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CLIMATOLOGICAL DATA FOR JULY, 1911.

DISTRICT No. 10, GREAT BASIN.

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GENERAL SUMMARY.

Typical of the summer climate of an arid, mountainous country, the weather during July in the Great Basin was generally fair and quiet, though much cooler weather than is usual in July occurred in the Wasatch Mountains and generally over the eastern portion of the basin; and in limited districts local rains were so heavy during thunderstorms as to produce some flooding. The record for cool weather was not exceeded, however, at any station so far as is known, neither was the record for excessive precipitation at the few stations receiving the large amounts.

The month was quite uniformly reported as being favorable for all agricultural and manufacturing interests. The comparatively light precipitation, and the few rainy days, permitted almost uninterrupted field work, and the harvesting of grain and the cutting of the second crop of alfalfa in most districts proceeded in safety. The cool weather also had the tendency to lessen evaporation on the arid farms, yet it was sufficiently warm to produce normal growth and proper maturing of practically all crops.

There was an average of 16 clear days, 10 partly cloudy days, and 5 cloudy days in the basin, though the number of clear days was somewhat greater in the middle and western portions. The wind movement was generally light.

TEMPERATURE.

The mean temperature for the basin, 69°, was 2.5° below the normal, considering departures only from the stations having the longer records. This mean value is 3° below the mean of July, 1910.

As a general rule, the temperature was slightly above normal in the northwestern part of the Great Basin, about normal in the middle portion, and considerably below normal in the eastern portion.

The first decade was the coolest part of the month in practically all parts of the district, the lowest temperatures for the month occurring quite uniformly within that period. At the time of coldest weather the minimum temperatures fell below freezing at a great many stations, especially the mountain stations of Utah, and scattered reports were received of slight damage to vegetation. Comparatively cool weather continued throughout the rest of the month, though not below freezing in any of the agricultural districts. The daytime temperatures were at no time excessive. A few days about the middle of the month were warmest in practically all parts of the basin.

PRECIPITATION.

The average precipitation of 0.62 inch was a departure of 0.17 inch below the normal of the long record stations, being considerably lighter than the average for last July. Most of this precipitation occurred in moderate showers, though at a few places local thunder showers produced excesses of rain which in portions of southern Utah and western Nevada ran through the fields and down the streams in damaging quantities. On the average the rainfall was heavier in the eastern and southeastern portions of the district than in the middle and northwestern portions.

The rainy period covered about two weeks' time, the greater portion of the rain falling within the middle two weeks of the month in the middle and western portions and during the last two weeks in the eastern portion of the basin. There was an average of 4 rainy days, ranging from none at several places to 10 or more at scattered places in Utah. Thunderstorms were numerous in the northern and western portions of the district, and in the western portion they were reported as being unusually severe in certain localities. Elsewhere the electrical storms were comparatively few and light. No snow fell during the month so far as is known, and that remaining in the mountains of Nevada was reported by the section director to have receded beyond the 7,000-foot contour during the month. Water continued plentiful in all parts of the basin for irrigation and other purposes, and the comparative dearth of rain was not seriously felt anywhere.

PRECIPITATION AVERAGES FOR LARGE AREAS.

ALFRED H. THIESSEN, Section Director.

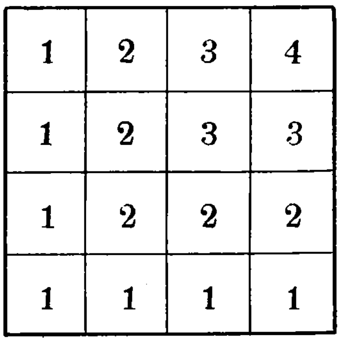
The fact that precipitation varies considerably over not only large but also over quite limited areas is a matter of common observation. Many factors enter into the question as to why different amounts of precipitation are recorded at stations quite near one another, chief of which are the relation of stations to mountain ranges, their elevation, latitude, nearness to large bodies of water, and locations in relation to the average tracks of storms. Any one of these factors or any combination of them may cause a great difference between the rainfall in different sections of an area, as a State or large county.

In calculating the average amount of precipitation for an area it is a common practice to add together the amounts recorded at each station within the area and divide the sum by the number of stations considered. Using this method the average rainfall for an area may be represented by the following equation:

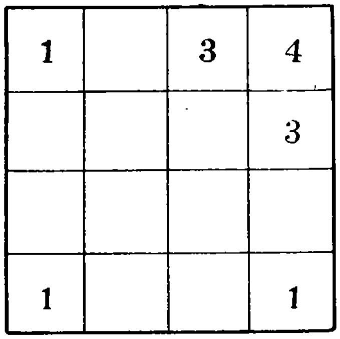
$$1.\quad Q=\frac{(R_a+R_b+R_c+\ \dots.\ R_n)}{n},$$

where Q is the average rainfall, R_a, R_b, R_c, and so forth, represent the rainfall at stations a, b, c, and so forth, and n the number of stations.

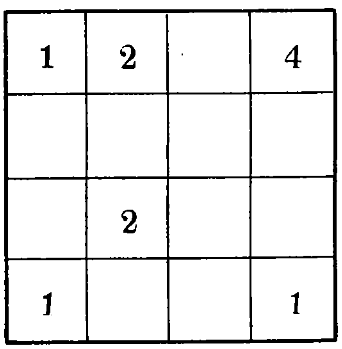
The method outlined above is incorrect and may be so realized by a consideration of the cases exhibited in the following figures:



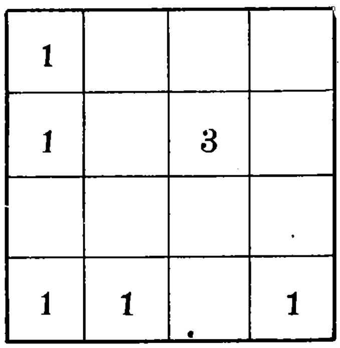
CASE 1, FIG. 1.



CASE 2. FIG. 2.



CASE 3. FIG. 3.



CASE 4, FIG. 4.

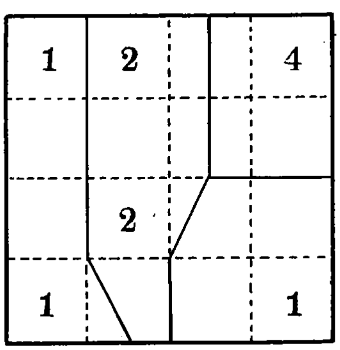


FIG. 5.

The cases represent the same area, but with different combinations of stations considered in each case in determining the average for the area. The stations are located in the center of each square. In case 1 data from all stations were received, and it is seen that the rainfall diminishes from the northeast to the southwest. In cases 2, 3, and 4 data from only six stations were received, but a different six in each case. In calculating the average rainfall in the four cases by the method just explained various results are obtained, and are shown in the table below:

	Number of stations.	Average precipitation, in inches.	Variation from true amount.
Case 1	16	1.88	0.
Case 2	6	2.17	15 per cent too high.
Case 3	6	1.83	3 per cent too low.
Case 4	6	1.43	24 per cent too low.

The true average for the area is 1.88 inches. This was calculated from data given in case 1, where the stations are evenly distributed, and data are available from each station. But in the other cases where data from many stations are missing, and those stations from which data are available are unevenly distributed, the averages calculated by the same method are discordant.

The discordant results are due to the fact that the extent of the areas represented by the data was not considered. The amount of rain recorded at any station should represent the amount for only that region inclosed by a line midway between the station under consideration and surrounding stations. Giving, therefore, each station its proper weight in reference to the area which it represents, we have, instead of the former equation the following:

$$2.\quad Q=\frac{A_a\,R_a+A_b\,R_b+A_c\,R_c+\ \dots.\ A_n\,R_n}{A_a+A_b+A_c+\ \dots\dots\ A_n},$$

where A_a, A_b, A_c, and so forth, stand for the areas represented by the rainfall recorded at stations a, b, c, and so on.

Let case 3 be considered from this new point of view.

Figure 5 shows this case with lines drawn midway between those stations where data are available. Assuming that the area of each small square is 4 and substituting in the last equation, we have:

$$3.\quad Q=\frac{4\times12+2\times20+1\times32}{12+20+32}=1.88\ \text{inches.}$$

which is the true average for the area.

The more stations in any area, the more nearly correct will the average be when found in accordance with the last equation.

When the stations are evenly distributed as in case 1, then as all areas are equal, the last evolved equation becomes the same as the first.

The average precipitation for an area is useful in making comparisons; as, the precipitation of one month compared with another. If it is desired to compare the rainfall of one year with that of another, one must either use data from the same stations in both years if he wishes to compute the average rainfall in accordance with equation 1, or use equation 2, which will give nearly the true value even if data from an entirely new set of stations were used, but, of course, the distribution of the stations in both cases should be very nearly the same.

The rainfall in Utah varies greatly, being quite heavy on the western slope of the Wasatch Mountains, and considerably lighter elsewhere. I have found the average annual rainfall of this State to be 13.25 inches when calculated according to equation 1, but only 11.11 inches when found by using equation 2, making the first determination almost 19 per cent too high.

In using equation 2 the data were entered on a map of Utah, lines being drawn midway between the stations in much the same manner as shown in figure 5, with the exception that greater accuracy was sought for. A planimeter was used to obtain the square contents of the irregular areas, and substitution was made in the equation as illustrated in equation 3.

In Utah most of the weather stations are situated in a belt about 80 miles wide, extending from Rich County in a southwesterly direction to Washington County. In this belt lie the fertile valleys and consequently the bulk of the population; while to the northwest and southeast of this belt, the land is not nearly so thickly settled and weather stations are much less numerous. Therefore, having a great many stations in this belt of greater rainfall, these receive undue prominence in calculating averages for the State by simply adding the amounts at each station and dividing the sum by the number of stations. To give the data at each station its proper weight, equation 2 should be used.