

NOTES ON THE SEVERE HEAT AND DROUGHT OVER THE MIDDLE WEST DURING THE SUMMER OF 1913.

By P. C. DAY, Climatologist and Chief of Division.

About the middle of June unusually warm weather set in over nearly all portions of the country to eastward of the Rocky Mountains, with the center of greatest temperature excess above the normal in the middle portions of the Great Plains and Mississippi Valley.

With but slight interruptions this unusually heated condition continued over the above-mentioned districts and generally in the regions adjacent thereto until near the end of the first decade of September. During this entire period of about 12 weeks of almost continuous excess of heat dry weather also prevailed in the same region with more or less severity, which, with almost continuous sunshine, frequent hot winds, and deficient humidity, combined to produce one of the most disastrous seasons in the history of the region affected.

The continuation of the heat and drought during the latter part of July and throughout August, the period when corn requires the most favorable weather conditions, proved especially disastrous to that crop, and in the central portion of the area, which included practically the whole of Kansas and portions of adjoining States, the corn crop was almost a complete failure. Farther south, over Oklahoma and portions of Texas, the continuation of the heat and drought into September caused a serious reduction in the cotton crop in those States. In addition to the great damage to the above-mentioned staples, vast injury was done to small fruits, vegetables, and stock food of all kinds, while the water supply was threatened and, in fact, many portions of the region affected suffered severely from lack of water for both stock and domestic use.

Farm work was greatly delayed by the unfavorable conditions, ground could not be plowed for the next wheat crop, and manufacturing activities were in some places suspended and in others severely handicapped by the lack of water, while the railroads were frequently compelled to transport it long distances for use at points where the supply was exhausted.

The following summary of the general weather conditions from week to week will illustrate the progress of the drought over the various sections:

For the week ended June 23 high temperatures prevailed throughout nearly the entire interior portion of the country, with excessive sunshine, and with deficient rainfall over much of the western portions of the great corn and winter-wheat regions and in the middle and southern portions of the cotton belt.

During the following week temperatures were again abnormally high, sunshine was excessive, and there was a further lack of rain over much of the southern and western portions of the corn belt and the northern portions of the cotton region. The need of rain was then beginning to be severely felt in Kansas and Oklahoma, while portions of adjoining States were likewise becoming dry.

The first week of July brought no relief from the intense heat, which had then extended to nearly all portions of the country, save the far Northwest. A few heavy local showers occurred from Texas northward, giving relief over small areas, but in much of the corn belt there was a further absence of beneficial rains and vegetation was beginning to suffer over large areas.

During the second week of July the temperature moderated somewhat over the more northern districts, and the area of high temperatures was confined to the middle

Plains region, and it was generally warm over the South. Some relief from the drought occurred over the middle and lower Mississippi Valley, but to the westward, from Texas northward over Oklahoma and Kansas to central Nebraska, there was no material relief from the adverse weather and vegetation continued to deteriorate.

During the week ended July 21 there was a further contraction of the heated area, but it still continued hot over the middle and southern Plains States and thence eastward, and rainfall was greatly deficient over nearly the entire western and southern portions of the corn belt. The drought was then becoming serious in Kansas, Oklahoma, Texas, and portions of Missouri, and adjoining States were beginning to suffer as well.

The last week of July brought temporary relief from the severe heat, and beneficial showers occurred over limited areas in the regions where most needed, principally, however, in southeastern Kansas, Oklahoma, and northern Texas. Over the greater part of Kansas no material relief from drought occurred, and the lack of rain was very general also in other parts of the western corn belt and in the central portion as well, although the moderate temperatures doubtless materially lessened the effect of the continued drought.

With the beginning of August high temperatures again overspread the districts to eastward of the Rocky Mountains, and maximum temperatures of 100° or higher occurred over a large area in the Plains region and middle Mississippi Valley. The rainfall was again greatly deficient over the principal corn-growing States, the sunshine was excessive, the humidity low, and altogether the first week of the month was decidedly the worst of the season to that time in its effect on the growing corn, and practically ended all hope for that crop in the greater part of Kansas, and seriously impaired the outlook in other portions of the belt.

For the week ended August 11 high temperatures again prevailed, the average for the week ranging from 6° to 12° per day above the normal over portions of Kansas and surrounding States, with extreme temperatures ranging from 100° to 110° or more. Precipitation was again generally deficient, no beneficial rains occurring over much of the corn belt, especially the middle and southern portions, and but little falling over the western cotton belt. The adverse weather conditions had now become serious over much of the territory between the Mississippi River and Rocky Mountains. Corn prospects were rapidly diminishing in this region, and the need of more favorable weather was being greatly felt in the principal corn-growing States of the Ohio Valley as well, while the outlook for cotton in the western part of the belt was rapidly growing more discouraging.

The water supply was now growing low in the central part of the affected area, especially in portions of Kansas and Missouri, and the prospective scarcity of both water and feed for stock necessitated the shipping of large numbers of cattle and other stock to market.

During the following week the heat continued unabated over all the interior portions of the country, with the greater excess, as during many preceding weeks, over Kansas and Missouri and portions of surrounding States. No beneficial rains occurred over much of the southern and western portions of the corn belt, and there was a general deficiency over the northern and western portions of the cotton belt. Such showers as occurred proved of little permanent benefit to vegetation, especially in the western portions, where high temperatures and excessive sunshine quickly evaporated the small amounts that fell.

No material break occurred in the adverse weather during the week ending August 25, temperatures still continuing high over all central and western districts and but little rain occurring over the western portions of both the corn and cotton belts.

During the last week of August the heat greatly increased over the interior portions of the country, continuing especially high in the States of the Middle West, where the day temperatures passed above 100°, reaching extremes of 110° to 113° at points in Kansas. No appreciable precipitation occurred over nearly the entire corn belt and little or none over much of the cotton belt, especially the western portion. Pastures had become bare and the feeding of stock was as necessary as in mid-winter. The scarcity of water had increased and the area affected had considerably extended over that of the preceding week. The high temperatures and lack of moisture during this week greatly advanced the maturing of corn and lowered its quality in the northern portions of the corn belt where earlier in the season more favorable conditions had prevailed and the outlook for an average crop had been favorable.

The first week in September brought no relief over the greater part of the drought-affected area; in fact, it was in some sections the most trying week of the entire season. The average temperature was above the normal over nearly the entire country and it was far above in the Middle West, where at points it was the warmest week of the summer and among the warmest weeks ever known in that region. Maximum temperatures were near or above 100° almost daily and at many points were higher than observed in any previous September. Sunshine was excessive, and the absence of any appreciable precipitation over the great corn-growing States still further increased the losses that had already been experienced, by prematurely forcing corn to maturity over the more northern districts, at the same time reducing the quality of the uncut forage, and rendering the outlook for late fall pasturage more discouraging.

Much discomfort was experienced by both human and animal life from the severe heat, which persisted both day and night, and from the growing scarcity of water which had now greatly extended, and was becoming a most serious problem.

Near the end of the first decade of September a marked change in weather conditions occurred, a cool wave overspreading the entire region, bringing a much-needed respite from probably the most prolonged period of heat ever known. Near the same time copious rains occurred over the greater part of the region where the drought had been particularly severe, thus ending, coincident with the heated term, one of the longest periods of drought ever known in the Middle West.

Frequent rains occurred during the remainder of September, and although they came too late to benefit the staple crops they replenished the water supply, put the ground in condition for plowing, which had been delayed on account of dryness of the soil, enabled the sowing of rye and other forage crops for late fall pasturage, and conditions improved so rapidly that at the end of September pastures were in better condition than at any period since early in the summer, preparations for the sowing of fall grain had made rapid headway, and all seasonable farm work was progressing favorably.

Summarizing the more important features of this heated and droughty period, it appears that the month of August as a whole was one of the warmest ever known in the Middle West, the heat exceeding in some of the States that of July, 1901, which has generally been ac-

cepted as the warmest month ever known in this country save in the desert regions of the Southwest.

In Kansas, the central State of the affected area, the records of 50 well-selected stations that reported both in July, 1901, and August, 1913, show that the average maximum temperature in July, 1901, was 100.9°, while for August, 1913, it was 101.5°, the afternoon temperatures of August, 1913, showing an increase of more than half a degree over those of July, 1901. Despite this increase in the day temperatures the nights were cooler than in July, 1901, the average minimum temperatures being, in July, 1901, 69.3°, and in August, 1913, 67.3°, a difference of 2°.

The average daily range of temperature, therefore, was 2.6° greater during August, 1913, than during July, 1901. This increased range is doubtless due to the drier and clearer weather of August, 1913, favoring more intense radiation during the night and more effective insolation during the day, as shown by the following data:

The average relative humidity determined from the three reporting stations in the State for July, 1901, was 51 per cent, while in August of the present year it was but 42 per cent. At the same time the average weight of vapor per cubic foot of space for July, 1901, was 6.11 grains, while for August, 1913, it was only 5.03 grains.

Clouds were less frequent also in August, 1913, than in July, 1901, thus tending to increase the range of temperature, the records from 45 stations reporting in both months showing 31 stations with one or more cloudy days during July, 1901, while for August of this year cloudy days were observed at but 11 stations out of the 45 reporting.

SOME OF THE EXTREME FEATURES.

The highest temperature reported during the period was 116° at Farnsworth, Kans., on July 11, and several stations reported as high as 113° in both July and August. The station reporting the highest mean maximum temperature was Clay Center, Kans., 107° for August, a record doubtless never exceeded in the United States save only at a few of the hottest points in the desert valleys of southwestern Arizona and southern California. At the above-mentioned point in Kansas the maximum temperatures were 100° or higher each day from August 1 to September 7, inclusive, save for one day, when it rose only to 92°, the average for the period of 38 days being 106.5°, while the total number of days with maximum temperature 100° or above from June 16 to September 7 was 64.

At the same point from July 1 to September 8, a period of 70 days, the precipitation was but 0.03 inch, a record likewise probably unsurpassed, for the principal crop-growing season, in the history of the State. Wells and springs dried up that had never previously failed, and streams were in many cases the lowest of record, the observer at Ottawa, Kans., reporting the river at that place as being the lowest in a period of 53 years.

DAMAGE TO CROPS.

An examination of the estimated yields of some of the more important crops, as prepared by the Bureau of Statistics, shows enormous reductions from those of the preceding year. The winter wheat crop was not materially injured, as it had largely matured before the extreme dry weather set in, save in the more western portions, where drought earlier in the season greatly reduced the yield.

The oat crop over the more southern portions also matured sufficiently early to escape serious injury, but over the more northern and eastern sections of the affected area the loss to this crop was heavy, the reduction from the crop of the preceding year amounting to probably 300,000,000 bushels in the States of the lower Missouri, middle Mississippi, and lower Ohio Valleys.

The drought occurred at the most critical period in the growth and development of the corn plant in the middle and southern portions of the great corn belt, and hence the losses to that crop were exceedingly heavy. In Kansas the crop was practically a failure, the production being estimated at about 24,000,000 bushels, compared with 174,000,000 bushels produced in 1912, a loss of about 150,000,000 bushels in that State alone. In Missouri the loss from that of the preceding year was estimated at about 121,000,000 bushels, in Iowa about 109,000,000 bushels, in Nebraska about 80,000,000 bushels, and in Oklahoma about 37,000,000 bushels. Adjoining States were not so severely affected, but the total reduction of the corn crop this year as compared with 1912 is estimated at about 750,000,000 bushels, the greater portion of which was sustained by the States of the Middle West.

Potatoes suffered severely also, the late crop proving a complete failure in many sections, while the total crop for the country is estimated to have fallen off more than 100,000,000 bushels as compared with the crop of 1912.

In the Western States of the cotton belt the condition of cotton in Texas fell from an average of 81 on July 25 to 63 by September 25; Oklahoma in the same time fell from 81 to 42, Missouri from 80 to 64, and Arkansas from 87 to 63.

All vegetables and fruits suffered severely, and gardens were largely total failures. Hay and pasturage were greatly reduced, and the feeding of stock became necessary in many sections early in August, and by September 1 it was general over much of the region. On account of the scarcity of feed of all kinds, the shortage of the water supply, and the impossibility of carrying stock through the coming winter except at heavy cost, much of it was forced upon the market in unfit condition and under circumstances that entailed great loss to the owners and at the same time greatly reduced the opportunities for promptly restocking.

EFFECT ON HEALTH CONDITIONS.

Despite the long-continued periods of excessive heat and lack of appreciable rainfall, the general health of the communities was sustained in a remarkable manner. Few deaths occurred that were directly attributable to the adverse weather, and the number of sunstrokes was scarcely greater than usual.

Extracts from reports of Weather Bureau officials at points in the districts affected, together with charts showing some of the more important phases of the unusual weather conditions, are appended.

THE DROUGHT OF 1913 IN KANSAS.

By S. D. FLORA, Observer, Topeka, Kans.

The drought of the summer of 1913 was one of the most damaging that Kansas has experienced since authentic weather records were begun in the State. The three summer months—June, July, and August—were drier than the summer months of any other year since State-wide

weather records were begun in 1887, and came within a fraction of a degree of averaging warmer than the same months of 1901, which is the warmest summer on record in the State. At some places in the south-central part of the State the average for these months was higher than for the corresponding months of 1901. If, however, the comparison be continued to September 10, the date when the heat wave was broken, the average temperature for the whole period June 1 to September 10, 1913, was the highest of record for the State.

Prior to 1887 reliable records of precipitation were kept at comparatively few places in the State, but a study of those available indicates that even the famous drought years of 1860 and 1864 were favored with a greater summer rainfall than 1913, and that, with the possible exception of the summer of 1874, the summer of 1913 stands alone as the driest the State has experienced since the early fifties, when there were only a few settlements in the State.

The following table gives a comparison of the mean temperatures and total precipitation over Kansas during June, July, and August, 1913, with those of the corresponding months of 1901 and 1911, the two previous driest and warmest summers since a complete record of weather over the State was begun in 1887:

Year.	Mean temperature.	Total precipitation.
1901.....	80.5	6.85
1911.....	78.5	8.38
1913.....	80.2	4.24

Normal temperature for the State as a whole for June, July, and August, 76.2°; normal precipitation for the same period, 11.32 inches.

Though the year 1913 is the fourth successive one of deficient precipitation in Kansas, weather conditions the first five months were favorable in all parts of the State except the south central and south western portions and a few counties in the extreme west central part, where there was considerable need of more moisture. Between the middle of June and the 10th of September there were no rains of consequence anywhere in the State except in some southeastern counties and a few scattered stations in the lower Kansas River Valley and in the northwestern portion. For the entire three months, June, July, and August, the average precipitation over the eastern division of the State was 4.42 inches, a deficiency of 8.67 inches; for the middle division, 3.81 inches, a deficiency of 7.06 inches; and for the western division of the State, 4.51 inches, a deficiency of 4.64 inches.

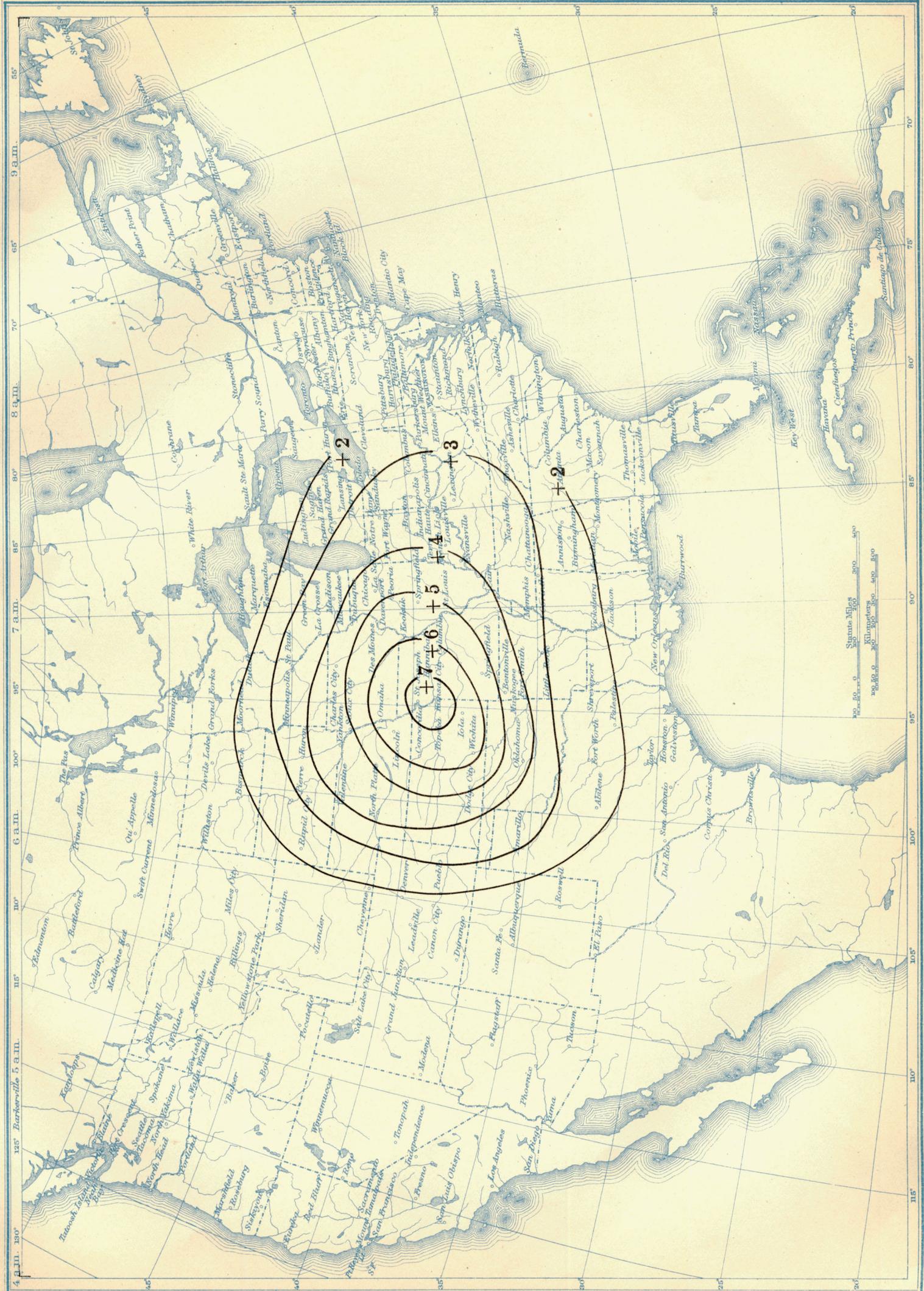
There was no part of the State where the drought was not felt greatly, but it was most severe in the central portion, and the ill effects of it were least felt in the east central portion, the lower Kansas River Valley, and some northwestern counties.

In the most severe droughts of recent years, 1901 and 1911, soaking rains fell the latter part of July and the first of August, but this year the rains were delayed until September 10—too late to benefit even late corn or vegetables and almost too late to start fall pastures or produce another cutting of alfalfa except in a few favored localities.

EFFECT ON THE CORN CROP.

The damage to the corn crop was considerably greater than the damage by the drought of any previous year.

Average Departure of the Daily Mean Temperature from the Normal, June 16 to September 8, 1913.



Percentage of Normal Precipitation for Period, June 16 to September 8, 1913.



Number of Days Maximum Temperature 100° or Above, June 16 to September 8, 1913.



Area Showing Maximum Temperatures 105° or Above During the Period, June 16 to September 8, 1913.

