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THE
DIURNAL VARIATION

OF

THE RAINFALL

AS OBSERVED

AT KINGSTON, JAMAICA,

BY

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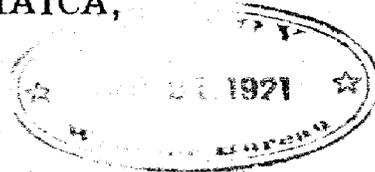
During the years 1908-1919.

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THE DIURNAL VARIATION OF THE RAINFALL AT KINGSTON, JAMAICA; AND OTHER DATA.

In the Jamaica Weather Report No. 358, October 1908, the late Mr. Maxwell Hall gave the results of his studies of the diurnal variation of Rainfall from the notes made in the large Kingston Registers between the years 1881 and 1896, and he therein mentioned that "the U.S. Meteorological Station in Kingston is provided with a self-registering rain-gauge which measures the amount of rain fallen at intervals of time, so that the Diurnal Variation will be very accurately known in the course of a few years." His results were also reproduced in his "Rainfall of Jamaica" 1911.

Since the time of his writing we have had faithful records secured, covering a complete twelve years, 1908-1919.

The U.S. Weather Bureau established their instruments and placed them in charge of the Jamaica Weather Service, sometime in the year 1907. They provided a fine "Triple-register," which included an electrical registering instrument attached to the tip-bucket of the 12 inch rain-gauge, arranged so as to record, automatically, upon a revolving drum; the time and quantity of rain falling during each hour, continuously. Advantage is now taken of this record in order to pursue a more extensive investigation for a different set of years; giving the results of a complete period of twelve years, besides, affording the opportunity of also arriving at other features.

In the following Report five tables have been compiled.

Table I.—Hourly total amount of precipitation in inches (12 year period) for each year.

Table II.—Hourly frequency of precipitation for each year.

Table III.—Hourly rainfall in inches for each month.

Table IV.—The monthly rainfall for each year.

Table V.—Corresponding Wind directions during heavy rainfall.

During the whole period of 12 years under review there was a grand total rainfall of 306.82 inches, varying considerably for each year. This gives the year's average as 30.07 inches, whereas the mean yearly fall for 49 years shows 33.59 inches. The greatest total was 68.11 inches in the year 1909, and the least only 8.50 inches in the year 1914.

Taking Table I, it will be perceived, that, between the hours of 3 and 4 p.m. the maximum amount, in relation to any other hours, was registered, being 31.57 inches representing nearly nine per cent. of the entire total of 360.82 inches. Then, near to midnight we have a minimum of only 7.15 inches, which is just about one-fiftieth part of the whole. There is also another, less pronounced, minimum, but very notable, occurring between 9 and 10 a.m., just at the interval when the maximum amount of sunlight has been recorded. From a little after midnight, there appears to be an unmistakable tendency for precipitation to increase until about 7 and 8 a.m., up to 12.99 inches, immediately before the sudden diminution appears during 9 to 10 a.m., when it drops to 7.70 inches.

There is also ample evidence of a small departure, with a sudden rise in the total, somewhere between 8 and 9 p.m. by over 2 inches.

During the whole period the greatest hourly amount of rain registered was in the year 1909, between the hours of 2 and 3 p.m., where the Table I shows 5.24 inches; that is in respect of the entire 12 months of that year. In the dry year 1914, between the hours of 4 and 5 a.m., no rain fell at this hour on any date of the 12 months, being the only exception.

By examining this table it will at once become evident that nearly one-half of the total rainfall for the day is confined to the hours between noon and 7 p.m.

In the year 1909, in November, there were heavy flood rains, when when a fall of 30.45 inches was recorded for that month; vide Table IV., being the greatest for any of the months of the 12 years. A diagram has been prepared and herein reproduced to illustrate the diurnal rainfall.

On referring to table II it will be interesting to note the number of hours that rain fell between the hour intervals of any year. For example, during the year 1916 it is shewn that rain fell on 36 occasions between the hours of 3 and 4 p.m., and also between 4 and 5 p.m., representing an average of one fall in every 10 days near to these hours. As would be expected it is also found to correspond with the hours of the maximum rainfall. On the other hand, there are a few instances in this Table II, where it will be found that the rain fell only once for certain hours during the whole year, as in 1911 between 3 and 4 a.m., 9 and 10 a.m., 11 a.m. to noon, and 11 p.m. to midnight; even on such occasions the fall was within the small limits of .01 to .03 inch.

It follows, of course, that this Table II will bear a strong resemblance in character to Table I for therefrom we also discover prevailing the maximum number of rainy hours between 3 and 4 p.m., the minimum between 11 p.m. and midnight, and a sudden increase at about 9 and 10 a.m.

From Table II will be gathered that rain fell during the hour intervals 3002 times in the 12 year period, and this fact goes to demonstrate that it rains in Kingston only about 3 per cent. of the time upon an average, throughout.

The aforementioned two Tables deal solely with the hourly results from year to year, irrespective of the monthly results.

Now, for the purpose of analysing the relationship throughout the twelve months of the year, in order to determine the effect of seasonal changes, Table III has been constructed. Here we find the maximum hourly rainfall for each individual month, occurring as follows:—

In January between 6 and 7 p.m., February 1 and 2 p.m., March 3 and 4 p.m., April 4 and 5 p.m., May 5 and 6 p.m., June 2 and 3 p.m. (excepting the abnormal maximum near to midnight owing to the flood rains of June in the year 1915.) July 2 and 3 p.m., August 5 and 6 p.m.

September is quite exceptional with its maximum just before noon, then a falling off to repeat a less marked maximum between 3 and 4 p.m. with a sudden decrease between 5 and 6 p.m. followed by another maximum between 6 and 7 p.m. November between 3 and 4 p.m. December somewhat earlier: from noon to 1 p.m. The general mean result places the maximum, as shown in the previous Tables, between 3 and 4 p.m.

There is an unmistakable minimum persistent in nearly every month somewhere at about 9 and 10 a.m. This phenomenon is particularly noticeable in all the months except June when its minimum occurs earlier, between 7 and 8 a.m., instead.

From the records for the entire 12 years, it has been shown that no rain at all fell in any month of February between the hours of 1 and 2 a.m., 5 and 6 a.m., and in any month of March between the hours of 3 and 5 a.m. All the remainder of the months had rain at some time between any of the hours.

There is also given at the foot of this Table the percentages of rainfall, hour by hour, and by comparison with the late Mr. Maxwell Hall's results, it will be found to be in close accordance.

It is interesting to supplement here that during these 12 years there were only 16 occasions when a high rate of fall (of short duration) was above 0.20 inch in 5 minutes. The highest rate being 0.45 inch in 5 minutes on October 12th, 1910.

The following gives the dates of these occurrences, during a 5 minutes rainfall:—

1908	February 7th	..	0.25	inch
do	May 24th	..	0.25	"
1909	November 8th	..	0.22	"
1910	March 14th	..	0.32	"
do	October 12th	..	0.45	"
1913	November 9th	..	0.23	"
1915	April 3rd.	..	0.22	"
do	June 15th	..	0.21	"
1915	June 18th	..	0.27	"
do	August 21st	..	0.25	"
do	September 4th	..	0.25	"
do	October 31st	..	0.30	"
1916	May 12th	..	0.28	"
do	May 14th	..	0.24	"
1919	March 20th	..	0.21	"
do	October 15th	..	0.30	"

To render this article more complete it seems desirable that figures should be also given showing the highest falls of rain during one hour and the respective dates, etc. The following list is therefore supplied for all falls of 1 inch and over, and it will be seen that in the year 1915, October 31st 2.30 inches fell in 1 hour.

Year.	Date.	Hour of day.	Fall of Rain in 1 hour.	Total fall for that day.
			Inches.	Inches.
1908	Dec. 31st	12 to 1 p.m.	1.06	3.62
1909	Ap. 19th	8 to 9 p.m.	1.03	1.13
"	Nov. 8th	8 to 9 a.m.	1.11	8.93
"	Nov. 8th	5 to 6 p.m.	1.41	
1910	June 6th	5 to 6 a.m.	1.46	4.10
"	Oct. 12th	6 to 7 a.m.	1.91	6.49
1915	Ap. 3rd.	7 to 8 a.m.	1.23	1.35
"	Ap. 14th	4 to 5 p.m.	1.18	1.38
"	June 15th	12 to 1 a.m.	1.65	4.22
"	June 15th	11 to 12 p.m.	1.09	
"	June 18th	12 to 1 a.m.	1.58	2.82
"	Sept. 4th	10 to 11 a.m.	1.95	6.45
"	Oct. 30th	3 to 4 a.m.	1.00	2.83
"	Oct. 31st	3 to 4 a.m.	1.32	4.59
"	Oct. 31st	6 to 7 p.m.	*2.30	
"	Nov. 1st	3 to 4 a.m.	1.15	2.51
1916	May 12th	12 to 1 p.m.	1.00	7.04
1919	Oct. 15th	3 to 4 p.m.	1.59	6.00
"	"	5 to 6 p.m.	1.48	

It may be also required to state the dates when heavy rainfalls of 6.00 inches and over for 24 hours were registered. The following gives them:—

1909	November 8th	..	8.93	inches
"	November 9th	..	8.22	"
1910	October 12th	..	6.49	"
1915	September 4th	..	6.45	"
1916	May 12th	..	7.04	"
1919	October 15th	..	6.00	"

By summarising the most important results as to rate and extent of rainfall during this 12 year period we get the following:—

- Greatest rate of fall in 5 minutes 0.45 in. October 12th 1910.
- Greatest fall in one hour 2.30 ins. 6.7 p.m., October 31st, 1915.
- Greatest fall in one day 8.93 ins. November 8th 1909.
- Greatest fall in one month 30.45 ins. November 1909.
- Greatest fall in one year 68.11 ins. 1909.

The greatest fall, however, for one month occurred in October 1879 when 30.67 inches was recorded, long years before this automatic registration was established.

The principal Weather disturbances occurring during this 12 year period are given below.

Minor Cyclone 28th September 1908	..	S.E. Jamaica.
Flood Rains 4th to 11th November, 1809	..	Eastern part of Island
Hurricane 17-18th November, 1912	..	West Jamaica.
Hurricane 12-13th August, 1915	..	Near North coast of Jamaica
Hurricane 23rd September, 1915	..	South of Jamaica, moving Westward.
Hurricane 15-16th August, 1913	..	Along South side of Island.
Depression 7-14th October, 1916	..	South of Jamaica.
Depression 21-27th October, 1916	..	Extended.
Depression 7-14th November, 1916	..	Extended.
Hurricane 23rd September, 1917	..	Over centre of Island moving East to West.

In view of the importance that would be attached to this article by having a knowledge of the direction of the wind during heavy rain so as to make provision for "weather protection" in building operations, this part, as a subject, could hardly be omitted. Therefore, to meet all practical purposes, it has been deemed sufficient to confine our attention to only such falls as gave one inch and over within 24 hours. There were 86 such cases occurring during the 12 year period

Table V has been compiled for the principal eight wind directions, and the number of occurrences grouped into 3 hour intervals. A glance at the Table will demonstrate that on most occasions rain is accompanied by a south-easterly wind, about 36 per cent. of cases on an average, and this phenomenon prevails throughout the whole 24 hours, but is far more marked between noon and 3 p.m., and least between 9 p.m. and midnight. Then, coming next in order is the north-westerly wind (quite the opposite side of the compass) where we have 17 per cent. of cases, on an average, occurring; and this direction is more apparent between 3 and 6 p.m., immediately following the S.E. wind maximum from noon to 3 p.m. The next directions, in point of percentage, are the N., N.E., and E., in each case somewhere about 13 per cent. In all these cases the maxima do not follow as in the case of the N.W., but occur during the earlier hours, for we have the N. rain wind showing its maximum from 6 to 9 a.m., N.E. between 3 a.m. and noon, E. midnight to 3 a.m. The very least of all shows that only about one per cent. of rainy hours, is accompanied by westerly wind, and almost similarly with the south. Now, with the West wind the rainfall is insignificant and occurs chiefly between midnight and noon, and again between 3 and 6 p.m. Then with the South wind it occurs chiefly between 3 and 9 a.m. and from noon to 6 p.m. and shortly before midnight. Only about 4 per cent. of S.W. wind and rain has been recorded. So it will be obvious that nearly all the precipitation occurs with wind in the sector from N.W. via N.E. to S.E., and the remainder giving a total of only 7 per cent. from South, South-west and West.

During the 12 years these 86 cases of one inch and over, within 24 hours, are distributed as follows:

1 to 2 inches	..	..	55 times
2 to 3 "	..	..	15 "
3 to 4 "	..	..	6 "
4 to 5 "	..	..	4 "
5 to 6 "	..	..	0 "
6 to 7 "	..	..	3 "
7 to 8 "	..	..	1 "
8 to 9 "	..	..	2 "
Total	..	..	86

It may be not generally known that out of some two hundred Jamaica rainfall stations reporting, Kingston stands the lowest on the records, showing an average annual rainfall for 49 years of 33.59 inches, only and barely one-half the average for the Island's rainfall.

It would be of great scientific interest if it were practicable to determine, on the same lines of observation, the results for such a station as Fellowship, in Portland, where it gives a phenomenal yearly average of nearly 196 inches.

In concluding it appears desirable to refer briefly to the feature of the distribution of rainfall around Kingston, or more properly on the Liguanea Plains. It is notable, if we study the Annual rainfall, to find that along the Kingston foreshore, the least amount of precipitation occurs with about only 27 inches, and then as we proceed northward the mean rainfall increases rapidly. For example, Halfway Tree, which is only about two and a half miles further inland, gives a mean annual rainfall of nearly 38 inches. King's House, about three and a half miles to the north, gives nearly 46 inches. King's House is taken as being about 400 feet above sea-level. On the Spanish Town Road, at a low-level station, named Clifton Pen, about two and a half miles to the northwest of Kingston, the mean annual fall is shewn as 37 inches. It is well known that an area of country between Clifton Pen and the Ferry, further to the northwest, a fall of rain is frequently observed, when Kingston is found dry. The Quarantine Station at Green Bay, about 6 miles to the southwest of Kingston, records a similar rainfall to the Kingston station.

J. P. BRENNAN,

TABLE I.—Hourly total amount of Precipitation, in inches (12-year period).

Year.	M.												P.M.												Total.
	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11		12
1908	21	36	18	33	30	32	70	1.56	1.05	3.55	5.9	1.01	2.45	2.48	3.87	3.22	1.63	1.15	1.23	1.46	3.34	3.39	4.2	42	26.41
1909	219	305	292	224	333	201	1.35	2.82	4.04	1.60	1.17	1.72	3.00	1.65	5.24	4.03	4.10	4.51	3.57	2.18	5.34	2.39	2.01	42	68.11
1910	30	53	22	1.48	2.45	5.12	3.02	1.25	9.8	1.30	2.48	1.50	1.01	1.82	1.72	2.30	3.03	4.04	3.98	0.9	5.1	3.4	2.0	32	37.33
1911	65	17	14	42	19	61	37	28	34	69	25	01	25	1.10	1.76	2.08	1.58	6.7	6.1	4.4	8.0	2.8	4.2	02	13.07
1912	55	29	53	70	20	98	73	32	38	55	1.08	1.57	3.2	1.71	1.10	1.08	1.02	8.5	1.25	8.9	5.4	1.38	9.4	1.16	18.32
1913	102	70	47	27	23	10	73	40	25	07	54	18	64	1.49	1.22	2.11	1.86	5.3	1.8	6.5	9.5	1.19	2.6	11	16.45
1914	20	65	02	14	00	30	12	19	11	08	17	12	14	1.31	9.4	2.06	4.4	3.4	0.8	4.8	0.9	5.3	3.5	24	8.50
1915	479	321	2.44	4.98	1.78	1.69	1.97	2.59	1.18	1.49	4.48	2.97	1.67	1.89	1.02	2.84	3.90	4.15	4.11	1.76	1.58	1.34	1.18	1.15	59.46
1916	1.29	1.01	81	29	49	24	81	1.29	2.11	1.75	1.95	3.02	4.04	2.78	4.26	3.84	4.08	2.50	4.32	1.75	2.63	5.6	.91	1.04	48.18
1917	23	12	29	49	24	23	94	48	16	58	25	32	88	1.94	2.95	3.11	1.44	2.02	8.8	1.12	8.4	4.4	2.6	06	20.25
1918	55	37	29	14	07	17	39	73	26	48	71	48	70	1.41	1.61	1.35	1.50	2.01	2.01	0.9	4.1	2.2	1.5	17	16.42
1919	97	35	25	49	39	78	1.03	1.20	1.62	6.4	6.5	82	55	2.26	2.43	3.12	2.45	3.38	1.20	3.5	4.2	8.4	6.9	8.4	27.72
Totals	12.26	10.21	9.86	11.57	9.72	13.15	11.55	12.99	12.48	7.70	14.62	14.02	15.65	20.84	28.72	31.57	27.63	25.70	20.42	11.86	14.46	8.90	7.79	7.15	360.82

TABLE II.—Hourly frequency of Precipitation.

Year.	M.												P.M.												Total.
	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11		12
1908	5	6	4	7	6	6	6	8	10	4	8	8	13	15	20	27	13	11	9	7	9	8	6	3	220
1909	22	18	16	16	11	14	14	16	16	13	14	18	16	22	26	30	32	23	23	18	15	16	16	14	443
1910	7	8	6	11	5	4	6	3	3	7	7	12	14	20	17	26	26	22	17	5	6	6	6	6	287
1911	2	3	5	1	5	4	6	6	8	10	4	4	4	10	20	18	16	11	9	6	4	5	4	1	146
1912	6	5	4	10	6	4	8	7	8	10	9	8	11	15	15	12	16	13	10	9	8	6	4	2	176
1913	7	9	7	5	6	3	6	6	3	2	5	4	5	11	12	13	11	5	2	4	3	4	3	2	112
1914	5	2	2	3	0	3	5	5	3	2	5	4	5	11	12	13	11	23	16	13	7	13	14	12	347
1915	13	10	12	16	19	14	11	16	11	13	11	13	14	16	17	23	23	23	16	18	18	13	14	12	422
1916	18	18	10	10	8	9	11	12	11	17	17	22	18	23	28	36	36	27	23	18	18	13	12	13	202
1917	3	6	5	11	7	7	5	6	6	7	7	6	11	12	20	22	19	10	11	7	6	8	4	2	180
1918	5	4	4	4	4	5	8	8	3	4	8	6	5	13	17	18	19	13	10	5	5	4	4	3	255
1919	9	9	8	8	8	11	13	10	11	12	7	8	8	16	16	20	13	14	12	9	4	7	7	7	76
Totals	100	98	84	102	96	95	107	108	91	86	109	115	123	184	223	261	230	179	145	108	94	101	89	76	3,002

TABLE III.—Hourly Rainfall for each month in inches.

Month.	M.												Total.												
	1	2	3	4	5	6	7	8	9	10	11	12													
January	.21	.32	.09	.20	.31	.49	.24	.43	.08	.23	.13	.18	.39	.37	.14	.71	.46	1.16	1.47	.23	.12	.64	.69	.14	10.23
February	.08	.00	.18	.02	.01	.00	.20	.39	.09	.03	.11	.09	.06	.80	.75	.43	.43	.10	.08	.13	.12	.28	.30	.15	4.87
March	.05	.08	.08	.00	.00	.13	.10	.09	.15	.06	.12	.15	.34	.50	1.42	3.28	1.74	2.38	.69	.03	.08	.11	.05	.01	11.59
April	1.17	.63	.74	.20	.19	.15	.84	1.50	.22	.18	.60	.23	.52	1.54	1.86	1.81	4.38	2.14	1.35	1.09	1.37	.20	.20	.32	23.43
May	.76	.70	.31	.47	.21	.62	.99	.80	1.48	1.17	2.25	1.99	1.96	1.81	3.20	3.40	2.52	3.55	2.01	2.75	1.46	1.24	.73	1.24	37.62
June	4.27	2.21	.82	1.45	.99	2.62	1.04	.77	1.01	1.25	1.39	1.88	1.62	3.09	3.17	2.73	1.55	1.85	.93	.54	1.45	.95	.69	1.01	30.18
July	.13	.45	.83	.38	.41	.30	.95	.59	.13	.07	.36	.27	.72	.52	1.56	1.29	1.38	1.43	1.12	1.22	.22	.63	.27	.14	12.27
August	.24	.35	.85	.78	.37	.15	.16	1.51	.80	.98	1.60	1.03	1.05	1.85	2.25	2.71	3.12	3.94	2.19	1.33	1.70	.58	.47	.51	30.47
September	1.33	1.37	1.96	1.55	1.11	1.54	1.05	.50	.50	.86	3.58	3.88	2.27	2.71	3.40	3.68	3.22	1.96	1.48	1.63	2.76	1.54	.75	.37	45.98
October	1.55	1.51	1.90	3.35	3.83	4.47	2.88	2.60	2.71	.89	2.69	1.46	2.01	3.30	5.17	5.53	3.93	3.15	5.85	1.41	.95	.65	1.14	.88	64.85
November	2.15	2.29	2.04	2.80	1.91	2.62	2.26	2.44	3.27	1.57	1.56	2.22	2.43	3.07	4.55	5.08	3.98	4.64	3.43	2.50	3.85	1.87	2.12	1.83	66.49
December	.37	.30	.06	.37	.38	.19	.35	.82	1.14	.46	.26	.70	1.38	1.19	1.24	.62	.92	.40	.82	.10	.43	.41	.38	.55	13.84
Totals	12.26	10.21	9.86	11.57	9.72	13.15	11.55	12.99	12.45	7.70	14.62	14.02	15.65	20.84	28.72	31.57	27.63	25.70	20.42	11.71	14.46	8.30	7.79	7.15	360.82
Percentage for the month	3.4	2.8	2.7	3.2	2.7	3.6	3.2	3.6	3.5	2.1	4.0	3.9	4.3	5.8	8.0	8.7	7.7	7.1	5.7	3.3	4.0	2.4	2.1	2.0	100.0

TABLE IV.—Monthly Rainfall from 1908 to 1919 in inches.

Year.	Number of Rainy Days.												Total Rainfall.	
	January	February	March	April	May	June	July	August	September	October	November	December		
1908	0.92	1.28	1.27	0.30	1.61	6.93	0.95	1.41	0.64	4.72	1.54	4.83	26.41	91
1909	1.24	0.03	0.82	1.61	1.50	4.74	1.60	4.11	10.27	11.74	30.45	6.00	68.11	93
1910	2.10	0.02	1.45	1.32	1.32	5.09	1.49	3.39	5.12	11.30	1.43	3.09	37.33	88
1911	0.13	0.03	2.05	1.36	1.92	0.37	0.35	1.48	1.63	1.78	1.63	1.11	13.07	67
1912	1.40	0.74	0.56	0.51	0.27	0.08	0.02	1.13	1.58	1.87	10.68	0.08	18.92	66
1913	0.09	0.06	0.47	2.57	3.05	0.48	1.82	1.08	3.57	1.41	1.68	0.17	16.45	81
1914	0.14	0.28	0.56	0.95	0.80	0.60	0.18	0.80	1.58	1.58	1.56	0.56	8.50	63
1915	1.11	0.83	0.58	5.08	3.08	14.51	0.42	6.24	11.90	10.58	4.57	0.56	59.46	81
1916	0.09	0.57	0.79	2.99	11.92	1.53	3.94	5.92	0.97	8.17	11.27	0.02	48.18	112
1917	0.26	0.16	0.07	0.97	1.90	3.33	0.66	1.15	8.00	2.05	0.71	1.04	20.25	91
1918	0.58	0.52	1.02	3.16	3.44	0.84	0.24	2.87	0.30	2.17	0.71	0.67	16.42	76
1919	2.17	0.34	1.95	2.40	6.81	0.68	0.60	0.80	1.95	7.63	0.15	2.14	27.62	74
Totals	10.23	4.87	11.50	23.43	37.62	39.18	12.27	30.47	45.98	64.85	66.49	13.84	360.82	987

TABLE V.—Showing the direction of the Wind during rainy hours, when one inch, and over, of rain were registered within 24 hours. The columns give the number of occasions at each three-hour interval, for each direction.

Wind direction.	12 to 3 a.m.	3 to 6 a.m.	6 to 9 a.m.	9 a.m. to Noon.	Noon to 3 p.m.	3 to 6 p.m.	6 to 9 p.m.	9 p.m. to midnight.	Totals.	Percentage
N	8	14	16	8	13	15	8	6	88	12.9
NE	11	15	15	15	14	11	5	12	98	14.4
E	15	10	9	9	11	11	11	11	87	12.8
SE	22	30	35	32	43	31	38	15	246	36.1
S	0	1	1	0	3	4	0	1	10	1.5
SW	3	4	3	2	0	7	7	3	29	4.2
W	2	1	1	2	0	2	0	0	8	1.2
NW	12	10	14	13	14	27	14	11	115	16.9
Totals	72	85	94	81	98	108	83	59	681	100.0

Diagram showing Diurnal Variation of Rainfall

