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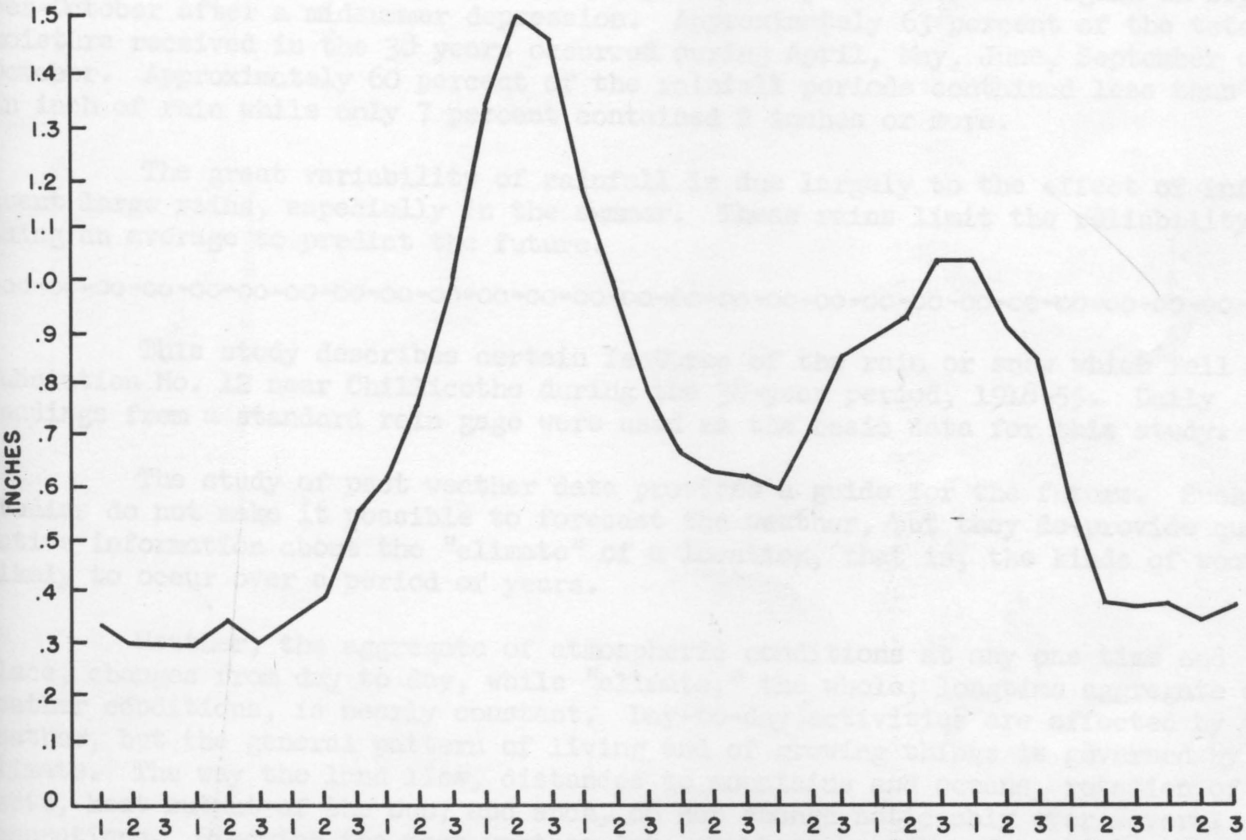

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RAINFALL AT CHILLICOTHE, TEXAS

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SUMMARY

Great variability exists in the rainfall at Chillicothe over 38 years of record.

The rainfall data were analyzed by rainfall periods, days and months. Rainfall is low in the winter, reaches a peak in May and increases again in September-October after a midsummer depression. Approximately 63 percent of the total moisture received in the 38 years occurred during April, May, June, September and October. Approximately 60 percent of the rainfall periods contained less than half an inch of rain while only 7 percent contained 2 inches or more.

The great variability of rainfall is due largely to the effect of infrequent large rains, especially in the summer. These rains limit the reliability of using an average to predict the future.

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This study describes certain features of the rain or snow which fell at Substation No. 12 near Chillicothe during the 38-year period, 1918-55. Daily readings from a standard rain gage were used as the basic data for this study.

The study of past weather data provides a guide for the future. Such studies do not make it possible to forecast the weather, but they do provide qualitative information about the "climate" of a location, that is, the kinds of weather likely to occur over a period of years.

Weather, the aggregate of atmospheric conditions at any one time and place, changes from day to day, while "climate," the whole, longtime aggregate of weather conditions, is nearly constant. Day-to-day activities are affected by the weather, but the general pattern of living and of growing things is governed by the climate. The way the land lies, distances to mountains and oceans, rotation of the earth, heat output of the sun, and such, do not change noticeably over several generations. Studying the past weather data enables the determination of these basic patterns which make up the "climate" of the location.

Annual Rainfall Course

The annual cycle of rainfall was examined by dividing the year into 10-day periods with the average rainfall for the first and second 10-day period of each month and the remaining days adjusted to 10-day periods of the month, Table 1. A measure of variability, the standard deviations of the rainfall amounts, also is shown in Table 1. Approximately two-thirds of the observations can be expected to

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Table 1. Average and standard deviations of rainfall amounts by thirds of months, Chillicothe, 1918-55

Month	Thirds	Number of days	Average rainfall, inches	Standard deviation, inches	Smoothed means
January	1	10	.377	.461	.33
	2	10	.291	.449	.30
	3	11	.287	.463	.30
February	1	10	.261	.353	.29
	2	10	.396	.584	.34
	3	8¼	.258	.409	.30
March	1	10	.341	.469	.34
	2	10	.353	.486	.39
	3	11	.582	.667	.55
April	1	10	.588	.879	.61
	2	10	.724	.831	.76
	3	10	1.008	1.064	1.01
May	1	10	1.302	1.410	1.33
	2	10	1.726	1.892	1.48
	3	11	1.272	1.317	1.46
June	1	10	1.296	1.670	1.16
	2	10	.887	.855	.97
	3	10	.804	1.114	.76
July	1	10	.557	.802	.65
	2	10	.687	1.038	.61
	3	11	.558	.936	.60
August	1	10	.494	.980	.57
	2	10	.772	1.265	.68
	3	11	.732	.956	.83
September	1	10	.917	1.106	.87
	2	10	.975	1.949	.91
	3	10	.994	1.616	1.03
October	1	10	1.161	2.094	1.03
	2	10	.816	1.411	.91
	3	11	.951	1.111	.84
November	1	10	.504	.670	.54
	2	10	.301	.540	.36
	3	10	.351	.590	.35
December	1	10	.381	.666	.36
	2	10	.328	.547	.33
	3	11	.321	.592	.35

fall between the average, plus or minus the standard deviation. Relatively high values of these standard deviations indicate that the average values of the 10-day rainfall are of little use in predicting the future. This also can be seen in the ups and downs of the average rainfall by periods, Table 1. To show the average annual cycle more clearly, weighted averages of the three consecutive thirds were computed. The central third is weighed twice as heavily as the first and final thirds. The weighted average for each 10-day period is shown in the last column of Table 1. Observations of Table 1 show winter rainfall to be low, extending from mid-November to late March, with the lowest values in late January and early February. The summer rainfall shows two peaks, May and September-October. The midsummer depression of rainfall occurs from mid-June through mid-September.

Amount from Rainfall Periods of Various Sizes

During the 38 years, 1918-55, 932.96 inches of rainfall occurred, Table 2. Approximately 63 percent of the total moisture was received during April, May, June, September and October. May had the largest amount of precipitation, 161 inches, or 17 percent of the total.

The daily rainfall data were grouped into rainfall periods. A rainfall period is a sequence of days, all having a measurable amount of rainfall. For example, if it rained Monday, Tuesday and Friday, that week had two rainfall periods. Some rainfall periods, therefore, will include more than one shower or rainstorm. The total precipitation of the years under study has been grouped into amount of rainfall per period, Table 2. Approximately 36 percent of the total moisture occurred in periods with less than 1 inch of rain, 28 percent of the total moisture occurred in periods with between 1 and 2 inches of rain, while only 6 percent of the total moisture occurred in periods of over 5 inches of rainfall.

Of the 1,404 rainfall periods which occurred during 1918-55, 841 or 60 percent, brought less than half an inch of rain, Table 3. A total of approximately 142 inches of rain, 15 percent, of the total moisture during 1918-55 occurred in these 841 periods.

A comparison of Tables 2 and 3 shows how rainfall periods of different sizes contribute to the average monthly rainfalls. In January, approximately 8 percent of the rainfall periods contained 1 inch or more of moisture and contributed approximately 14 inches of the total January moisture or approximately 37 percent, Table 2. Twenty-six percent of the rainfall periods in May contained 1 inch or more moisture, Table 3. However, these periods contained approximately 115 inches or 72 percent of the total moisture occurring in May, Table 2. Thus the higher average rainfall for May as compared with January is due largely to rainfall periods with an inch or more of precipitation. The midsummer depression of rainfall in July and August is caused by the lack of these rainfall periods with larger amounts of moisture.

Since rains of 2 inches or more are most effective in building up soil moisture for growing crops, the distribution frequency of these big rains is important at Chillicothe. In the 38 years, there were only 104 rainfall periods which brought 2 inches of rain or more. On the average, this is a fraction more than 2 rainfall periods a year.

For each month of the year, there is a higher probability that there will be no big rains than there will be one or more big rains. September is the favored month for big rains with May, second. The big rains in September and October may help to build up the moisture supply in subsoil for crop use during the next growing

Table 2. Total moisture per rainfall period, Chillicothe, 1918-55

Rainfall per period	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
.01- .49	13.35	12.51	12.50	11.18	15.54	14.22	13.29	9.64	10.29	10.33	10.11	9.01	141.97
.50- .99	9.67	11.13	16.32	20.97	29.75	21.89	9.94	17.43	22.75	13.10	9.05	12.19	194.19
1.0 -1.49	4.52	7.22	10.35	19.54	19.24	27.48	8.05	12.27	5.24	15.03	8.55	3.22	140.71
1.5 -1.99	5.02	1.70	1.51	18.29	15.70	17.49	15.74	11.74	9.16	12.20	8.24	5.13	121.92
2.0 -2.49	4.14	2.33	4.24	6.48	15.56	8.80	9.26	4.50	13.13	9.22	2.04	6.78	86.48
2.5 -2.99			2.71	8.29	22.13	5.77	5.42	5.76	8.41	10.67	5.35	2.96	77.47
3.0 -3.49					12.76			6.54	6.36	3.15			28.81
3.5 -3.99				7.37	3.56	7.37		3.77		14.97			37.04
4.0 -4.99					13.75	4.13	4.94	4.90	18.35	4.19			50.26
5.0 -5.99					5.69								5.69
6.0 -6.99									6.20	6.97			13.17
7.0 -7.99					7.09	7.66							14.75
8.0 -8.99													
9.0 -9.99									9.65				9.65
10.0 -										10.85			10.85
Total	36.70	34.89	47.63	92.12	160.77	114.81	66.64	76.55	109.54	110.68	43.34	39.29	932.96
Average	.97	.92	1.25	2.42	4.23	3.02	1.75	2.01	2.85	2.91	1.14	1.03	24.55

Table 3. Summary of rainfall periods per month resulting in various increments, Chillicothe, 1918-55

Range of moisture per rainfall period, inches	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
0 - .49	84	71	70	67	94	73	83	60	54	60	63	61	841
.50 - .99	14	16	24	29	43	31	14	22	31	18	13	16	272
1.00 - 1.49	4	6	9	16	15	23	7	10	4	12	7	3	116
1.50 - 1.99	3	1	1	11	9	10	9	7	5	7	5	3	71
2.00 - 2.49	2	1	2	3	7	4	4	2	6	4	1	3	39
2.50 - 2.99			1	3	8	2	2	2	3	4	2	1	28
3.00 - 3.49					4			2	1	1			9
3.50 - 3.99				2	1	2		1		4			10
4.00 - 4.49					1	1			1	1			4
4.50 - 4.99					2		1	1	3				7
5.00 - 5.49													
5.50 - 5.99					1								1
6.00 - 6.49									1				1
6.50 - 6.99										1			1
7.00 - 7.49					1								1
7.50 - 7.99						1							1
8.00 - 8.49													
8.50 - 8.99													
9.00 - 9.49													
9.50 - 9.99									1				1
10.00 - 10.49										1			1
10.50 - 10.99													
Total	107	95	107	131	186	147	120	107	110	113	91	87	1,404

season. The moisture coming in big rains in May helps the spring-planted crops by building up subsoil moisture supply for crop use during the midsummer rainfall depression.

Frequency of Rainfall Periods

The frequency of rainfall periods is shown in Table 4. May leads in the number of rainfall periods per month. The midsummer rainfall depression is not apparent by looking at the average number of rainfall periods per month. September and October have about the same average rainfall periods per months as do July and August. This indicates that larger rains in September and August are responsible for higher average amounts of rainfall. Rainfall periods are least likely to occur in December and February and most likely to occur in May, Table 4.

Probability of Monthly and Annual Rainfall

The probabilities of obtaining a certain amount of annual rainfall are given in Table 5. For example, the probability of obtaining 20 inches of rainfall or less is 26 percent while the probability of obtaining 20 inches or more is 74 percent. The probability of obtaining 40 inches or more of rainfall is only 3 percent, while the probability of obtaining 40 inches or less is 98 percent.

The probabilities of obtaining a certain amount of monthly rainfall are shown in Table 6. For example, 2 inches of rainfall or less may be expected 89 percent of the time in January, 46 percent of the time in April, 23 percent of the time in May and 45 percent of the time in September.

Table 4. Percent frequency of rainfall periods per month, Chillicothe, 1918-55

Number of rainfall periods per month	Percent frequency												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
0		11	5				3	5	8	3	8	8	4
1	13	15	18	8		11	8	8	8	11	21	21	12
2	36	29	18	18	8	8	24	39	31	16	32	21	23
3	24	21	29	26	5	18	25	16	16	37	18	34	23
4	11	11	13	29	26	18	24	13	18	25	11	16	18
5	13	8	11	11	29	37	8	11	8	5	5		12
6	3	5	3	3	21	8	8	8	8	3	5		6
7			3	5	5				3				1
8					3								0.5
9					3								0.5
Total	100	100	100	100	100	100	100	100	100	100	100	100	100
Average	2.8	2.5	2.8	3.4	4.9	3.9	3.2	2.9	3.0	3.0	2.4	2.3	

Table 5. Percent probability of annual rainfall more or less than various amounts, Chillicothe, 1918-55

Inches of rain	Probability for more, percent	Probability for less, percent
0	100.0	0.0
2	100.0	0.0
4	100.0	0.0
6	100.0	0.0
8	100.0	0.0
10	100.0	0.0
12	100.0	0.0
14	99.5	0.5
16	96.2	3.8
18	87.3	12.7
20	73.9	26.1
22	59.1	40.9
24	45.2	54.8
26	27.8	72.2
28	20.0	80.0
30	14.5	85.5
32	10.2	89.8
34	7.2	92.8
36	5.2	94.8
38	4.3	95.7
40	2.6	97.4
42	1.8	98.2
44	1.4	98.6
46	.8	99.2
48	.6	99.4
50	.5	99.5
52	.4	99.6
54	.3	99.7
56	.2	99.8
58	.1	99.9
60	.1	99.9
62	.1	99.9

Table 6. Percent probability of monthly rainfall less than or equal to various amounts, Chillicothe, 1918-55

Inches of rain	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
.2	13.8	18.4	7.8	4.5	6.1	3.4	11.1	12.5	13.8	15.6	16.6	24.2
.4	23.6	27.8	12.3	7.5	7.4	5.3	15.9	16.9	16.9	18.7	23.9	32.3
.6	34.8	38.2	18.4	10.7	8.7	7.8	21.2	21.8	20.0	21.8	32.3	40.5
.8	46.4	49.2	26.1	14.7	10.2	10.6	27.1	26.8	23.6	25.1	40.9	48.8
1.0	56.7	59.5	35.2	19.2	11.9	14.0	33.4	32.3	27.1	28.4	50.0	56.7
1.2	66.3	68.4	45.2	24.2	13.8	17.9	39.7	37.8	30.5	31.9	58.3	63.7
1.4	74.2	76.4	55.2	29.5	15.9	22.1	46.0	42.5	34.1	35.6	66.3	69.8
1.6	80.2	82.6	65.2	34.8	18.1	26.4	51.6	48.4	37.8	39.0	72.9	75.2
1.8	85.3	87.5	74.2	40.1	20.3	30.9	57.5	53.2	41.3	42.5	78.8	80.0
2.0	89.1	91.1	81.6	45.6	22.7	35.6	62.6	57.9	44.8	45.6	83.6	83.6
2.2	91.7	93.8	87.7	51.2	25.5	40.1	67.4	62.2	48.0	48.8	87.7	86.9
2.4	94.1	95.8	92.1	56.0	28.1	44.8	71.6	66.3	51.2	52.0	90.8	89.6
2.6	95.7	97.2	95.2	61.0	30.9	49.2	75.5	70.2	54.4	54.8	93.2	91.8
2.8	96.9	98.2	97.3	65.5	33.4	53.2	78.8	73.6	57.5	57.5	94.9	93.4
3.0	97.7	98.6	98.6	69.5	36.3	57.5	81.6	76.4	60.3	60.3	96.4	94.8
3.5	98.9	99.5	99.7	78.2	43.6	66.6	87.5	82.9	67.0	66.6	98.6	97.1
4.0	99.5	99.9		84.8	50.8	74.2	91.6	87.5	72.6	72.2	99.4	98.6
4.5	99.8			89.6	57.9	80.2	94.5	91.1	77.3	76.7	99.7	99.2
5.0				93.1	64.4	85.1	96.3	93.6	81.3	80.5	99.9	99.5
5.5				95.4	70.2	88.9	97.6	95.4	84.6	83.9		99.7
6.0				96.9	75.5	91.8	98.2	96.7	87.5	86.7		99.9
6.5				98.2	80.2	93.8	98.9	97.7	89.6	89.1		
7.0				98.6	84.1	95.4	99.4	98.2	91.6	90.8		
7.5				99.2	87.5	96.6	99.5	98.9	93.1	92.5		
8.0				99.4	90.1	97.5	99.6	99.2	94.3	93.8		
8.5				99.6	92.4	98.2	99.8	99.4	95.4	94.6		
9.0				99.7	94.2	98.6		99.5	96.2	95.7		
9.5					95.5	98.9		99.6	96.9	96.5		
10.0					96.6	99.2		99.7	97.4	97.1		
11.0					98.2	99.5		99.9	98.2	97.7		
12.0					98.9	99.7			98.9	98.6		
13.0					99.4	99.9			99.2	98.9		
14.0					99.7				99.4	99.2		
15.0					99.9				99.6	99.5		
16.0									99.7	99.6		
17.0									99.8			

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