

## Significance and frequency of occurrence of thunderstorms at Coimbatore

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### 1. Introduction

In this paper a preliminary attempt has been made to assess the significance and frequency of occurrence of thunderstorms at Coimbatore. Thunderstorm has been taken by the authors as a phenomenon, accompanied with thunder and lightning. Of course, during daytime the lightning may not be visible. Cases of thunderstorms with and without rain have been considered.

### 2. Materials and methods

*Materials*—The above study is based on the data collected at the Agricultural College and Research Institute, Coimbatore on the days of thunderstorms during 41 years (1916-1956). A day of occurrence of thunderstorm has been taken as a day on which the thunderstorm, as defined above, has occurred.

The daily rainfall data collected during this period have also been made use of, in assessing the significance of thunderstorms with reference to their being accompanied with light or heavy rains, ranging from 1 cent to a few inches. These rainfall data have been collected from an ordinary rain-gauge, installed as per instructions of the India Meteorological Department. There is no tall building or high tree within a radius of 100 feet of the raingauge.

Incidentally, the data on the occurrence of hailstorms have also been compiled.

*Methods*—By adopting the centre-shift average method as followed by Narasimhamurthy (1955) for periods ranging from

1 to 12 years, the cyclic nature of the monthly occurrence of thunderstorms was statistically assessed by working out the standard deviation, coefficient of variation and standard error for the months of March to May and August to November. The period of average for which the coefficient of variation has the lowest value has been taken as the duration of the cycle, which the particular weather element follows. For example, the thunderstorms in the month of March appear to follow a cycle of 6-year period, since the coefficient of variation for the centre-shift average for six years has the lowest value.

A table has been prepared for the two thunderstorm seasons, *viz.*, March to May and August to November, to bring out the association or otherwise of thunderstorm with rain (Table 1).

Frequency of occurrence of thunderstorms is shown in Fig. 1 drawn with the data presented in Table 2.

In regard to the significance of these thunderstorms at Coimbatore with reference to the total rainfall received in two thunderstorm seasons of March to May and August to November, seven correlations were worked out (Table 3).

### 3. Discussion

(i) In Table 4, mean number of thundery days, standard deviation and coefficient of variation are indicated for 12 months. The periods or seasons of maximum thunderstorm activity are March to May and

TABLE 1  
Association or otherwise of thunderstorms with rain

Thunder-storm season	Month	No. of days of thunderstorms with no rain within 24 hrs		No. of days with rain but no thunder-storm within 24 hrs		No. of days of thunderstorms with rain within 24 hrs	
		Total for 41 years	Average	Total for 41 years	Average	Total for 41 years	Average
Summer	March	58	1.41	18	0.44	51	1.24
	April	180	4.39	43	1.05	207	5.05
	May	182	4.44	76	1.85	226	5.51
Monsoon	August	43	1.05	228	5.56	67	1.63
	September	75	1.83	146	3.56	145	3.54
	October	66	1.46	226	5.51	318	7.76
	November	18	0.44	288	7.02	148	3.61

TABLE 2  
Monthly and annual number of thunderstorms

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1916	—	—	—	9	22	—	9	10	7	9	4	1	71
1917	—	1	5	4	6	2	—	6	17	9	9	1	60
1918	—	—	6	8	4	—	2	3	4	11	12	2	52
1919	2	—	4	13	16	3	1	2	13	9	1	—	64
1920	—	—	—	13	13	3	1	1	10	9	7	—	57
1921	2	—	—	4	8	2	5	2	2	9	4	—	38
1922	1	—	—	—	—	—	—	—	—	9	5	—	15
1923	—	—	3	10	7	1	—	—	4	11	2	1	39
1924	1	—	5	11	15	1	1	1	9	9	3	1	57
1925	—	—	5	6	8	1	—	—	6	8	3	—	37
1926	1	—	2	8	11	—	1	—	3	8	2	2	38
1927	—	—	1	4	13	2	1	1	4	7	5	—	38
1928	—	1	3	11	13	—	4	1	1	9	9	—	52
1929	—	—	3	16	12	1	—	2	9	3	1	—	47
1930	—	—	3	11	7	5	—	4	3	9	8	2	52
1931	—	—	—	6	9	1	—	—	4	8	5	—	33
1932	—	3	—	13	9	4	—	9	—	6	7	—	51
1933	—	—	5	11	8	—	3	8	7	11	3	—	56
1934	1	—	1	7	13	4	—	1	—	8	1	—	36
1935	—	—	—	12	11	3	—	4	4	7	1	—	42
1936	—	1	6	1	10	—	—	—	9	8	5	—	40
1937	—	2	6	12	8	2	—	2	3	8	4	—	47
1938	—	—	5	10	6	1	3	2	3	3	1	—	34
1939	—	—	2	13	15	1	1	3	9	19	1	—	64
1940	—	—	—	13	17	5	—	—	14	4	5	—	58
1941	1	—	—	6	10	3	2	3	13	10	7	—	55
1942	—	—	—	9	7	3	—	2	4	12	—	—	37
1943	1	2	4	6	9	—	—	—	4	11	3	—	40
1944	—	2	6	6	12	—	—	1	4	8	6	2	47
1945	—	—	—	9	9	1	1	1	2	14	1	—	38
1946	—	—	8	16	10	—	—	—	9	11	4	3	61
1947	—	—	2	8	6	2	1	8	4	12	5	1	49
1948	—	1	4	6	10	2	1	7	1	15	3	—	50
1949	—	—	1	13	9	—	—	1	1	16	3	—	44
1950	—	3	1	2	8	—	—	3	3	8	2	—	30
1951	—	—	4	14	18	2	—	2	6	6	6	—	58
1952	—	2	2	9	6	1	1	1	2	3	1	1	29
1953	—	3	1	18	9	6	2	2	4	20	—	—	65
1954	—	—	10	15	12	2	—	7	1	8	2	—	57
1955	—	—	1	11	11	3	4	4	15	9	3	—	61
1956	—	—	—	13	1	2	—	6	2	10	12	—	46

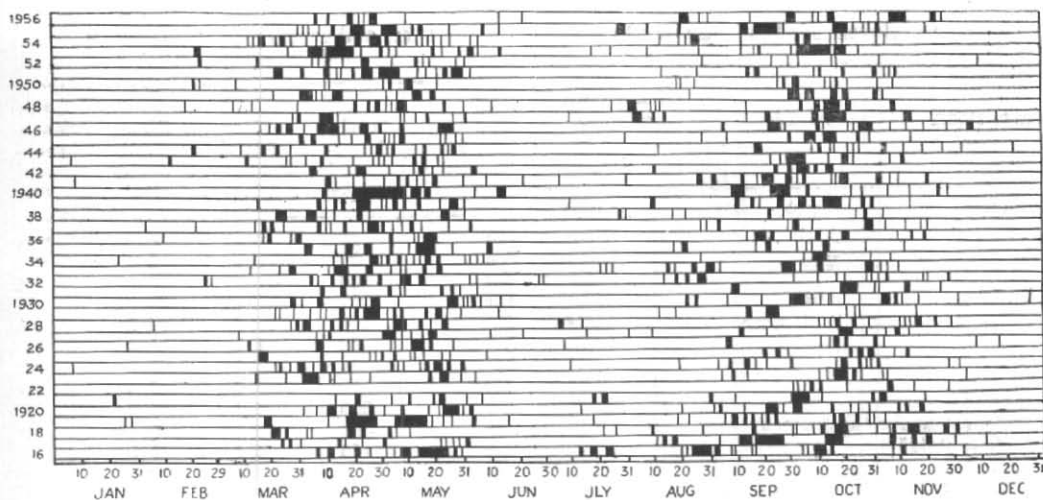


Fig. 1. Frequency of thunderstorms at Coimbatore — 1916 to 1956

NOTE.—When there have been thunderstorms on consecutive days, the whole series of days is shown by continuous black shading

August to November. This is the inference drawn both from Table 2 and the frequency diagram. The first period of March to May covers the summer months. The other period of August to November covers the latter half of the southwest monsoon and the transition period between the southwest and the northeast monsoons. The total number of thunderstorms in the first period is more than the same in the other period, the numbers being 904 and 880 respectively. Further, the maximum thunderstorms occur in the month of May, preceded by the next best frequency in the month of April. The frequency in October is of greater magnitude than that of September.

The average annual number of days of thunderstorm at Coimbatore is 47, which is roughly twice the average of 25 days worked out for India by Kendrew (1949). In places like East Indies, Central and Western Africa, Plateau region of South Africa, the Amazon Basin, Central America and Mexico, the average annual number of thundery days is 75, while it is as high as 200 in Java. This finding in regard to Coimbatore may be due to its geographical features like the proximity of the Western Ghats, which may create favourable

conditions for the development of thunderstorms like "adequate supply of moisture for cloud development" and "a lapse rate of temperature in excess of the saturated adiabatic through a range of height of not less than 10,000 feet above the cloud base", as stated by Ralph Abercromby (1934).

(ii) The data given in Table 1 show the nature of association or otherwise of thunderstorms with rain during the months of maximum thunderstorm activity—March to May and August to November. It is seen that while during the summer months of March to May, thunderstorms may or may not be accompanied by rain, these mostly occur with rain during the monsoon months of August to November. Further, during the monsoon months, there are cases of rainfall without their being associated with thunderstorms.

(iii) Thunderstorms are either preceded or followed by rains. According to Geddes (1930), "the rain does not fall continuously during these storms, but generally in very heavy showers". To examine Geddes's finding in detail, monthly correlations were worked out with the total rainfall and number of days of thunderstorms separately for

TABLE 3  
Correlation between thunderstorms and rainfall

Thunderstorm season	Month	Correlation coefficient ( $r$ )
Summer	March	+ 0.5128*
	April	+ 0.6920*
	May	+ 0.3735**
Monsoon	August	+ 0.6902*
	September	+ 0.5830*
	October	+ 0.5446*
	November	+ 0.9311*

\*Significant for the accuracy level of  $P = 0.001$  ( $r = 0.4955$ )

\*\* Significant for the level of  $P = 0.02$  ( $r = 0.3624$ )

the seven months, March to May and August to November. The details regarding these seven correlations are given in Table 3. Six out of the seven correlations, with the exclusion of that for the month of May, have values higher than 0.4955, indicated by Fisher and Yates (1949) for a precision level of  $P = 0.001$ . The correlation for the month of May is significant for the accuracy level of  $P = 0.02$ . This indicates that thunderstorms are sure to be preceded or followed by rains, though not of torrential type. Coimbatore is in the rainshadow region of the Western Ghats and this geographical feature may be the cause for thunderstorms not being generally associated with heavy downpours.

(iv) Hails are not always associated with

TABLE 4  
Number of thundery days at Coimbatore (1916--1956)

Month	Total No. of days of thunder	Mean No. of thundery days	Standard deviation	Coefficient of variation (%)
Jan	10	0.2	0.5	224
Feb	21	0.5	1.0	187
Mar	109	2.7	2.6	98
Apr	387	9.4	4.2	45
May	408	10.0	4.3	43
Jun	69	1.7	1.6	95
Jul	44	1.1	1.3	122
Aug	110	2.7	2.4	90
Sep	220	5.4	4.4	82
Oct	384	9.4	3.6	39
Nov	166	4.1	3.0	74
Dec	17	0.4	0.5	139
Annual	1945	47.6	..	..

thunderstorms in the tropics, though they are frequently recorded in temperate regions. In the period of 41 years considered in this paper, hailstorms have occurred on only seven days on 16 May 1919, 2 May 1927, 26 April 1933, 23 April 1942, 19 May 1942, 22 March 1951 and 17 May 1951. These data show that the probable period of occurrence of hailstorms at Coimbatore is in the summer months of March to May.

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#### REFERENCES

- |                            |      |  |
|----------------------------|------|--|
| Fisher, R.A. and Yates, F. | 1949 | <i>Statistical Tables.</i>                                 |
| Geddes, A.E.M.             | 1930 | <i>Meteorology—An Introductory Treatise, Chap. VI (E).</i> |
| Kendrew, W.G.              | 1949 | <i>Climatology, Chap. XXV.</i>                             |
| Narasimhamurthy, B. L.     | 1955 | <i>Andhra agric. J., May 1955.</i>                         |
| Ralph Abercromby           | 1934 | <i>Weather, Chap. XI.</i>                                  |