THE WEATHER AND CIRCULATION OF JULY 1951[1]

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During July, the month of the record Kansas flood, the mean circulation (fig. 1) and weather were made up of two contrasting regimes. The first was dominated by a huge ridge throughout the troposphere over the Gulf of Alaska which brought cool rainy conditions to the Central and Northern Plains States, while the weather continued warm and dry in the Far West and Deep South. The second was characterized by the opposite flow pattern with a trough off both coasts of the United States, a ridge in the center, and a markedly reversed precipitation pattern.

[1] See Charts I-XV following p. 152, for analyzed climatological data for the month.

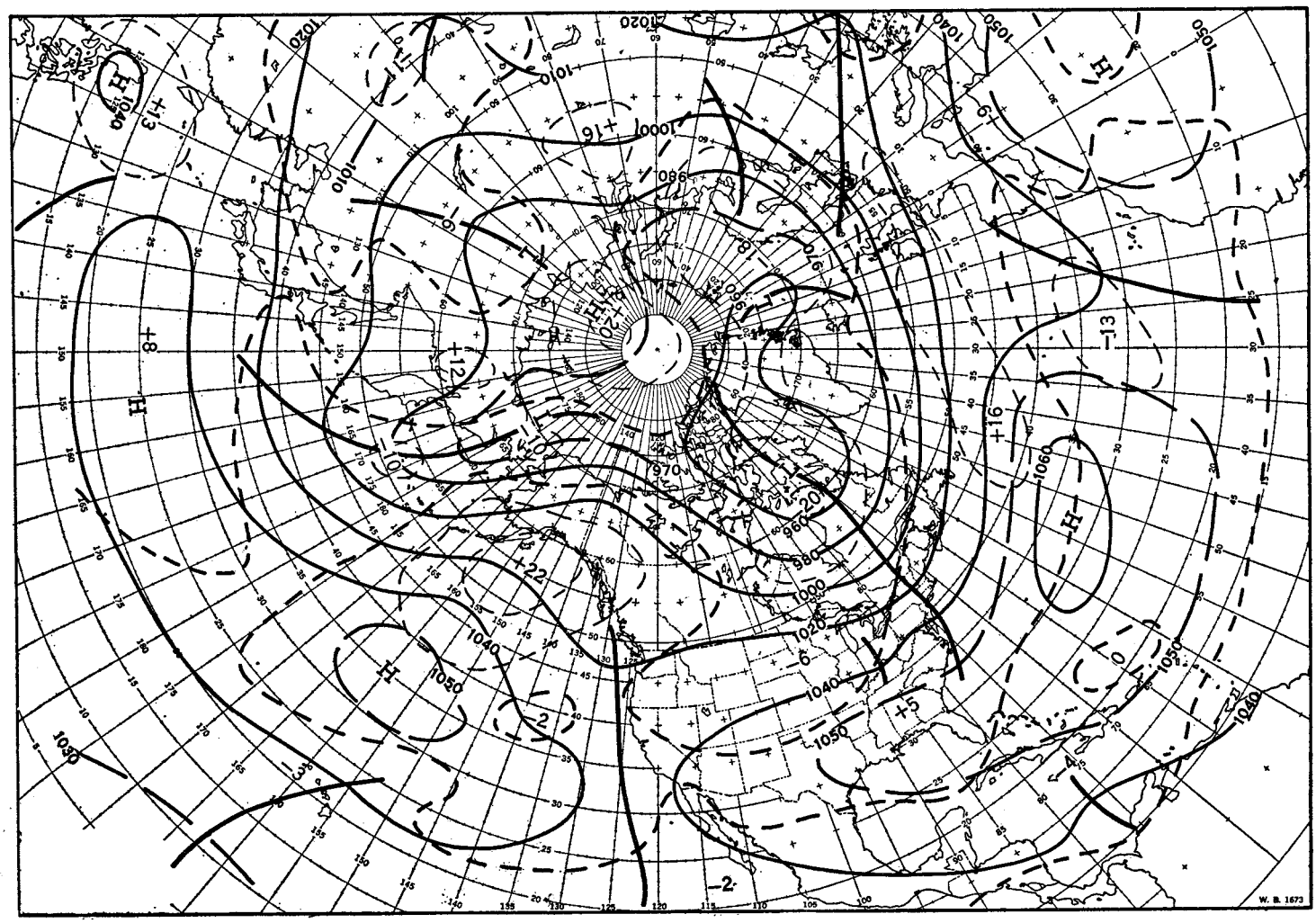

FIGURE 1.—Mean 700-mb. chart for the 30-day period June 30-July 29, 1951. Contours at 200-foot intervals are shown by solid lines, intermediate contours by lines with long dashes, and 700-mb. height departures from normal at 100-foot intervals by lines with short dashes with the zero isopleth heavier. Anomaly centers and contours are labeled in tens of feet. Minimum latitude trough locations are shown by heavy solid lines.

The first regime is illustrated in figures 2, 3, and 4. The strong 700-mb. ridge shown in figure 2 in Alaska and the Gulf of Alaska first became pronounced in western Canada in April and gradually retrograded to the position shown reaching its peak intensity in late June to early July [1]. East of it, and to the west of the unusually deep trough in east-central Canada, strong northerly winds poured cold air far down into the central United States. The southern edge of the cold air mass stagnated just south of Kansas. This is well indicated by the fact that temperatures for the week of July 10–17 averaged more than 3° F. above normal in Texas but more than 6° below normal in Nebraska (fig. 3). During this same period a pronounced current of moisture-laden air from the Gulf of Mexico (fig. 4) streamed northward into Kansas, up over the southern edge of the cold dome, and then continued eastward. This flow pattern brought copious rainfall to the central Plains where precipiatation had been above normal every month since February. By the end of June the soil there, already saturated, could absorb no more moisture. However, the torrential rains continued, resulting in the most damaging flood in the history of the United States [2].

Elsewhere during early July the weather was different. Drought blighted crops and fostered forest fires west of the Continental Divide, caused shedding in the cotton fields along the coasts of Texas and Louisiana, and endangered the citrus and tung oil groves of Florida. In the Northwest not a single Pacific storm could penetrate the tremendous ridge in the Gulf of Alaska to bring Pacific moisture to the coast. In this area dry north winds had prevailed since mid-June and cut off the normal source of moisture from the south and west. In central Florida, Louisiana, and northeastern Texas drought was produced by a combination of light rains and above-normal temperatures. Throughout the Southeast temperatures and insolation were above the normal under the sharp upper-level ridge where subsidence produced the dry tongue shown on figure 4.

Fortunately, just as the crest of the floods hit eastern Kansas on July 13–15, the weather there underwent a dramatic change. Bright sunny skies and rapidly soaring temperatures heralded the new regime. It was inaugurated when a trough deepened off the west coast, accompanied by a build-up of general anticyclonic conditions in the center of the country and trough development off the east coast. The most striking contrast with the former regime was the complete cessation of the influx of cold air from the northwest (contrast figs. 2 and 3 with 5 and 6). Almost the entire country reported temperatures well above normal (fig. 6), as warm continental air brought the first summer heat wave to central United States. In parts of the northern and central Plains States temperatures during the last week of July averaged more than 20° F. higher than they had been during the first week of the month.

The moisture pattern, like the temperature pattern, during the latter part of July was radically different from that characterizing the earlier weather regime, as can be seen by a comparison of figures 4 and 7. The extensive moist tongue from the Gulf of Mexico shifted westward, giving widespread showers to the parched Southwest. These were especially heavy in Utah and Nevada, where local flash floods occurred. As is evident from the temperature charts (figs. 3 and 6) these rains were not caused by the forced ascent of warm moist air over a cold air dome, as were the Kansas rains in the earlier regime. On the contrary, during the latter half of July the precipitation associated with the moist tongue was primarily convective and orographic in nature. A better representation of the three-dimensional moisture distribution could probably be obtained on an isentropic surface instead of on the 700-mb. surface. However, due to the difficulties of constructing isentropic charts from our present type of upper air reports, none has been prepared for this article.

Another marked difference between the moisture patterns of figures 4 and 7 is the replacement of the dry tongue by moist air over the Gulf States. The arrival of the moist air was concomitant with the disappearance of the sharp ridge aloft in this area and the development of a weak cyclonic circulation. (See figs. 2 and 5.) Drought was relieved in the citrus country of Florida and in the cotton and rice districts of Louisiana and northeastern Texas. Increased cloudiness and precipitation in these areas under the cyclonic circulation diminished the solar radiation and lowered the temperatures to near, and in some cases slightly below, the seasonal average during the last week of July. (See fig. 6.)

This weak cyclonic circulation in southeastern United States was not in evidence on the 700-mb. mean map for July (fig. 1). The outstanding feature of this monthly mean map is the strong ridge extending northeastward from a high center north of the Hawaiian Islands through the Gulf of Alaska to the Alaskan-Canadian border. The +220-ft. height departure from normal in the Gulf of Alaska is indicative of the abnormal intensity of the ridge, which slowly retrograded during the month. To the southeast of this ridge the trough along the west coast was first in evidence about the 4th of July. It persisted for a few days and then disappeared. But by the time of the Kansas floods the Pacific ridge had retrograded far enough to the west to permit the development of a deep, stable trough along the west coast of North America with a corresponding ridge in the vicinity of the Rockies. Figure 1 also shows that the area of greatest confluence on the monthly mean chart was located along the northern border of the United States. Rainfall generally exceeds the

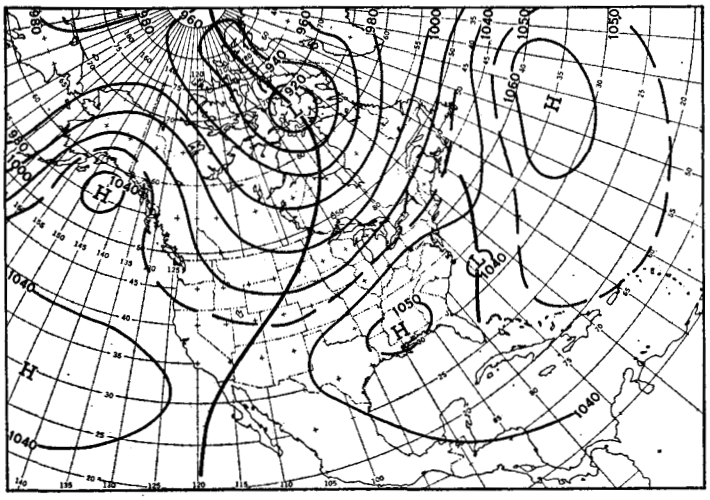

FIGURE 2.—Mean 700-mb. chart for the 5-day period July 7–11, 1951. Contours at 200-foot intervals are shown by solid lines, selected intermediate contours by dashed lines, and minimum latitude trough lines by heavy solid lines.

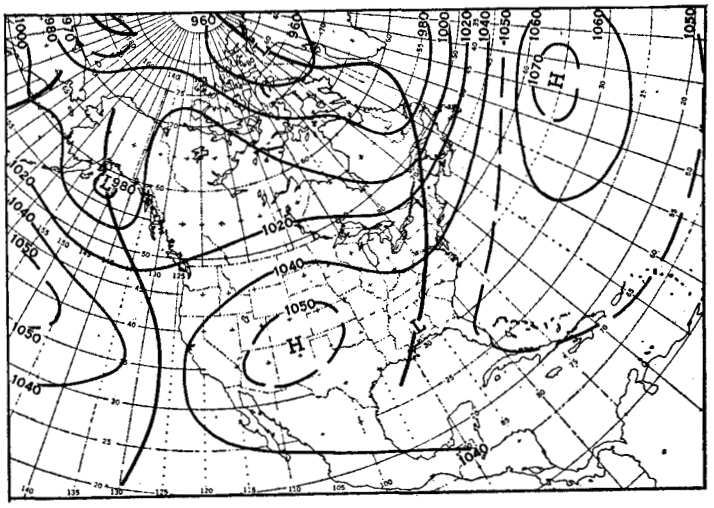

FIGURE 5.—Mean 700-mb. chart for the 5-day period July 28–August 1, 1951. Contours at 200-foot intervals are shown by solid lines, selected intermediate contours by dashed lines, and minimum latitude trough lines by heavy solid lines.

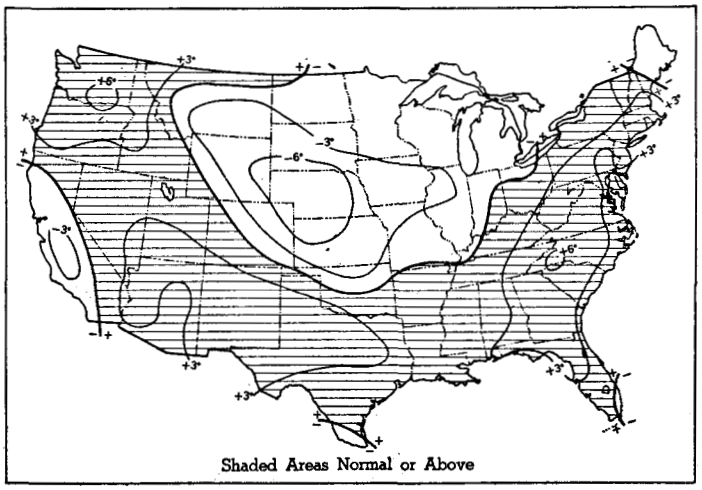

FIGURE 3.—Departure of mean temperature from normal for the week ending July 17, 1951. (From U. S. Weather Bureau, *Weekly Weather and Crop Bulletin*, week ending July 17, 1951.)

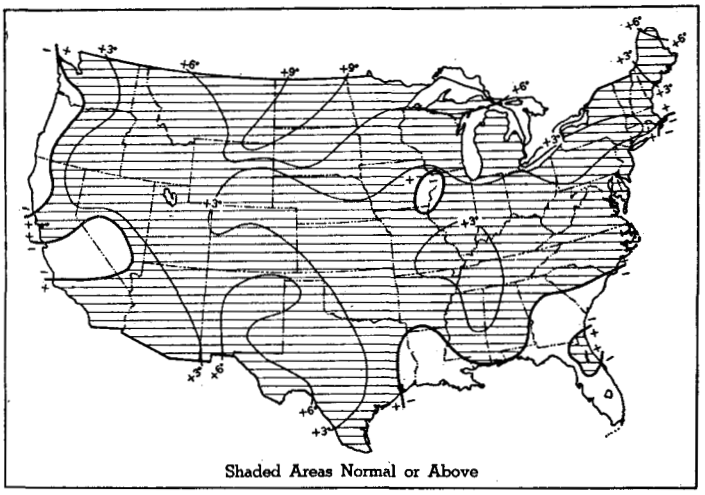

FIGURE 6.—Departure of mean temperature from normal for the week ending July 31, 1951. (From U. S. Weather Bureau, *Weekly Weather and Crop Bulletin*, week ending July 31, 1951.)

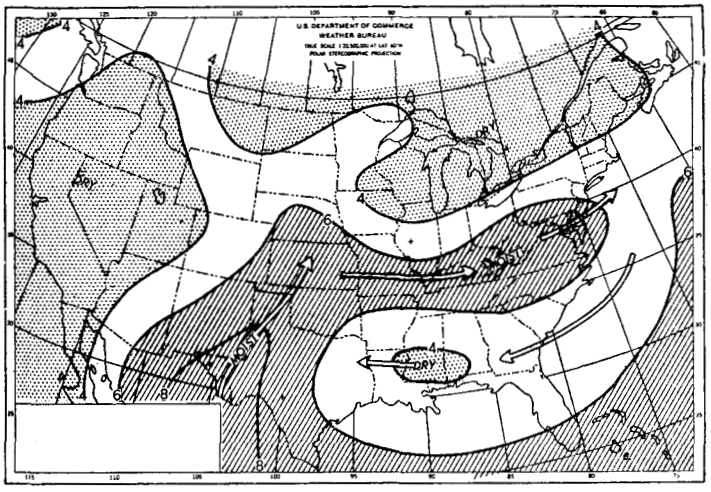

FIGURE 4.—Mean 700-mb. moisture chart for the 5-day period July 11–15, 1951. Areas with mixing ratio above 6 gm/kg of dry air are hatched. Areas with less then 4 gm/kg are dotted. Arrows indicate schematic flow of principal moist and dry tongues.

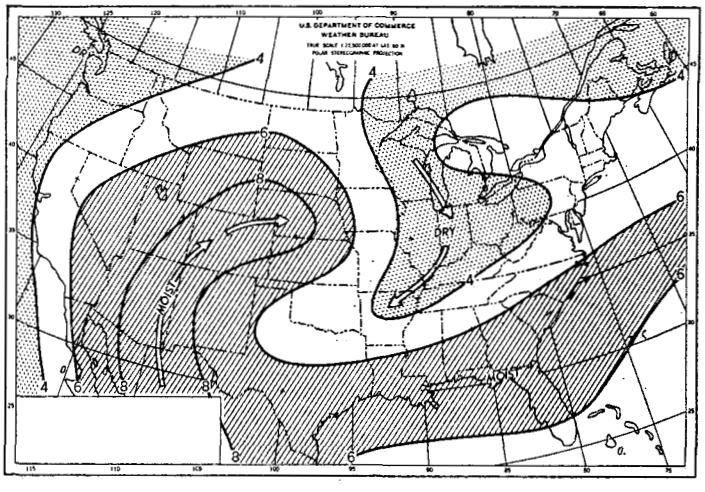

FIGURE 7.—Mean 700-mb. moisture chart for the 5-day period July 28–Aug. 1, 1951. Areas with mixing ratio above 6 gm/kg of dry air are hatched. Areas with less than 4 gm/kg are dotted. Arrows indicate schematic flow of principal moist and dry tongues.

seasonal normal in this confluence zone (Chart III). Early in the month marked confluence had persisted over the central Plain States in the flood area (fig. 2), but by the end of the month the principal confluence zone was in Canada (fig. 5). Downstream from the region of confluence a band of strong flat westerlies extended all the way across the Atlantic Ocean and western Europe (fig. 1).

In summary, July was the month when the persistent ridge in the Gulf of Alaska finally gave way and cyclonic circulation, developing along the west coast of the United States, gradually extended northward into the Gulf of Alaska. As this circulation pattern evolved, it cut off the strong rush of cold air into the central United States, where seasonal heating lent an impetus to the development of a strong ridge.

REFERENCES

1. L. H. Clem, "The Weather and Circulation of June 1951," *Monthly Weather Review*, vol. 79, No. 6, June 1951, pp. 125–128.
2. J. A. Carr, "Some Aspects of the Heavy Rains Over Eastern Kansas, July 10–13, 1951," *Monthly Weather Review*, vol. 79, No. 7, July 1951, pp. 147–152.