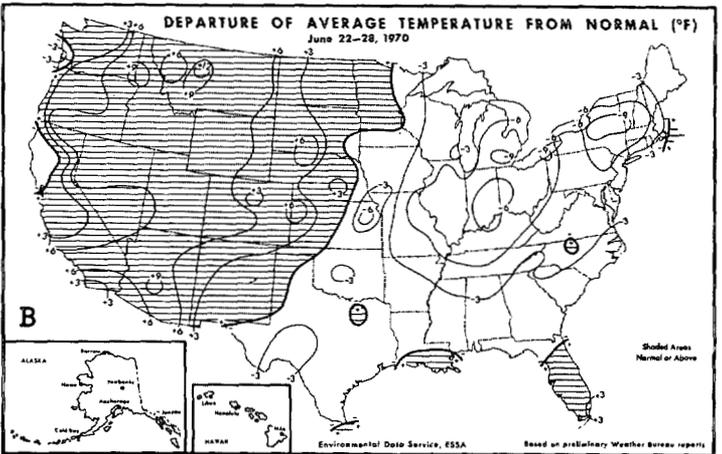
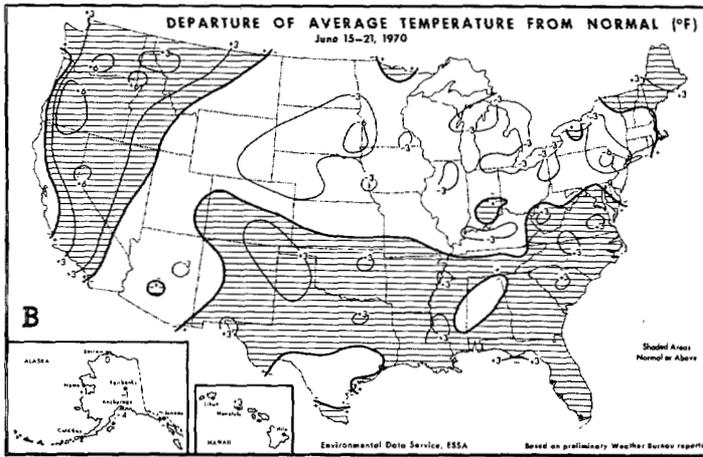
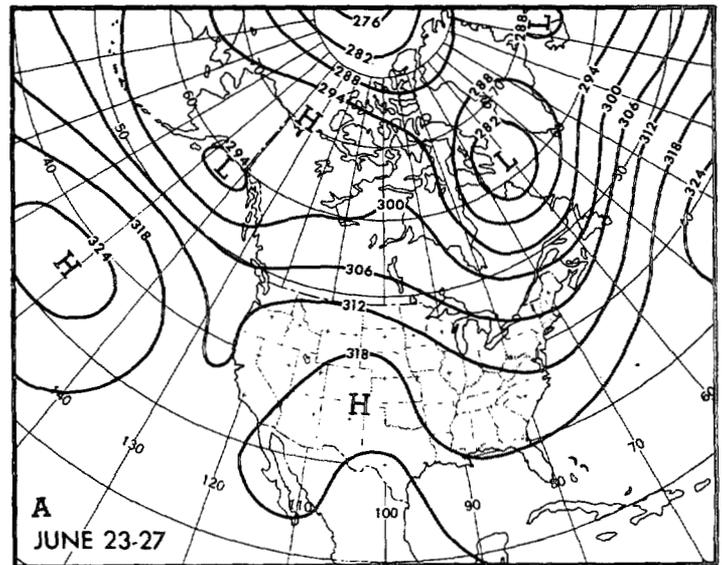
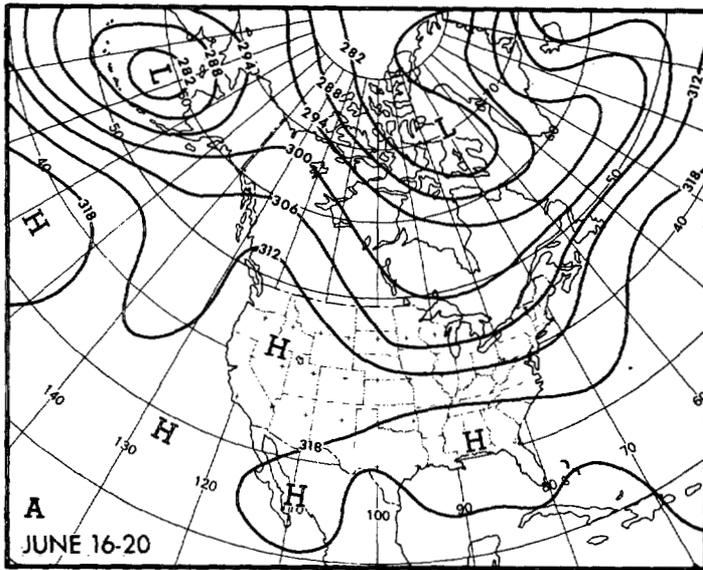


FIGURE 9.—Same as figure 7, (A) for June 16-20, 1970; (B) and (C) for June 15-21, 1970 (from Environmental Data Service 1970).

FIGURE 10.—Same as figure 7, (A) for June 23-27, 1970; (B) and (C) for June 22-28, 1970 (from Environmental Data Service 1970).

the heat wave in the west set off severe thunderstorms, some with damaging winds, from the central basin to the northern Rockies on the 27th. During the closing days of the month, much cooler air again moved into the west, and snow fell in the higher elevations of the Rockies, with 2 in. at West Yellowstone, Mont., on the 30th.

REFERENCES

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 Posey, Julian W., "The Weather and Circulation of May 1970—A generally Warm Month Associated With Small Amplitude Flow," *Monthly Weather Review*, Vol. 98, No. 8, Aug. 1970, pp. 621-625.