23099

No. 275.

TEMPERATURES

In Kingston, Jamaica, and the connection between the

SUN-SPOT FREQUENCY, THE MEAN MAX. TEMPERATURE AND THE RAINFALL IN JAMAICA.

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United States Station, Halfway Tree.

1901. Mean Temperature for each hour of seventy fifth meridian time.

Month.	1 a.m.	2 a.m.	3 a.m.	4 a.m.	5 a.m.	6 a.m.	7 a.m.	8 a.m.	9 a.m.	10 a.m.	11 a.m.	Noon.	1 p.m.	2 p.m.	3 p.m.	4 p.m.	5 p.m.	6 p.m.	7 p.m.	8 p.m.	9 p.m.	10 p.m.	11 p.m.	Mid nt.	Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
January	69.2	68.6	68.5	68.2	67.7	67.7	67.4	71.3	76.9	79.8	81.3	82.1	82.6	81.8	81.4	80.4	78.8	76.3	73.8	72.7	76.6	71.7	70.5	69.5	74.2
February	70.0	69.6	69.3	69.2	69.1	68.8	68.9	73.1	78.3	80.5	82.0	82.6	82.9	82.1	82.2	81.6	80.4	78.5	75.9	74.4	72.6	71.7	71.0	70.4	75.2
March	71.0	70.2	69.8	69.7	69.7	69.7	70.3	77.2	79.3	82.1	83.2	83.0	83.0	82.2	82.3	81.5	80.4	79.0	76.8	75.4	74.0	72.6	72.0	71.3	76.0
April	72.6	71.9	71.5	71.0	70.6	70.4	73.3	77.8	81.1	82.9	83.5	83.6	83.8	83.5	82.8	82.6	81.0	79.6	77.9	76.9	75.7	74.8	74.0	73.2	77.3
May	74.1	73.4	73.3	72.7	72.8	72.5	76.2	80.7	83.3	84.8	85.5	85.6	85.0	84.5	83.4	82.5	81.6	80.5	78.9	78.2	77.3	76.3	75.7	74.6	78.9
June	74.3	73.9	73.6	73.7	73.5	73.3	76.0	79.8	82.2	84.1	85.6	85.2	84.3	84.0	82.4	82.1	81.4	80.6	79.0	77.7	76.4	75.7	75.0	74.3	78.6
July	74.2	74.0	73.7	73.4	73.3	73.1	75.2	79.0	82.1	84.6	84.7	85.1	84.8	83.6	83.1	82.7	82.7	81.2	79.6	78.3	76.8	75.9	75.4	74.8	78.8
August	74.3	73.7	73.6	73.4	73.4	73.3	75.3	78.6	82.6	84.9	86.0	86.4	85.5	84.5	83.1	82.0	81.5	80.2	78.9	77.9	76.7	75.7	75.1	74.5	78.8
September	74.6	74.2	74.0	73.7	73.3	73.1	75.1	78.2	81.8	83.4	84.0	84.2	84.1	83.4	82.3	81.3	80.5	79.3	77.5	76.9	76.1	75.5	75.2	74.7	78.2
October	73.8	73.3	73.0	72.7	72.7	72.5	74.2	78.2	82.6	84.5	85.0	85.0	83.6	83.0	82.4	80.9	79.4	77.1	76.4	76.0	75.1	74.7	74.3	73.8	77.7
November	72.5	72.2	72.3	72.0	71.9	71.5	72.6	76.9	80.1	81.7	82.9	83.3	83.2	82.1	81.4	80.6	79.0	76.1	75.4	75.0	74.1	73.6	73.0	72.7	76.5
December	71.3	70.7	70.6	70.9	70.6	70.2	70.9	74.5	78.6	81.4	82.5	82.7	82.9	82.2	81.3	80.6	78.9	76.0	74.8	74.4	73.5	72.7	72.0	71.8	75.7
Means	72.7	72.1	71.9	71.7	71.6	71.3	73.0	77.0	80.7	82.9	83.8	84.1	83.8	83.1	82.3	81.6	80.5	78.7	77.1	76.2	75.0	74.2	73.6	73.8	77.2

Comparison of Formula.

Month.	Mean.	A. $\frac{M + m}{2} - 10$	B. 7 am + 3 p.m. / 2	C. 7 + 3 + 11 / 3	D. 8 a.m. + 8 p.m. / 2	$\frac{A + B}{2}$
	°	°	°	°	°	°
January	74.2	74.0	74.4	73.1	72.0	74.2
February	75.2	74.7	75.6	74.0	73.8	75.2
March	76.0	75.8	76.5	74.9	75.3	76.0
April	77.3	76.9	78.0	76.7	77.4	77.4
May ...	78.9	78.4	79.8	78.4	79.4	79.1
June ...	78.6	78.8	79.2	77.8	78.8	79.0
July	78.8	78.6	79.2	77.9	78.6	78.9
August	78.8	79.0	79.2	77.8	78.2	79.1
September	78.2	77.8	78.7	77.5	77.6	78.2
October	77.7	77.9	78.3	77.0	77.1	78.1
November ...	76.5	76.6	77.0	75.7	76.0	76.8
December	75.7		76.1	73.7	74.4	
Means	77.2		77.6	76.2	76.6	

The results for 1900 and 1901 given in the above tables confirm those for 1899, and leave little to be desired. The formula $\frac{A+B}{2}$ gives the mean monthly temperature with an average error of 0°2 only, while the greatest error in any month during the two years is only 0°5.

We clearly cannot do better than adopt $\frac{A+B}{2}$ for any place in Jamaica; but A may be used alone, or B may be used alone, in case any instrument at any station was out of order for a short time. The rule is therefore:—add together the 7 a.m., 3 p.m., Max., and Min. temperatures; substract 2° from their sum; and divide the remainder by four to get the mean temperature of the day. And by employing monthly means, we similarly get the mean temperature of the month.

As already stated it was at one time assumed that the mean temperature of the day would be given by $\frac{7\text{ a.m.} + 3\text{ p.m.} + 11\text{ p.m.}}{3}$ and certain results were deduced and published in W. R. No. 123. We now propose to revise those results for Kingston and to extend them to the whole time the Weather Service existed, or rather to the complete years 1881 to 1898 inclusive.

Summary of Kingston Temperatures for each Year.

Year.	Mean.	7 a.m.	3 p.m.	Max	Min.	Highest Max. and date.		Lowest Min. and date.	
	°	°	°	°	°	°	°	°	°
1881 ..	79.0	75.7	84.0	87.2	71.2	93.8	July 7	60.3	Jan. 13
1882 ...	78.8	75.6	84.0	86.4	71.2	92.2	Aug. 27	61.5	Feb. 6
1883	79.0	75.6	84.1	86.8	71.5	93.3	July 28	63.6	Dec. 10
1884 ...	78.5	75.3	83.8	86.3	70.7	92.7	Sep. 18	62.3	Feb. 7
1885 ...	79.4	76.6	84.3	86.9	71.6	95.2	Nov. 6	58.2	Dec. 29
1886 ...	79.5	75.6	84.5	89.0	70.9	96.4	Oct. 1	62.2	Jan. 26
1887 ...	78.4	74.6	83.4	88.3	69.3	93.3	July 21	56.7	Dec. 4
1888	79.4	75.3	85.1	88.9	70.1	93.6	July 28	59.6	Jan. 5
1889 ...	79.7	75.0	85.5	89.5	70.9	94.3	July 28	60.0	March 2
1890	78.2	73.1	84.1	87.9	69.8	94.4	July 21	60.2	Feb. 4
1891 ...	79.0	74.1	84.7	87.5	71.5	96.7	Aug. 20	61.5	Jan. 27
1892 ...	78.1	73.6	83.4	86.7	70.7	94.8	July 11	63.0	Feb. 2
1893 ...	77.9	73.3	83.2	86.5	70.6	92.9	July 4	63.8	Mar. 17*
1894 ..	78.0	73.7	83.3	86.7	70.3	92.9	June 22†	61.2	March 9
1895 ..	78.6	73.7	84.3	87.5	71.0	94.6	Aug. 17	62.8	Dec. 21
1896 ..	79.2	74.2	84.7	87.8	71.9	93.9	July 13	62.7	Jan. 15
1897 ...	79.1	74.2	84.7	87.8	71.7	94.0	Aug. 9	62.0	Jan. 12
1898	78.2	73.3	83.8	86.9	70.7	93.5	Jan. 13	62.6	Nov. 12
Means ..	78.8	74.6	84.2	87.5	70.8	94.1	...	61.3	...

* And December 7.

† And July 17 and September 21.

Summary of the Kingston Monthly Temperatures.

Month.	Mean.	7 a.m.	3 p.m.	Max.	Min.	Average Highest Max.	Average Lowest Min.
	°	°	°	°	°	°	°
January	75.8	68.9	83.1	86.1	67.0	90.1	62.8
February	75.7	69.4	82.7	85.6	67.0	89.3	63.2
March	76.4	71.3	82.8	85.6	67.8	89.3	63.9
April	78.2	74.9	83.3	8[illegible].3	70.0	90.1	66.6
May	79.9	78.1	83.7	87.0	72.5	90.2	68.9
June	81.1	79.1	85.2	88.2	73.7	91.8	70.4
July	81.6	78.7	86.4	89.5	73.4	93.4	70.4
August	81.0	77.6	85.7	89.5	73.4	92.6	70.2
September	80.7	76.9	85.2	89.2	73.5	92.3	70.7
October	79.3	75.6	84.5	88.0	72.4	91.8	68.8
November	78.6	73.4	84.3	87.9	70.7	91.1	66.8
December ...	76.9	70.7	83.3	86.7	68.4	90.5	63.7
Means	78.8	74.6	84.2	87.5	70.8	91.0	67.2

The first thing which attracts our attention is the break in the 7 a.m. readings in the first table; from 1881 to 1889 the mean is 75.°5; from 1890 to 1898 the mean is 73.°7. During the first nine years the screen was as well exposed as possible; during the last nine years the screen was moved to the Parade Gardens, which had been recently planted with ornamental shrubs of all kinds. Of late years these shrubs have grown into trees, and gave anxiety as to the exposure of the screen; but it appears that the exposure was bad at first, and has not become worse with the growth of the trees.

But it is to be noticed that the daily Maximum temperatures, which occur shortly after noon, are in no way affected by the ornamental shrubs or trees: the sun is then vertical or nearly so, and of course the screen is exposed to its full blaze; the same applies to the 3 p.m. readings; and again the Minimum readings have not been affected.

It is therefore to be hoped that the Mean temperatures are not greatly affected as computed by the formula $\frac{A + B}{2}$.

But when we look down the Maximum column we are surprised to find that the two lowest results occur in 1884 and 1893, near the times of the Sun-spot Maxima, and that the highest result occurs in 1889 at the time of the Sun-spot Minimum. These effects are reproduced in the mean temperature column; but without doubt we ought to look to the mean of the daily Maxima throughout the year to show any variation in the intensity of Solar radiation.

Now the connection between the Sun-spot period and the Rainfall in Jamaica* was shown by reducing the irregularities by taking the mean of any three years as the mean of the middle year; and applying this process to the mean Maximum temperatures we get the following table:—

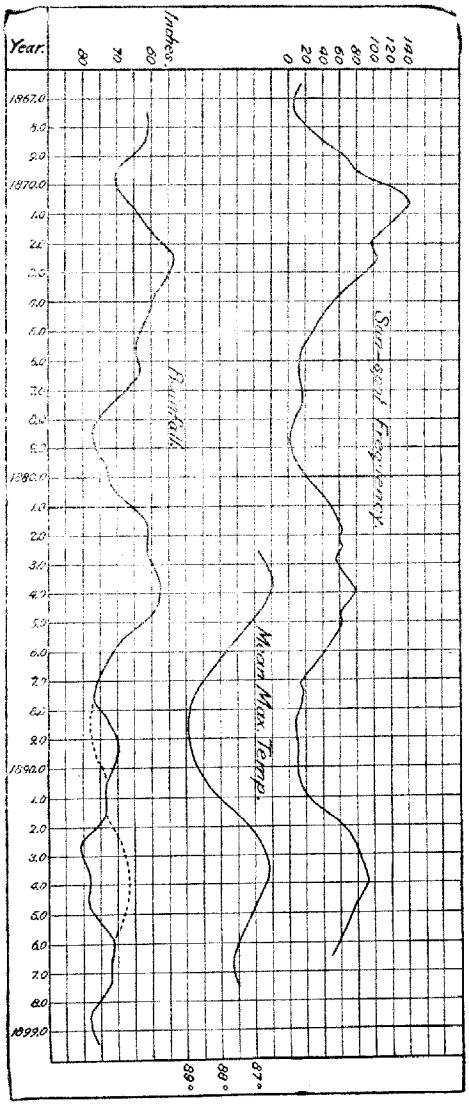
Mean Max. (smoothed) for middle of each year.

1882	...	...	86.°8
1883	...	...	86.5
1884	...	...	86.7
1885	...	...	87.4
1886	...	...	88.1
1887	...	..	88.7
1888	...	...	88.9
1889	...	..	88.8
1890	...	...	88.3
1891	...	...	87.4
1892	...	...	86.9
1893	...	..	86.6
1894	...	...	86.9
1885	...	...	87.3
1896	...	...	87.7
1897	...	...	87.5

* *Nature.* Vol. 49, p. 399

The following diagram gives the curves of Sun-spot frequency according to Wolf (*Nature*, Vol. 58, p. 80), of Mean Max. temperatures in Jamaica, and of the Jamaica Rainfall.

It will be noticed that the agreement between the first and second curves is remarkably close, and that there are about 2° in mean Max. temperature between the Solar Max. and Min.



In the Rainfall curve irregularities will be noticed near the dotted curves; from the middle of 1887 to the middle of 1890 the rainfall was less than it should have been; and from the middle of 1891 to the end of 1895 it was greater than it should have been.

Attention is strongly called to these irregularities because in 1892 it was assumed that the curve would recover its position, and a smaller rainfall for the next few years was predicted; but 1893 proved unusually wet, giving the smoothed max for the middle of 1892.

The following table gives the Rainfall in Jamaica from about 90 Stations :—

Year.	Rainfall In.	Smoothed. In.	Year.	Rainfall. In.	Smoothed. In.
1866 ...	53.65		1884 ...	56.90	58.67
1867 ...	64.47	61.95	1885 ...	59.86	69.12
1868 ...	67.74	62.53	1886 ..	90.61	73.71
1869 ...	55.37	70.85	1887 ...	70.66	77.79
1870 ...	89.43	64.96	1888 ...	72.11	72.31
1871 ...	50.09	61.57	1889 ...	74.15	70.23
1872	45.18	52.78	1890 ...	64.42	74.42
1873 ...	63.06	59.06	1891 ..	84.70	74.03
1874 ...	68.94	61.47	1892 ...	72.98	81.39
1875 ...	52.42	64.24	1893 ...	86.49	78.29
1876 ...	71.35	64.06	1894 ..	75.39	77.83
1877 ...	68.49	72.06	1895 ...	71.62	71.87
1878 ...	76.42	77.89	1896 ...	68.61	72.61
1879 ...	88.84	73.57	1897 ...	77.59	73.35
1880 ...	55.44	70.96	1898 ...	73.84	79.08
1881 ...	68.50	60.64	1899 ...	85.82	76.44
1882 ...	57.87	61.91	1900 ...	69.65	
1883 ...	59.26	58.01	1901 ..		

Montego Bay,
Jan. 17th, 1902.

MAXWELL HALL.