

An Introduction to the
Climate of Mammoth Cave National Park

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Mammoth Cave National Park is located in the Pennyroyal Plateau (Mississippian Plateau, Pohl E.R. and R.V. Cushman 1964) of Kentucky. Elevations within the park vary from ridge highs of approximately 800 to 850 feet AMSL along the principle ridge systems of the park to lows in the valleys of approximately 600 feet AMSL. The Green River, the major continuously flowing stream in the park flows in an essentially east-west course dropping from 470 to 428 feet separating the park into two physiographic provinces. The south province is characterized by broad valleys with internal drainage typified by Doyle Valley and local karst like Hunt's Sink or Double Cellars. The north side of the river has a more dense network of stream valleys with fewer typical solution features of the southern province. Most of the stream valleys are dry during the year, but during periods of winter precipitation they rise quickly as suggested by such names as Ugly Creek. Perched water tables occur throughout the park.

Mammoth Cave National Park was formally added to the National Park System in 1946 although land acquisition and relocation of land owners was completed during the mid 1930's. Most of the climatological records used in preparing this report were made at a station located in the employee residential area and maintained by the National Park Service. Martin L. Cook is the present observer

at the station which was established in August 1934.

The central feature of the park is the Mammoth Cave Ridge Cave System dominated by Mammoth Cave itself. Visitor activity is centered at the Visitor Center and hotel area about 1.25 miles from the weather station. The remainder of the park shows a mosaic of vegetation types illustrating many stages of plant succession from open fields to essentially undisturbed (since white contact in the region) climax forest. The climax forest is part of the Western Mesophytic Forest Region of Baun (1964). Kuchler (1964) classifies the area as having a potential natural vegetation of Oak-Hickory.

Storms cross the area from southwest to northeast. Precipitation is generally associated with low pressure systems containing moisture transported from the west Gulf coast. Some rain, particularly during the May to September period, is due to local thunder shower activity. The average wind velocity for the State of Kentucky is about seven miles per hour with the maximum reported in excess of 50 miles per hour. The intensity of these high winds is appreciated when you are located in a sheltered area like a well forested sink and still experience wind velocities in excess of ten miles per hour. On the average on tornado per year occurs in Kentucky. This average figure indicates that long periods may pass without the occurrence

of a tornado followed by a short period when several occur.

The local climatic data available does not indicate cloudy days, but for the state as a unit there is an average of 120 cloudy days per year. Winter is 35-50% clear, spring is 50-65% clear, summer is 65-75% clear and fall is 55-65% clear (U.S. Dept. of Comm. 1964).

Nighttime temperatures during the winter range from the mid teens to the twenties with daytime temperatures in the forties and fifties. Maximum temperatures in the seventies have occurred in January with minimums below zero expected occasionally during the winter months.

Minimums during the summer visitor season are in the sixties while maximums in the nineties occur frequently during July and August. Record minimums during the summer are close to freezing while record maximums are above 100° F. during June, July, August and September. The Park Service has begun to take relative humidity data, but there is not enough data available to include this factor in this report. Occasional humidity information has been taken for local use in determining fire status for the park.

Procedures Followed to Prepare Tables

Tables 1 and 2 were prepared by a ranking method which compared amounts, rather than dates. Each monthly value during the period of study was ranked in ascending order and percentile numbers directly interpolated. Table 3 was prepared from the monthly report forms of Mammoth Cave National Park Station.

Tables 4, 5 and 6 are summary comparisons taken from the Climatic Summary of Kentucky (1964).

Temperature

The recordings in the employee residence area represent the only location where continuous records have been maintained within the park. These are representative of the temperatures experienced in the visitor area and campgrounds. Limited data available illustrating some of the microhabitat differences which occur at two locations where stations have been established on opposite slopes and at the lowest point in a valley or a sink are presented in Figure 4. The sink data suggests that stagnant air is trapped and is not warmed as quickly as in the valley location. Minimums in the two locations are quite similar but the maximums tend to be higher in the valley location.

Temperature is not a limiting factor on outdoor

PRECIPITATION

Probability of this amount of precipitation or less each month for
a 34 year period.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	sum
10%	1.67	1.74	2.02	2.26	1.56	2.15	2.14	1.30	0.68	0.64	1.96	1.52	19.64
20%	1.88	2.22	3.51	3.04	2.10	2.56	2.66	2.07	1.32	1.44	2.46	1.88	27.14
30%	3.40	2.42	5.02	3.60	2.92	3.08	3.21	2.91	2.31	1.64	2.86	2.77	36.14
40%	3.96	3.16	5.78	4.01	3.34	3.75	3.67	3.56	2.89	2.08	3.41	3.36	42.97
50%	4.43	4.11	5.91	4.26	3.61	4.48	3.74	3.97	3.06	2.52	3.67	3.79	47.55
60%	5.93	4.61	6.41	4.59	3.81	4.82	4.78	4.31	3.48	2.82	3.89	4.45	53.90
70%	6.87	6.16	7.24	5.23	5.27	6.01	5.69	4.85	4.91	3.47	4.51	5.07	65.28
80%	7.81	7.01	7.73	6.22	6.23	7.39	6.72	5.55	5.34	4.01	5.73	6.13	75.87
90%	10.69	9.50	8.60	6.63	7.26	8.50	7.94	7.73	6.10	4.37	8.83	7.26	93.41

range for
each month

MAX	20.02	10.33	11.45	6.86	10.55	9.09	10.18	9.31	7.10	6.12	13.11	10.68	124.80
MIN	0.91	0.11	1.40	1.13	1.33	0.63	0.82	0.79	0.05	T	1.13	0.74	9.04

average precipitation for 34 year record 51.28 inches

Maximum observed 71.29 inches (1950)

Minimum observed 31.85 inches (1963)

based on period
1935-1968

TABLE 1

TEMPERATURE

Probability of this average temperature or lower
each month for a 34 year period.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
10%	28.31	30.36	39.05	53.07	60.48	68.61	71.08	70.01	65.12	53.05	40.30	30.43
20%	29.77	31.82	41.69	53.77	61.64	70.13	71.41	72.55	66.03	54.33	42.18	32.00
30%	32.91	34.34	43.67	54.58	62.92	71.43	74.42	73.89	67.13	55.95	43.86	34.51
40%	34.63	37.39	45.21	55.87	64.16	71.86	75.28	74.61	67.83	57.72	44.75	36.72
50%	34.97	38.07	46.18	57.30	64.89	71.99	75.83	75.00	68.05	58.27	45.90	37.34
60%	35.90	38.69	47.46	57.90	66.09	72.53	76.01	75.67	68.64	58.62	46.99	38.91
70%	37.40	40.63	48.58	59.02	67.17	73.55	77.03	75.85	70.00	59.16	47.67	40.66
80%	38.05	43.06	51.76	60.28	68.40	74.27	78.27	77.40	72.38	61.21	48.27	41.50
90%	41.99	44.01	53.93	62.05	68.89	76.73	79.07	77.91	73.32	62.26	49.25	42.76
range for each month												
MAX	46.44	46.88	56.22	62.82	72.24	80.32	80.41	80.35	75.25	51.28	50.28	47.85
MIN	17.95	26.67	32.91	51.30	59.49	66.90	70.08	68.58	64.03	64.58	40.10	26.27
average	34.69	37.84	46.67	57.17	65.18	72.42	75.53	74.88	68.81	58.06	45.65	37.53

based on 1935 to 1968 period

TABLE 2

human activity in any season. If extremes are experienced, they are short lived, often only one or two days in duration.

Precipitation

Rainfall in the park is evenly distributed throughout the year but some exceptions to this rule occur and have important effects with respect to flooding. August, September and October are the driest months during the visitor season. June is the wettest visitor month on the average but Table 1 shows that several months have both a higher maximum rainfall and can expect greater amounts of rain at similar percentile numbers.

During the winter the wettest month is January.

A maximum rainfall for January was recorded in 1937, a month which experienced heavy flooding along the Ohio and Mississippi Drainage Basins. Record flood crests were experienced on the Green both upstream and downstream from the park. The maximum flood recorded in the park occurred in 1962. A marker has been placed on a large sycamore (Platanus occidentalis) marking the highest point above normal pool level at New Ferry. With the establishment of two dams, one on the Green and one on the Nolan upstream from the park, it is felt that record crests

Duration of Precipitation
Periods by Month for 1968 in Hours

	>1	1-3	3-6	6-9	9-12	<12	sum	inches precipitation
January	2	3	2	5	5		15	1.47
February	1	4	3	2	1		11	1.06
March	2	5	4	2	2	3	18	7.33
April	3	3	5	2		2	15	6.80
May	5	5	4	3		4	21	10.55
June	6	3	3			1	13	3.04
July								
August	2	8	2	2			14	2.73
September		7	2				10	2.99
October	3	4	4	1	1		12	2.22
November	4	7				1	12	1.64
December	1	3	4		2	3	13	5.01
	5	9	2	1	2	3	22	3.36
	32	61	35	18	13	17	176	

TABLE 3

like this will not occur again.

Figures 2 and 3 are useful in understanding the effect of precipitation on the level of the Green River (prior to dam construction). Figure 2 shows the fluctuation of river level during a winter month (January 1951) while Figure 3 shows the fluctuation during a summer month (June 1951). The river level axis is changed by a tenfold magnitude in the two figures. The interception of rainfall and the retarding of surface runoff by the forest canopy and grasses during June is illustrated by this comparison.

Comparing the nature of river crests at the Brownsville and Mumfordsville Stations in karst topography with stations further downstream (closer to Evansville) shows that the Green River, once a flooding condition has occurred in the downstream drainage area, tends to remain high for several days. In the Brownsville and Mumfordsville region (including the park) river levels rise and fall very quickly, often within twenty-four hours. I feel that the peaks experienced in the park region are directly influenced by surface runoff and when this runoff ceases after a storm the river falls quickly and is again fed by the subsurface drainage characteristic of karst regions. The lag period from rainfall to maximum stream response is about two days (Figures 2 and 3).

Structures are required to handle large volumes of

Comparison of Snowfall by Month
Between Bowling Green FAA and Mammoth Cave National
Park for the Period 1951-1960.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
average snowfall Bowling Green FAA	1.4	2.2	3.7	0.1	0.0	0.0	0.0	0.0	0.0	T	0.4	0.5
average snowfall Mammoth Cave N.P.	2.3	3.2	4.3	0.1	T	T	0.0	0.0	0.0	T	0.6	1.0
average annual snowfall Bowling Green FAA	8.3											
average annual snowfall Mammoth Cave N.P.	11.5											

TABLE 6

Comparison of Precipitation by Month
Between Bowling Green FAA and Mammoth Cave National
Park for the Period 1951-1960.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
average precipitation Bowling Green FAA	5.19	4.41	4.80	3.63	3.82	4.76	3.65	2.72	2.77	2.45	3.51	4.25
average precipitation Mammoth Cave N.P.	5.65	4.51	4.99	3.83	3.61	4.98	3.44	3.79	3.19	2.44	4.64	4.71
annual precipitation Bowling Green FAA	45.96											
annual precipitation Mammoth Cave N.P.	49.78											

TABLE 4

Comparison of Temperature by Month
Between Bowling Green FAA and Mammoth Cave National
Park for the Period 1951-1960.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
average temperature Bowling Green FAA	36.6	39.3	44.6	57.3	66.4	74.9	78.8	77.8	70.9	58.1	45.0	38.1
average temperature Mammoth Cave N.P.	37.1	40.2	45.3	58.1	65.9	73.0	76.8	75.7	69.9	58.3	45.8	39.1
average annual temperature Bowling Green FAA	57.2											
average annual temperature Mammoth Cave N.P.	57.1											

TABLE 5

surface runoff in a short period of time, particularly during the winter when damage to culverts and road foundations can be caused if blockage to planned waterways occurs. Rainfall during the summer months, although occasionally heavy, is usually of short duration (Table 3) and presents no flooding problems for river users like fisherman and canoeists (Figure 3).

Snowfall

Snowfall occurs in the park during most years. Persistence of snow on the ground is limited with most melting within two weeks after a storm. The park receives more snow (Table 6) although average temperatures are slightly higher during the winter months (Table 5) than the surrounding region. The greater precipitation in the form of snow may be related to a generalized orographic effect in response to the difference in elevation of the two stations (Bowling Green FAA, 535 feet AMSL, Mammoth Cave National Park, 800 feet AMSL). Total precipitation is also higher at Mammoth Cave National Park than at Bowling Green FAA (Table 4). Ice and snow damage to powerlines, trees and other structures is relatively rare but can cause some discomfort in the area.

PRECIPITATION BY DAY JANUARY 1951
 RIVER GAGE BY DAY AT LOCK no. 6
 BROWNSVILLE, KENTUCKY

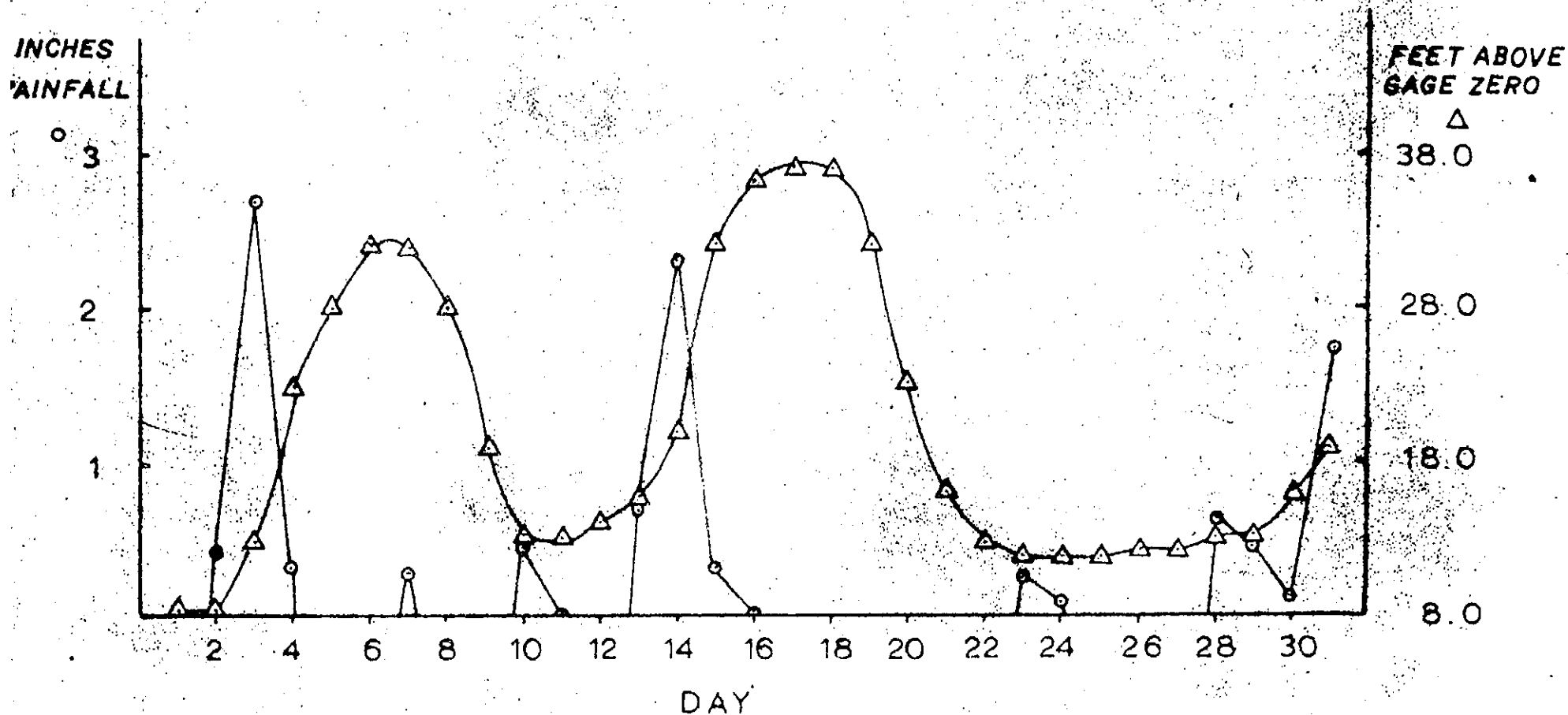


FIGURE 2

PRECIPITATION BY MONTH

Record maximum year	71.29 inches	1950
Record minimum year	31.85 inches	1963
Average 1951 - 1960	49.78 inches	

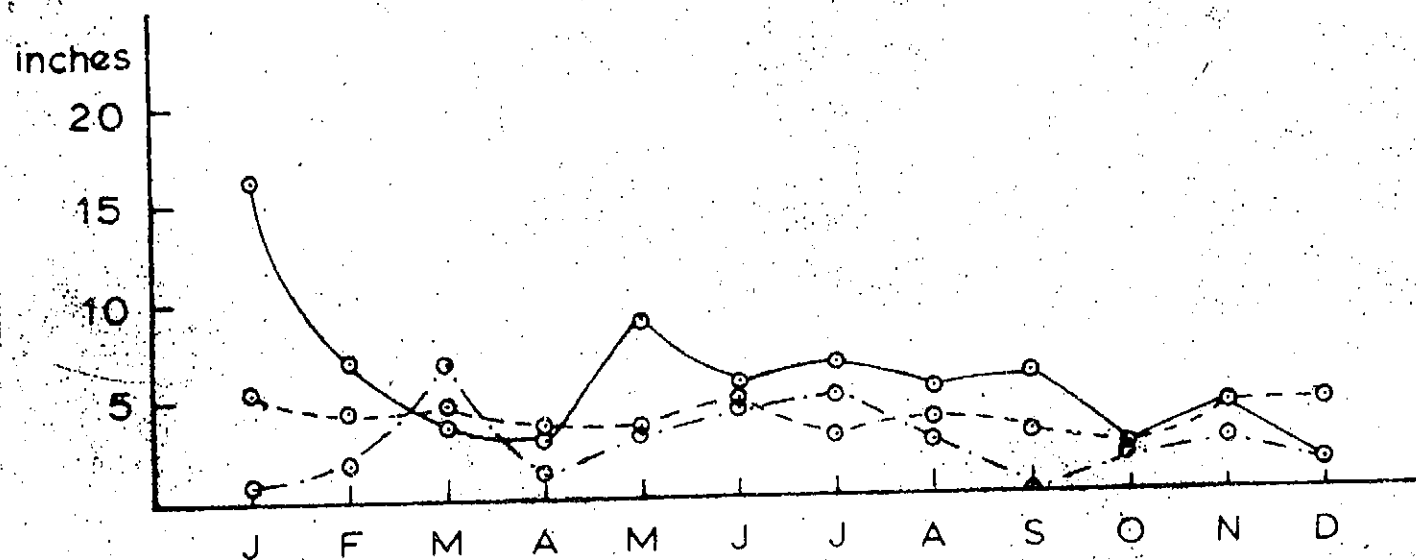


FIGURE 1

PRECIPITATION BY DAY JUNE 1951
 RIVER GAGE BY DAY JUNE 1951 AT
 LOCK no. 6 BROWNSVILLE, KENTUCKY

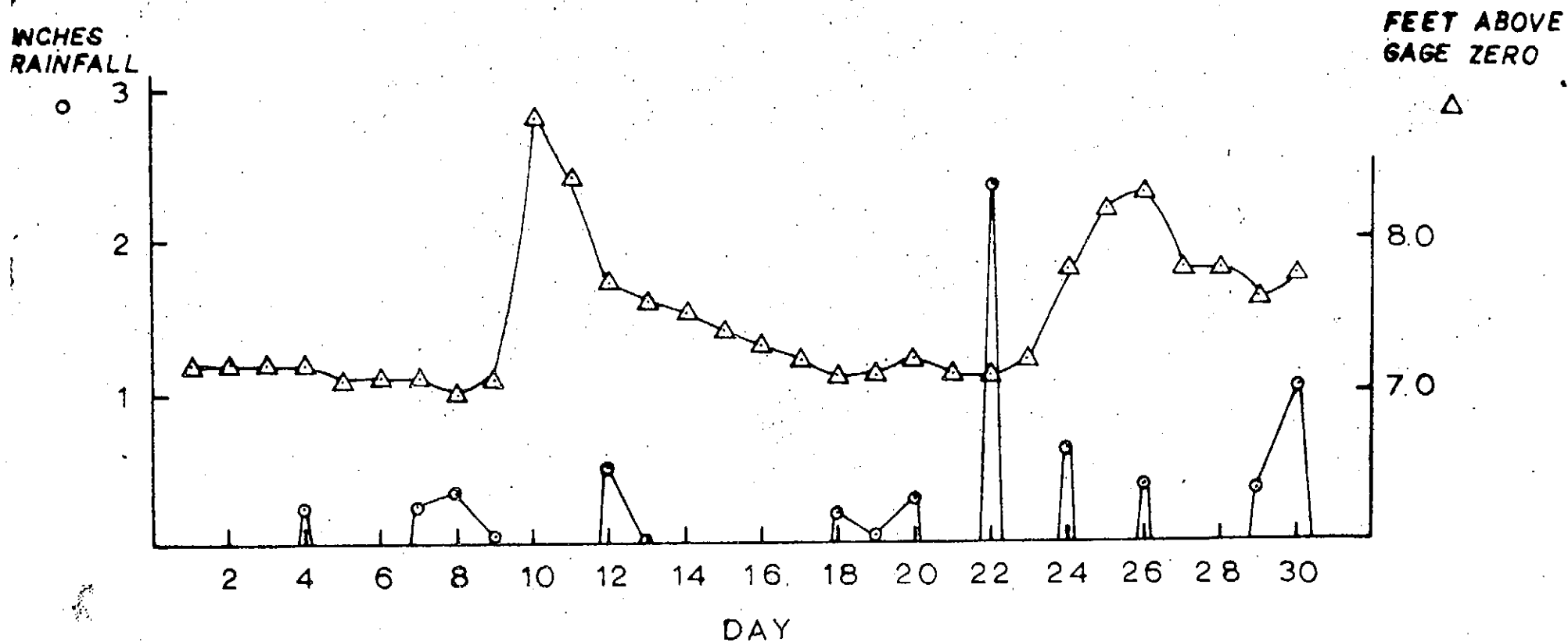


FIGURE 3

RANGE OF TEMPERATURE AT
TWO LOCATIONS period
11-26 APRIL 1969

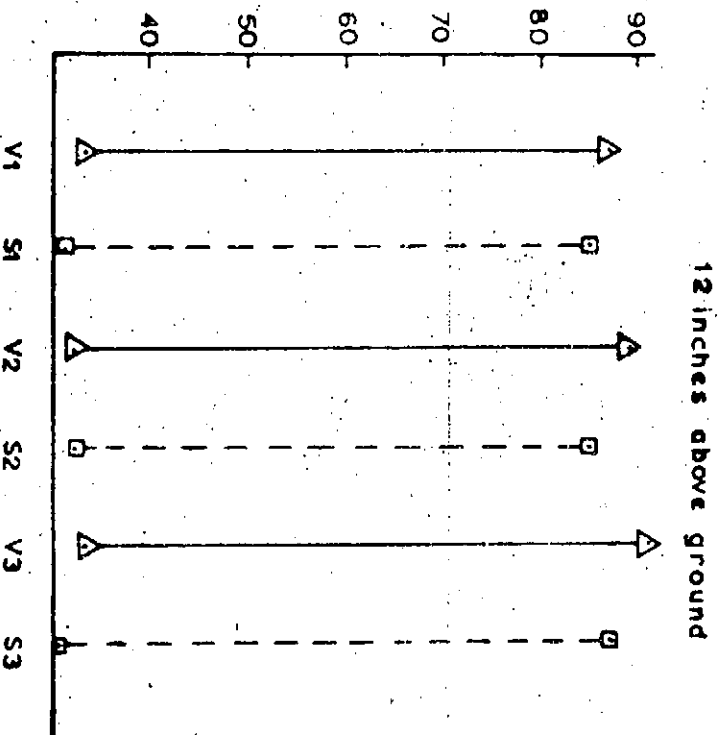
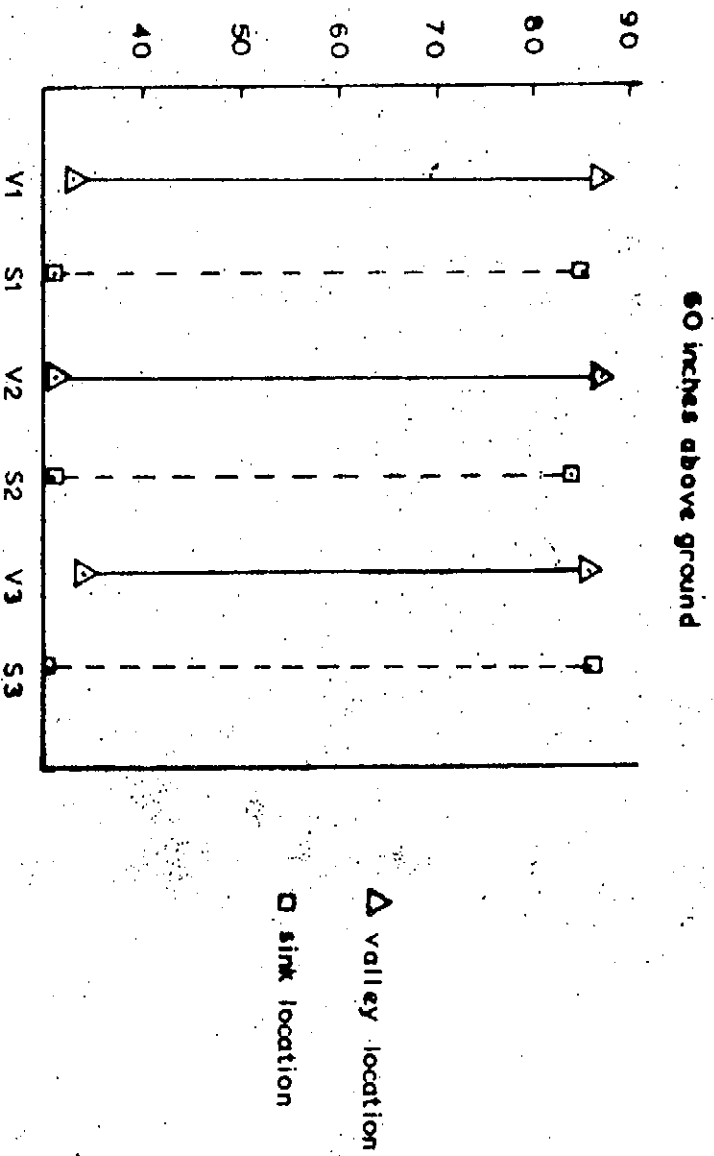


FIGURE 4

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