THE WEATHER AND CIRCULATION OF JUNE 1963

Interplay Between Blocking and Drought in the United States

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1. INTRODUCTION

Over much of the Northern Hemisphere circulation anomalies during June 1963 represented a reversal from those of May. One of the most pronounced changes was over eastern North America and the North Atlantic where blocking replaced a high index pattern. Introduction of blocking into North America had favorable implications for the Gulf Coast and Middle Atlantic States drought areas but produced another dry area stretching from the Middle Mississippi Valley to the Appalachians. Although there was a reversal of 700-mb. height anomaly in the western United States, the extreme precipitation contrasts of spring in that area continued into June. Thus, while Nevada locations received from 2 to 6 times normal precipitation, much of Arizona and New Mexico remained dry.

2. MONTHLY CIRCULATION

Over North America the mid-tropospheric circulation pattern during June (fig. 1) featured a trough in the West and a ridge in the East. In the West below normal 700-mb. heights extending from California to Alaska represented a reversal from the height anomaly during May [1], and were associated with the strong ridge which encompassed the eastern Pacific area during June. Above normal heights in the ridge extending from the Great Lakes through central Canada were also, to a large extent, a reversal of May conditions. They appeared to be related to a wave of blocking which, emanating from a May position in western Europe, spread westward during June affecting both the Atlantic and North America.

Over North America blocking was evidenced by positive 700-mb. height anomalies at high and middle latitudes (fig. 1), representing a substantial diminution of the zonal westerlies in eastern portions. Over the Atlantic and western Europe blocking was apparent in terms of the split westerlies, together with a high-latitude High with accompanying positive height anomaly center. Here too, June's height anomaly represents a reversal from that of May. The change of height anomaly between May and June as shown in figure 2 illustrates these blocking trends.

In terms of 15-day mean 700-mb. maps the blocking ridge, strongly evident near Great Britain during the first half of the month (fig. 3A), nearly vanished by the final half of the month (fig. 3B), while remnants of blocking persisted in North America and the Barents Sea. Variations in the mid-latitude zonal index as seen in figure 4 display this trend quite well. At the month's beginning blocking was strongly developed and the zonal index was low; as time progressed blocking spread westward and weakened and the index rose. Near the end of June, however, the westerlies diminished rapidly as blocking dominated the circulation in the Western Hemisphere. Thus, this June featured a pronounced index cycle. A similar cycle, although of different phase, was reported in June 1959 [2].

As the blocking ridge moved from Western Europe in May (fig. 1 in [1]) to the Norwegian Sea in June, northwesterly winds to its rear carved out a trough with below normal heights extending from the Barents Sea to the Caspian Sea (fig. 1). Farther downstream, heights rose (fig. 2) over eastern Asia, and May's Asiatic coastal trough was displaced eastward well into the western Pacific in June. The upper ridge (and associated positive height anomaly) which was located in the mid-Pacific in May amplified and moved eastward to the eastern Pacific in June.

It is of interest to note that a well developed positive 700-mb. height anomaly in the central or eastern Pacific has been a notable feature of the general circulation since March 1963 [1, 3, 4]. Another relatively stable height anomaly has been the positive center near Japan which has resided in the western Pacific since April 1963 [1, 4]. With heights well above normal at middle latitudes in both the western and eastern Pacific during June, stronger than normal easterlies were observed in the 20°–30° N. latitude belt across the Pacific. Thus, it is not surprising that this area was the site of three typhoons (compared to a June average of one [5]), two tropical storms, and one tropical depression in June. Each of the typhoons (Polly, Shirley, and Trix) was first located east of the Philippines to the south of the persistent positive height anomaly near Japan.

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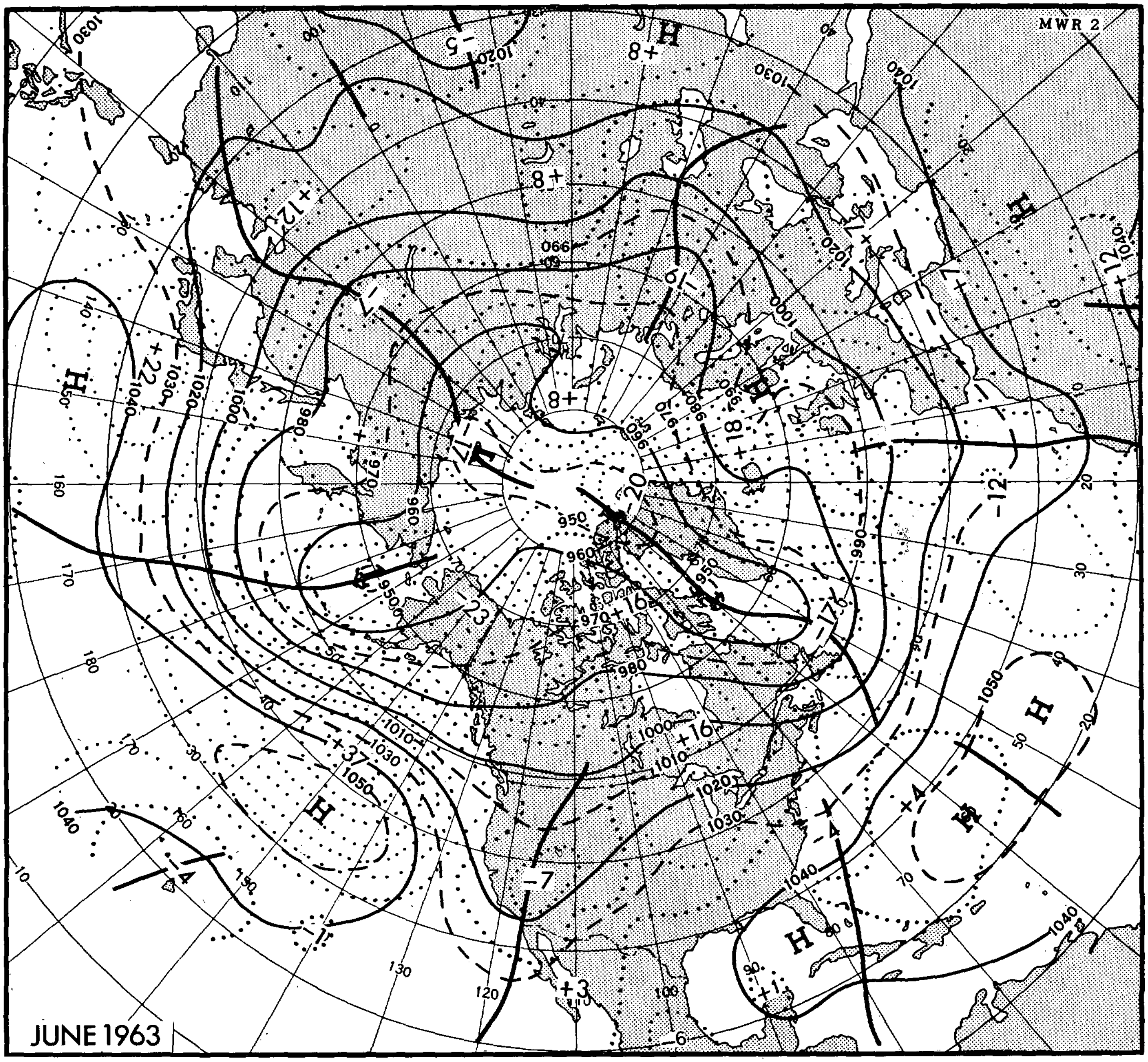

FIGURE 1.—Mean 700-mb. contours (solid) and height departures from normal (dotted), both in tens of feet, for June 1963.

3. TEMPERATURE

West of the Rocky Mountains monthly mean temperatures for June (fig. 5), as well as component 15-day means (fig. 6 A and B), were generally subnormal. This persistent anomaly was related to the strong eastern Pacific upper-level ridge whose circulation imported an abundant supply of cool Pacific air and maintained a relatively deep trough in the Far West. The frequency distribution of June daily temperature departures from normal at Ely, Nev. (fig. 7), in the midst of the observed cool area, illustrates the relative constancy of cool conditions in this region. Despite this persistence few record temperature abnormalities were observed. Albuquerque, N. Mex., experienced a record low temperature for June on the 9th, while the June record low temperature was equaled at Olympia, Wash. on the 3d.

Elsewhere in the Nation, above normal temperatures extending from the Northern and Central Plains to New England accompanied above normal 700-mb. heights in

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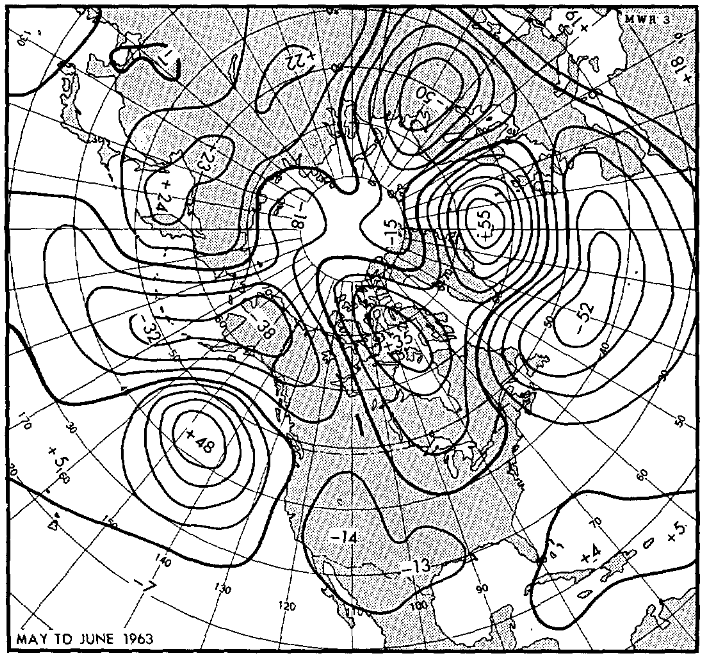

FIGURE 2.—Change of mean 700-mb. height anomaly from May to June 1963 in tens of feet.

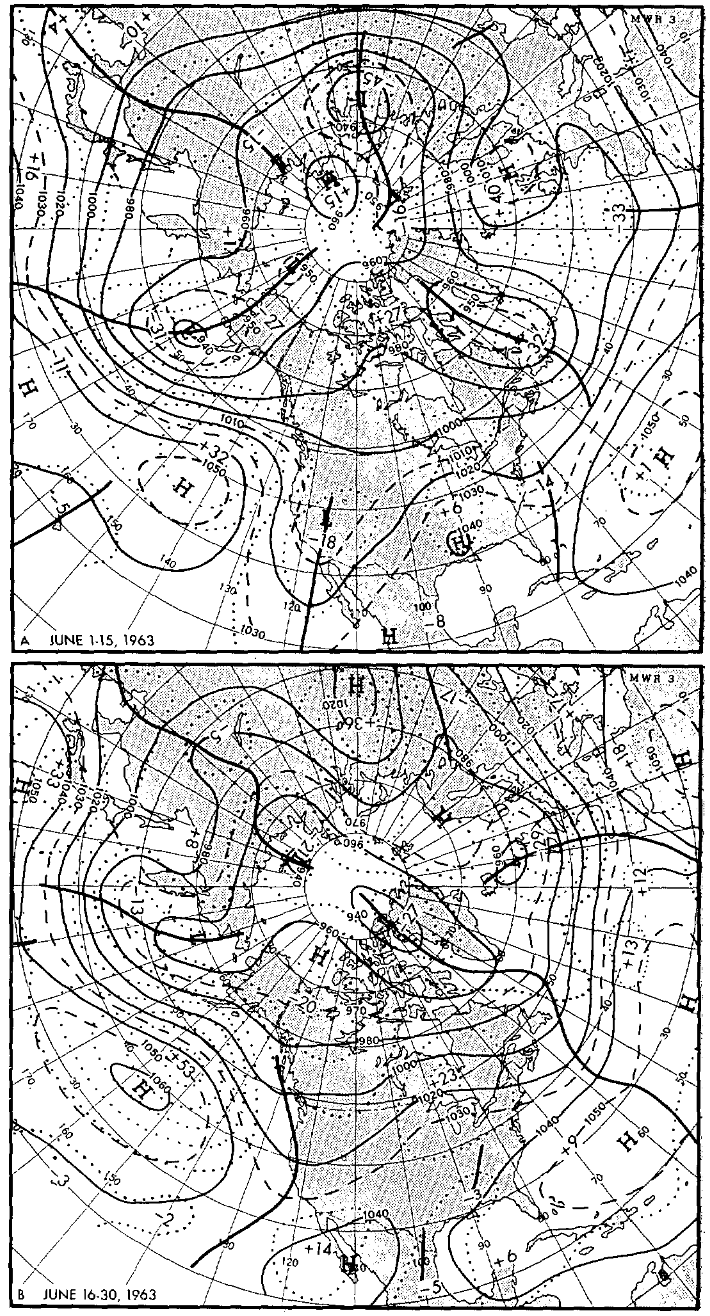

FIGURE 3.—Mean 700-mb. contours (solid) and height departures from normal (dotted), boths in tens of feet, for (A) June 1–15, 1963, and (B) June 16–30, 1963.

that area. The western portion of this warm area was the only relatively stable temperature feature during June east of the Divide, as can be seen by comparing half-monthly mean temperature charts (fig. 6) with the monthly mean (fig. 5). Reference to the comparable 700-mb. charts (fig. 3) reveals anomalous southerly wind components during both halves of the month with above normal heights confined to the latter period. The distribution of June daily temperature anomalies at Fargo, N. Dak. (fig. 7) shows that wide fluctuations of temperature were observed, even within the context of relatively invariant half-monthly means. Daily temperature anomalies at Fargo ranged from 16° F. above normal on June 4 to 13° F. below normal on June 11 and back to 14° F. above normal on June 29.

In the Southeast the coastal trough with below normal heights and northeasterly anomalous wind components brought sufficient cloudiness and precipitation coupled with cool air advection to insure relatively cool temperatures. In the Southern Plains (except western Texas) and Lower Mississippi Valley areas, above normal temperature prevailed despite slightly subnormal upper-level heights. These warm temperatures appear related to the warming influence of abnormally dry soils during the first half of the month.

Over most of the eastern and south central portions of the Nation temperatures, near or above normal during the first half-month, dropped to below normal during the final half of the month. Reference to half-monthly circulation charts (fig. 3) suggests that this trend was associated with the tendency toward rising 700-mb. heights in the Great Lakes region during the latter half of the month and the accompanying area of cloud and rain-related coolness in the Southeast. Also associated with the cooling was a vigorous cold front which swept through the area on June 20–22 during the incipient stages of the Great Lakes ridge-building. This influx of cool air was accompanied by an extensive area of frost on the 21st and 22d from southeastern Minnesota to central Pennsylvania, record low temperatures for so late in the season at Pittsburgh and Philadelphia, Pa. on the 22d and 23d respectively,

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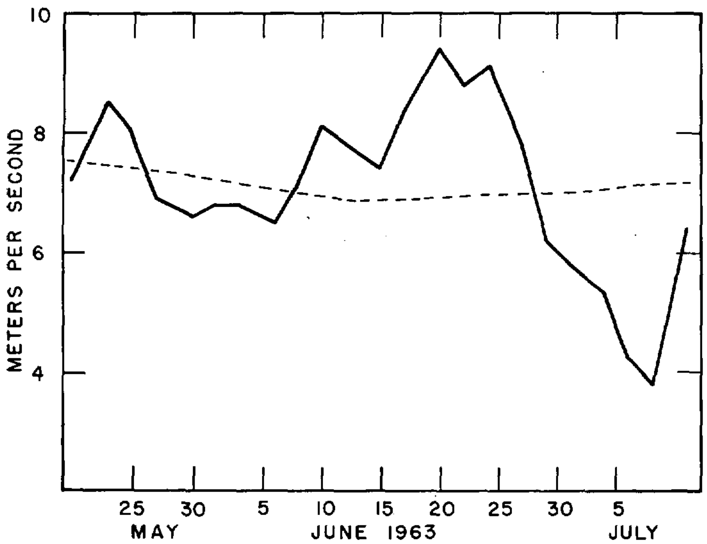

FIGURE 4.—Time variation of speed of 700-mb. westerlies averaged over the western half of the Northern Hemisphere between latitudes 35° and 55°N. Solid line connects 5-day mean zonal index values (plotted at middle of period and computed thrice weekly), while dashed line gives the corresponding normal values.

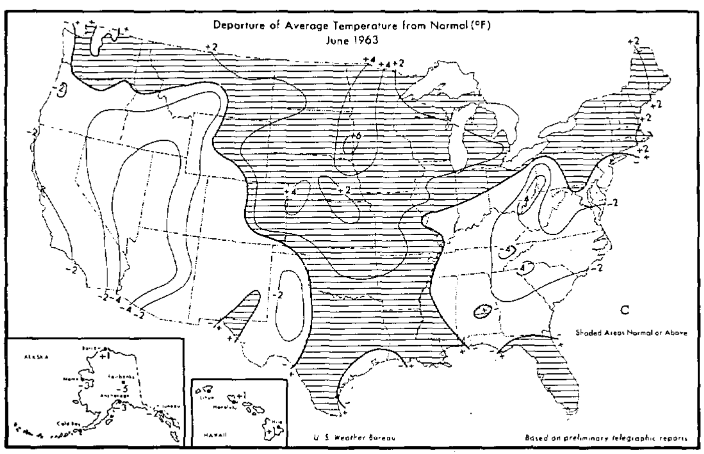

FIGURE 5.—Departure of average surface temperature from normal for June 1963 (from [6]).

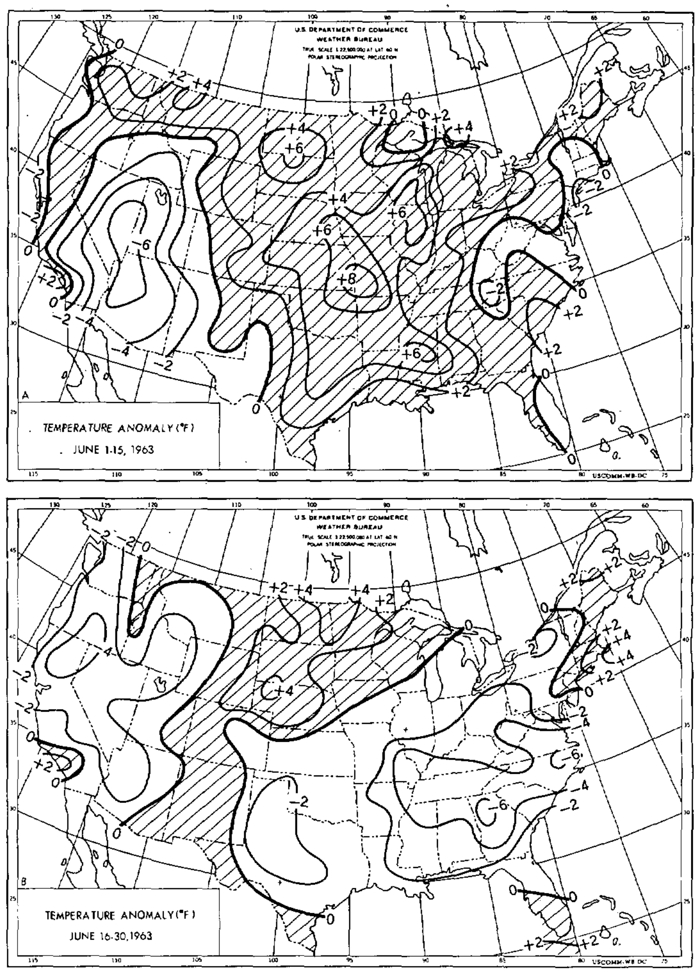

FIGURE 6.—Departure of average surface temperature from normal (°F.) for (A) June 1–15, 1963 and (B) June 16–30, 1963.

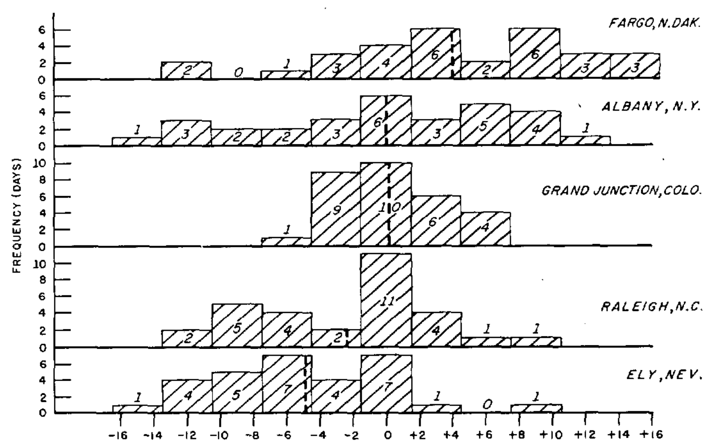

FIGURE 7.—Frequency distribution of daily temperature departures from normal (°F.) during June 1963. Numbers within blocks are frequency of occurrence in days. Monthly mean temperature departure from normal is shown in each instance by heavy dashed vertical line.

and the equaling of the June record low temperature at Toledo, Ohio on the 21st.

The distribution of daily temperature anomalies during June at Raleigh, N.C., in the midst of the monthly mean cool area in the East, is shown in figure 7. The bimodal tendency of the frequency distribution further documents the change of regime which took place near mid-month. Daily temperature anomaly frequency distributions are also provided in figure 7 for Grand Junction, Colo. and Albany, N.Y., stations whose monthly mean temperature for June averaged near normal. It is interesting to note the small variability at Grand Junction compared to that at Albany and other stations portrayed. Albany during June had a large variability of daily temperatures with values extending from 14° F. below normal to 12° F. above normal.

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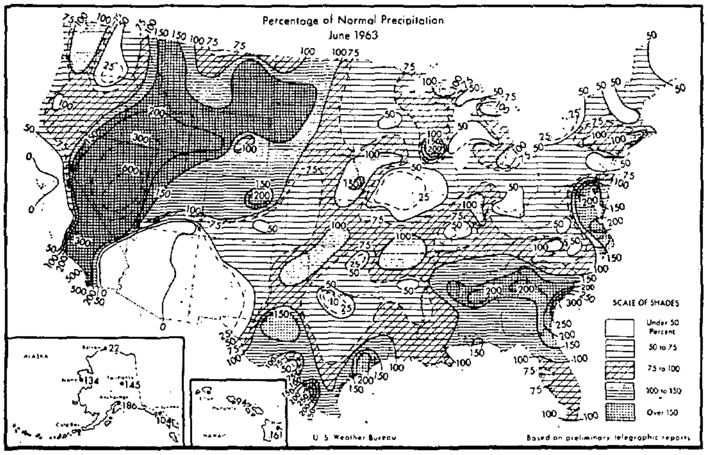

FIGURE 8.—Percentage of normal precipitation for June 1963 (from [6]).

4. PRECIPITATION AND DROUGHT

By the end of May extensive areas of soil moisture shortage were reported [6] in the Southwest, along the coast of the Gulf of Mexico from western Florida to southern Texas, and in a belt extending from northern Virginia to eastern New York. Most extreme shortages were in the New Mexico-Colorado area and along the Gulf Coast where spring (March–May) precipitation was less than 50 percent of normal [6].

The observed precipitation distribution for June (fig. 8) reveals that above normal precipitation fell on most of the parched Gulf Coast area and over much of the moisture-needing portions of the eastern seaboard. Thus, by the end of June the moisture shortage was greatly alleviated in these areas. In terms of the monthly mean circulation (fig. 1), this abundant precipitation was associated with below normal 700-mb. heights and anomalous easterly wind components.

Reference to half-monthly mean charts suggests, in view of the increasing cyclonic southerly flow aloft, that the latter half of the month was more conducive to precipitation over the Gulf Coast States. This, indeed, was the case. From all along the Gulf Coast came reports of drought-breaking rains from June 16 to 30 after a dry first half-month. Adjacent to the drought area, in northern Alabama, Georgia, and South Carolina, this June was one of the wettest of record.

The dry spell of the middle Atlantic Coast was partially alleviated early in June as a tropical disturbance, forming over the Bahamas, moved northward to central Pennsylvania, spreading heavy precipitation from southern Virginia to the Washington, D.C., area. Both Norfolk and Richmond, Va., reported record 24-hr. precipitation amounts (6.87 in. and 4.61 in., respectively) during the passage of the depression on June 2 and 3.

Elsewhere in the eastern half of the nation a relatively large area of subnormal precipitation extended from the Middle Mississippi Valley to the Appalachians. June precipitation totals in this area were among the lowest of record; at Moline, Ill., and Erie, Pa., new lows were established while at Burlington, Iowa, Tulsa, Okla., and Youngstown, Ohio, June precipitation was the second lowest of record. By the end of June serious soil moisture shortages were reported [6] in much of the Middle Mississippi and Ohio Valleys. These dry areas were related to the stronger than normal upper-level ridge over the western Great Lakes (fig. 1). In addition northerly and easterly anomalous wind components in these areas were contrary to the south or southwest winds required for the influx of Gulf moisture.

In the western half of the nation the extreme precipitation contrasts of spring continued into June with much of Arizona and New Mexico and parts of northern California receiving no precipitation, while an extensive area from southern California to Idaho received more than twice the normal June rainfall. Heavy precipitation in the Great Basin was favored by the deeper than normal upper-level trough and associated negative anomaly center with anomalous easterly wind components of the monthly mean 700-mb. chart (fig. 1). These features were better defined on the 700-mb. chart for June 1–15 (fig. 3 A) when most of the precipitation occurred. Rainfall over the Great Basin was of record, or near-record proportions. At Ely, Nev., June was the wettest month of record; a new record 24-hr. precipitation total was set (June 10); and more thunderstorms occurred than during any previous month of record. Elsewhere in the Basin, Elko, Nev., experienced its second wettest June, and Reno, Nev, accumulated a record high April–June precipitation total. By the end of June Nevada crop reporters [6] indicated the finest grass in many years and water going over spillways at many reservoirs—almost unheard of in this dry State. In nearby portions of southern California June precipitation of about one-third of an inch was the greatest in many years, and at Long Beach a new June precipitation record (0.52 in.) was established.

Over Arizona and New Mexico, stronger than normal southwesterly wind components continued the rain shadow which has plagued the area for several months. By the end of the month Phoenix and Flagstaff, Ariz., had experienced, respectively, 66 and 52 consecutive days with no measurable precipitation and Prescott, Ariz., reported subnormal precipitation for the ninth consecutive month. Thus, at month's end, the Southwest drought continued unabated.

In northern Rocky Mountain and Northern Plains States the deeper than normal upper-level trough with anomalous southerly wind components (fig. 1) brought generally near to above normal precipitation. Several locations in this region reported near-record June precipitation totals.

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REFERENCES

L. P. Stark, "The Weather and Circulation of May, 1963—A Month with Retrogression over North America," *Monthly Weather Review*, vol. 91, No. 8, Aug. 1963, pp. 403–410.

R. A. Green, "The Weather and Circulation of June, 1959—A Month with an Unusual Blocking Wave," *Monthly Weather Review*, vol. 87, No. 6, June 1959, pp. 231–238.

J. F. Andrews, "The Weather and Circulation of March, 1963—A Marked Reversal from February," *Monthly Weather Review*, vol. 91, No. 6, June 1963, pp. 309–316.

4. J. W. Posey, "The Weather and Circulation of April, 1963—Continued Warm East of the Continental Divide and Cool to the West," *Monthly Weather Review*, vol. 91, No. 7, July 1963, pp. 347–352.

5. U.S. Navy, Fleet Weather Central/Joint Typhoon Warning Center, Guam, *Annual Typhoon Report*, 1962, 305 pp.

6. U.S. Weather Bureau *Weekly Weather and Crop Bulletin, National Summary*, vol. L, Nos. 23, 26, 27, June 10, July 1 and 8, 1963.

New Weather Bureau Publications

ibliography on Meteorological Satellites (1952–1962), preared by Elemer Kiss, 380 pp. For sale by Superinndent of Documents, U.S. Government Printing Office, /ashington, D.C., 20402. Price, $1.25.

Annotated bibliography on material relating to meteorlogy and meteorological satellites and observations ierefrom.

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