Bermuda Meteorological Station

No. 4

Bermuda Temperatures

By

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CONTENTS

1. INTRODUCTION

Bermuda consists of a number of islands set end to end and forming a long narrow land of which no part is a mile from the ocean and most is less than half a mile. The surrounding sea is therefore a major factor controlling Bermuda Temperature which varies in the manner characteristic of such a situation. In addition the highest point is only 260 ft. above sea level and there is no great topographic affect. As will be shown later, however, there is sufficient effect for the range to be greater inland than near the seashore.

The surface temperature of the sea surrounding Bermuda ranges from approximately 60°F in Winter to about 85°F in Summer. These comparatively warm waters extend west and north some 400-500 miles to the Gulf Stream and in Winter prevent out-breaks of cold air from the American continent reaching Bermuda until they have been warmed in some cases as much as 30 to 40°F. Consequently very low temperatures have never been recorded in the Islands. Likewise in summer the proximity of the ocean prevents any very high temperatures.

Official Meteorological records have been kept continuously since 1891 and it is the purpose of this note to analyze and discuss the records available for these 57 years, 1891 to 1947.

2. SITE AND INSTRUMENTS

From 1891 until the end of March 1932 observations were taken at Prospect Military Camp which is situated about a mile North East of Hamilton mainly on a series of ridges from 100 to 150 ft. above sea level. For most of the period the observations were made at observatory cottage which is about one-third of the way between north and south shores but during 1927 the site was changed to the neighbourhood of the Military Hospital overlooking the North Shore. Since April 1st, 1932, the Meteorological Station at Fort George has been in operation and the records kept there.

The instruments at Fort George are on the Western slope of a hill some 10 ft. below the crest and at a height of 164 ft. above sea level. Except on the side towards the fort the ground falls very rapidly to sea level. The site is rather an exposed one and is surrounded by a wind break of cedars which are outside the enclosure and are kept cut to 6 or 7 ft. high.

So far as is known the thermometers used have been of standard British meteorological office type exposed in louvred screens of approved pattern and dimensions.

Figure one shows the location of each of the stations mentioned in the text. The height contours of Bermuda are very intricate and it is not possible to mark them clearly except on a very large scale map and consequently they are not shown.

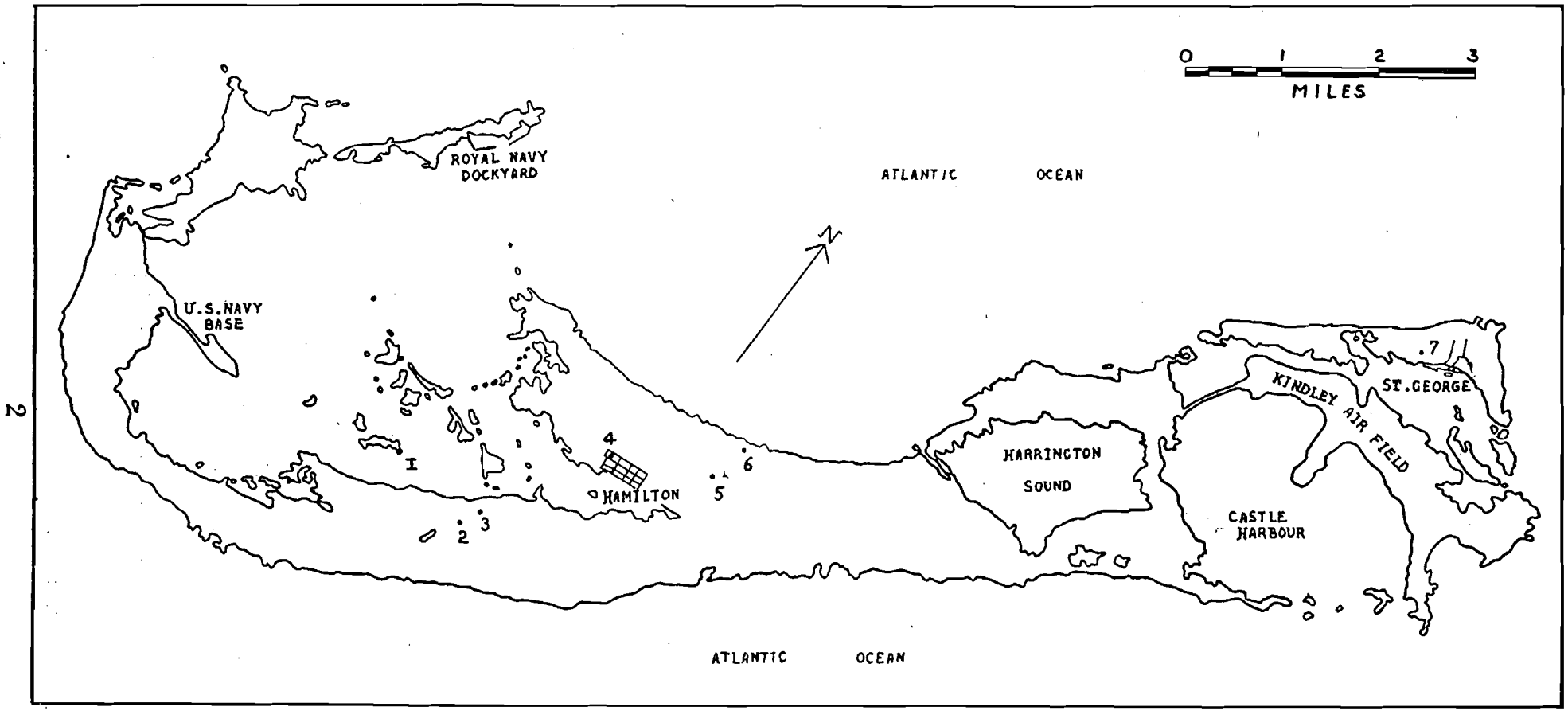

FIGURE 1. Location of meteorological stations.

1. Darrell's Island
2. Kirkdale
3. Belmont
4. Hamilton Hotel
5. Prospect Observatory Cottage
6. Prospect Hospital
7. Fort George

3. SOURCE OF DATA

The Prospect records were kept on behalf of the Canadian Meteorological Office and the original records forwarded to Canada were returned to this office by courtesy of the controller Dr. J. Patterson. All the data for Prospect has been taken from these records except for 1920 and 1921 for which published Canadian summaries were used as the original records are missing. The figures for Fort George have been taken from official records kept in this office. Although the times of observation at Prospect were mainly 8 a.m. and 8 p.m. the times varied and at different periods observations were taken at other times from 7.30 to 9 o'clock. Because of these changes it has not been possible to determine reliable averages over the whole period for observations at fixed hours. The discussion is therefore based mainly on the observations of maximum and minimum which are relatively little affected by these changes in observation time.

All averages have been computed as if the records all applied to one site. The validity of this assumption is discussed in section 25.

4. UNITS

All observations have been made on the Fahrenheit scale and the degree Fahrenheit is the unit used throughout this paper. For simplicity the notation Fahrenheit is omitted in the text and tables.

5. ANNUAL TEMPERATURE

The values of annual temperatures are given in Table one. The annual mean averages 70.2° and has always been between the limits of 68.6° to 71.8°. The annual maximum temperature has never been less than 85.6° or above 94.8° while it averages 89.8° and normally is within 1½° of this average. The annual minimum has always been between 43.0° and 50.2° with an average of 47.0°. The annual range averages 42.8° having been as great as 47.7° and as small as 37.9°. The average daily maximum is 75.5°, the average daily minimum 64.9° and the average daily range 10.6°.

	Average (A)	Average Departure from A	Highest and Date		Lowest and Date	
Mean.....	70.2	0.7	71.8	1937 1938	68.6	1915
Maximum.....	89.8	1.5	94.8	1931	85.6	1913
Minimum.....	47.0	1.7	50.2	1930	43.0	1908 1923
Range.....	42.8	2.2	47.7 (94.1-46.4)	1937	37.9 (87.9-50.0)	1897
Average Daily Maximum..	75.5	0.8	77.5	1927	73.4	1917
Average Daily Minimum..	64.9	0.8	66.5	1933 1937 1938	63.0	1915
Average Daily Range.....	10.6	0.7	14.1	1927	9.5	1906 1940 1942
Lowest Daily Maximum..	57.5	1.5	62.2	1928	52.1	1934
Highest Daily Minimum..	77.7	0.9	80.2	1942	75.6	1927

TABLE 1. Annual Temperatures.

There is usually one day per year on which the maximum does not reach 58° and there has never been a year without at least one day with maximum temperature below 63°.

On the hottest night of the year the temperature does not usually fall below 77°. It has remained above 80° and there has not been a year without at least one night when the temperature remained above 75°.

6. MONTHLY MEAN TEMPERATURE

The average monthly temperature ranges from 61.7° in February to 80.0° in August. The other two winter months of January and March are respectively 1.3° and 1.2° warmer than the minimum. April is more than 2° warmer than March and there is a very rapid increase of almost 5° per month until July which has an average of 1° less than August. There is a decrease of about 2° from August to September then 4° to 5° per month until December, followed by a drop of 2° from December to January.

	Average A	Average Departure from A	Highest	Date	Lowest	Date
January	63.0	1.4	68.9	1937	59.3	1893
February	61.7	1.1	65.0	1925	58.8	1908
March	62.9	1.3	66.1	1946	57.8	1915
April	65.2	1.2	69.0	1945	62.3	1911
May	69.8	1.3	72.8	1938	66.4	1920
June	75.0	1.1	78.3	1943	72.5	1907
July	79.0	1.0	81.7	1901 1941	76.3	1913
August	80.0	1.0	83.9	1937	77.0	1913
September	78.2	1.1	80.7	1931	75.2	1914
October	74.0	0.9	76.2	1936	70.5	1892
November	68.7	1.4	72.8	1895	65.3	1922
December	64.9	1.1	67.8	1932	60.6	1910

TABLE 2. Monthly Mean Temperatures.

The coldest month on record is March, 1915, with a mean temperature of 57.8° and the hottest August, 1937, with a mean of 83.9°.

February has never had a mean temperature above 65° nor has the mean in any of the five months from December to April ever been above 69°. The three months July August and September have all had mean temperatures above 80° and none has ever been below 75°.

January and November with normal departures from the average of 1.4° are the most variable while October with 0.9° departure is the least variable from year to year.

7. MONTHLY MAXIMUM TEMPERATURE

Table 3 gives a summary of monthly maximum temperatures and Table 4 gives figures of average daily maximum in each month.

February with 72.8° has the lowest average maximum and August with 89.2° the highest and the same two months have also the lowest and highest average daily maximum with 67.0° and 85.8° respectively.

The highest temperature ever recorded was 94.8° on the 18th August, 1931, and temperatures over 90° have been recorded in each of the three months July, August and September. Temperatures of 80° or above have been recorded in each month from May to November, while every month of the year has recorded at least 76°. The highest

monthly value of average daily maximum is 90.9° recorded in August, 1937, and this is the only month of record with the average daily maximum reaching 90°. January, February and March have all on occasions had a monthly average daily maximum below 65° the lowest being 64.1° in February, 1940. In July, August and September there has never been a month with an average daily maximum below 80°.

	Average A	Average Departure from A	Highest	Date	Lowest	Date
January	73.5	1.6	79.5	5th, 1937	70.2	1945
February	72.8	1.3	76.1	26th, 1935	69.8	1919
March	73.7	1.4	78.8	18th, 1944	69.0	1915
April	75.9	1.3	79.8	26th, 1902 27th, 1902	71.8	1917
May	80.1	1.6	84.4	30th, 1927	76.2	1903 1914
June	84.8	1.5	88.4	26th, 1928 25th, 1943	81.2	1910
July	88.2	1.6	92.4	18th, 1901	83.6	1918
August	89.2	1.6	94.8	18th, 1931	84.2	1913
September	88.0	1.6	92.8	25th, 1931	84.6	1915
October	84.1	1.6	88.4	29th, 1927	80.4	1914
November	79.2	1.7	83.6	9th, 1926	74.8	1901
December	75.4	1.6	79.5	7th, 1943	71.0	1909 1910

TABLE 3. Monthly maxima.

	Average A	Average Departure from A	Highest	Date	Lowest	Date
January	68.1	1.5	74.0	1937	64.6	1940
February	67.0	1.3	71.0	1927	64.1	1940
March	68.3	1.3	71.1	1934 1946	64.4	1915
April	70.6	1.4	74.4	1945	68.0	1892
May	75.2	1.4	78.0	1929 1938	71.9	1920
June	80.3	1.1	83.6	1943	76.9	1907
July	84.6	1.2	88.7	1901	81.1	1918
August	85.8	1.2	90.9	1937	82.4	1913
September	83.8	1.4	87.7	1931	80.3	1915
October	79.0	1.1	82.5	1927	74.7	1892
November	73.5	1.4	77.3	1938	70.2	1901
December	69.8	1.3	72.8	1929	65.8	1910

TABLE 4. Monthly average daily maxima.

8. FREQUENCY OF OCCURRENCE OF SPECIFIED DAILY MAXIMUM TEMPERATURES

Table 5 gives the percentage of days in each month on which the maximum temperature lies in each degree limit. Figure 2 gives the corresponding figures for each quarter month in the form of graphs giving the percentage of days with maximum temperatures greater than 55°, 60°, etc.

Degrees	Jan.	Feb.	Mar	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.
52	–	.1	–	–	–	–	–	–	–	–	–	–
53	–	.1	–	–	–	–	–	–	–	–	–	–
54	–	.1	–	–	–	–	–	–	–	–	–	–
55	.3	.3	–	–	–	–	–	–	–	–	–	–
56	.3	.8	.2	–	–	–	–	–	–	–	–	–
57	.5	1.1	.4	–	–	–	–	–	–	–	–	–
58	1.0	1.5	.6	.1	–	–	–	–	–	–	–	.3
59	.8	2.1	1.1	.1	–	–	–	–	–	–	.1	.3
60	1.7	3.2	1.4	.2	–	–	–	–	–	–	–	.7
61	2.7	3.6	1.9	.6	–	–	–	–	–	–	.1	1.2
62	3.5	4.8	3.1	1.3	–	–	–	–	–	–	.1	1.7
63	3.5	4.6	4.3	1.9	.1	–	–	–	–	–	.5	2.4
64	5.9	6.6	4.8	2.3	.4	–	–	–	–	–	.8	3.8
65	6.4	7.3	6.3	3.6	.5	–	–	–	–	–	1.0	5.0
66	7.9	8.9	9.6	5.2	.7	–	–	–	–	.1	1.8	7.5
67	10.3	8.9	9.0	7.4	1.0	–	–	–	–	–	2.5	7.3
68	11.2	10.3	10.4	8.2	1.3	.1	–	–	–	.1	3.7	9.0
69	10.1	7.9	9.6	8.3	2.4	–	–	–	–	.4	5.8	8.5
70	10.1	9.4	10.4	10.6	3.9	.1	–	–	–	.8	6.1	10.0
71	8.6	8.0	8.7	11.8	5.5	.5	–	–	–	1.4	8.3	10.5
72	5.9	5.4	7.6	12.6	7.4	.5	–	–	–	1. 8	11.2	10.2
73	4.4	3.7	6.1	8.9	10.0	.9	–	–	.1	2.8	11.3	8.2
74	1.9	1.1	3.2	7.0	10.8	1.8	–	.1	.3	3.7	10.2	6.5
75	1.5	.3	1.1	4.6	14.0	2.7	.1	.1	.4	6.4	8.4	3.7
76	.9	.1	–	3.6	11.8	5.4	.2	.1	.7	8.1	8.9	1.5
77	.3	–	.1	1.2	10.9	8.0	.3	.1	2.0	9.6	6.7	1.2
78	.1	–	.1	.3	7.0	10.7	1.3	.8	2.9	10.3	5.4	.5
79	.1	–	–	.1	5.2	11.6	1.8	.7	4.1	11.7	3.5	–
80	–	–	–	–	3.7	12.6	3.7	2.0	6.7	12.6	2.2	–
81	–	–	–	–	2.2	13.0	6.5	3.0	7.7	10.1	.9	–
82	–	–	–	–	.9	12.9	9.9	4.5	11.8	7.5	.5	–
83	–	–	–	–	.2	8.9	13.9	10.6	12.4	6.6	.2	–
84	–	–	–	–	.2	4.9	14.6	12.9	12.9	3.2	–	–
85	–	–	–	–	–	2.6	17.8	16.2	12.7	1.3	–	–
86	–	–	–	–	–	1.7	12.9	18.1	10.7	.7	–	–
87	–	–	–	–	–	.9	8.2	12.3	7.9	.3	–	–
88	–	–	–	–	–	.4	4.3	7.3	3.5	.3	–	–
89	–	–	–	–	–	–	2.5	4.7	1.9	–	–	–
90	–	–	–	–	–	–	1.1	3.1	.8	–	–	–
91	–	–	–	–	–	–	.9	1.5	.5	–	–	–
92	–	–	–	–	–	–	.1	1.2	.1	–	–	–
93	–	–	–	–	–	–	–	.3	–	–	–	–
94	–	–	–	–	–	–	–	.2	–	–	–	–

TABLE 5. Percentage of days with maximum in range figure stated to figure plus 0.9.°

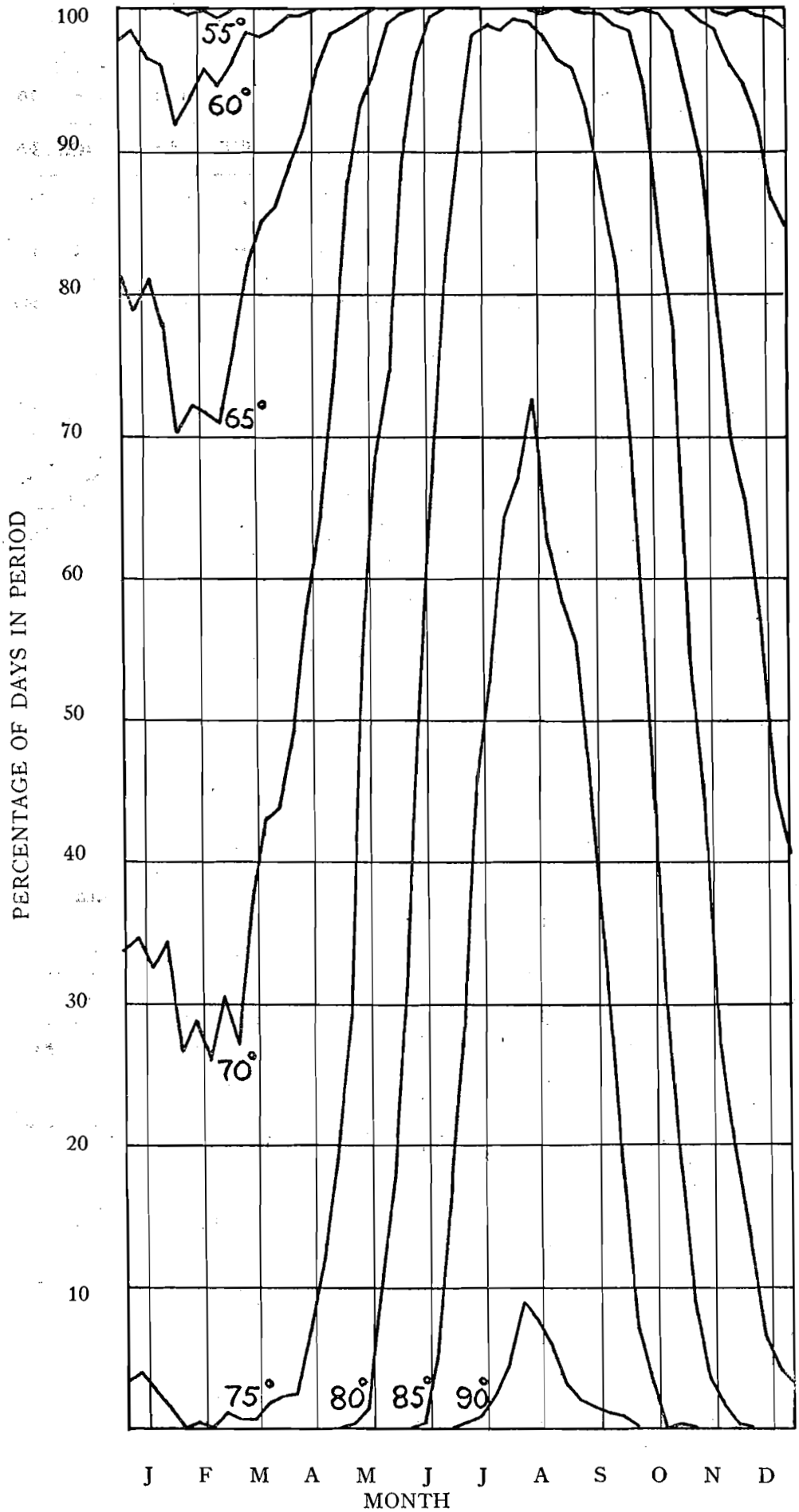

FIGURE 2. Percentage of days in each quarter month with maximum temperature above values indicated.

It is seen that only in February do days occur with maximum temperatures below 55° while July, August and September are the only months with a percentage of days above 90°.

The curves for 80° and above all touch the zero line in the winter half year when these temperatures are not recorded. The 75° curve just touches the zero line in February when this temperature is very occasionally recorded and lies along the 100% line throughout July and August when every day has a maximum temperature of at least 75°. All the remaining curves from 70° to 55° lie along the 100% line for longer and longer periods centred about the summer until the 55° curve reads 100% in all months except February.

9. MONTHLY MINIMUM TEMPERATURES

Table 6 gives a summary of monthly minimum temperatures while Table 7 gives figures for average daily minimum by months.

February with 48.6° and August with 69.5° have respectively the lowest and highest average monthly minimum and with 56.5° and 74.1° the lowest and highest average daily minimum.

In January and March the average monthly minimum is respectively 50.1° and 50.0° or 1½° above February. A rapid rise occurs from March to July and the five months June to October each average minimum of 63° or more with July only slightly lower than the August maximum.

	Average A	Average Departure from A	Highest	Date	Lowest	Date
January	50.1	2.5	59.5	1937	43.0	25th, 1908 18th, 1923
February	48.6	2.1	54.6	1939	43.6	27th, 1940
March	50.0	2.1	57.0	1903	43.6	13th, 1915
April	52.8	2.6	60.0	1945	46.4	4th, 1906
May	58.2	2.1	63.5	1938	48.8	14th, 1899
June	64.0	1.8	68.0	1933	59.4	2nd ,1926
July	69.0	1.5	73.0	1937	61.8	1st, 1927
August	69.5	1.4	73.0	1901 1910	64.5	18th, 1893
September	67.9	1.7	71.4	1901	61.2	22nd 1914
October	63.2	1.8	67.6	1906	57.2	29th, 1944
November	57.3	2.8	64.2	1941	49.2	27th, 1928
December	52.5	2.3	59.0	1932	46.0	27th, 1909

TABLE 6. Monthly minima.

EXTREME MIN

Minima below 44.0° have been recorded in January, February and March; below 50.0° in April, May, November and December, while in the three months July, August and September Minima have not been observed below 61°.

From December to April there has not been an occasion when the temperature at sometime during each month did not fall to 60° or less, while in July, August and September there have been occasions when the temperature did not fall below 71° at any time during the month.

The lowest temperature of 43.0° has been recorded twice, on the 25th January, 1908 and the 18th January, 1923. On 25th January, 1908 the maximum temperature was 59.4° and the 8 a.m. and 8 p.m. observations 56.9° and 58.0° respectively. While on 18th January, 1923 the maximum temperature was 58.2° and the 8 a.m., 3 p.m. and 8 p.m. observations 52.9°, 55.3° and 55.5° respectively. Thus the latter of these two occasions was the colder day.

The average daily minimum is from 56° to 58° in January, February and March and from 72° to 74° in July, August and September with rapid increases of the average from April to July and corresponding decreases from October to January.

	Average A	Average Departure from A	Highest	Date	Lowest	Date
January	57.9	1.7	63.8	1937	53.2	1893
February	56.5	1.2	59.9	1906	53.0	1908
March	57.6	1.5	61.9	1903	51.2	1915
April	59.8	1.3	64.0	1934	56.1	1927
May	64.4	1.4	67.6	1938 1946	60.4	1913
June	69.7	1.2	73.0	1943	67.2	1930
July	73.3	1.0	75.8	1937	70.0	1913
August	74.1	0.9	76.7	1937	71.7	1913 1928
September	72.7	1.0	74.9	1901	68.9	1914
October	69.0	1.1	71.5	1936	65.9	1924
November	63.9	1.5	69.0	1895	58.5	1922
December	60.1	1.3	63.3	1932	55.4	1910

TABLE 7. Monthly average daily minimum.

January, February and March have all had occasions with the average daily minimum below 54° and it has been below 60° in April, November and December but there has been no occasion when July or August had an average minimum below 70°.

The average daily minimum has never reached 60° in February but has been 73° or above in all months, June to September.

March, 1915 with an average daily minimum of 51.2° had the coldste nights in any month while August, 1937 with an average daily minimum of 76.7° had the hottest.

10. FREQUENCY OF OCCURRENCE OF SPECIFIED DAILY MINIMUM TEMPERATURES

Table 8 gives the percentage of days in each month on which the minimum temperature falls in each degree limit. Figure 3 gives the corresponding figures for each quarter month in the form of graphs giving the percentage of days with minimum temperature below 45°, 50°, etc.

Degrees.	Jan.	Feb.	Mar	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.
43	0.1	0.1	0.1	–	–	–	–	–	–	–	–	–
44	0.1	0.3	0.1	–	–	–	–	–	–	–	–	–
45	0.1	0.3	0.2	–	–	–	–	–	–	–	–	–
46	0.5	1.0	0.3	0.1	–	–	–	–	–	–	–	0.1
47	0.6	1.0	0.5	–	–	–	–	–	–	–	–	0.1
48	0.7	1.5	0.9	0.2	0.1	–	–	–	–	–	–	0.2
49	1.5	2.2	1.7	0.4	0.1	–	–	–	–	–	0.1	0.4
50	2.0	3.4	2.5	1.2	–	–	–	–	–	–	–	0.9
51	1.8	3.8	2.7	1.3	–	–	–	–	–	–	0.3	1.0
52	4.0	4.7	3.6	1.9	0.1	–	–	–	–	–	0.2	1.3
53	4.1	7.7	5.0	2.3	0.1	–	–	–	–	–	0.4	1.9
54	7.1	8.6	6.5	2.5	0.2	–	–	–	–	–	0.4	3.5
55	6.4	9.1	7.5	6.2	0.6	–	–	–	–	–	1.3	4.6
56	9.5	9.6	9.1	6.1	0.9	–	–	–	–	–	1.5	5.0
57	10.0	8.1	10.3	8.2	1.5	–	–	–	–	0.1	1.5	7.2
58	10.1	7.6	9.7	8.9	2.9	–	–	–	–	–	2.5	8.7
59	8.8	6.9	7.9	10.3	3.7	0.1	–	–	0.1	0.1	4.4	10.4
60	8.0	7.9	8.3	9.9	5.4	0.3	–	–	–	0.5	7.1	11.0
61	7.6	6.1	6.9	9.0	6.9	0.7	0.1	–	0.1	0.7	7.8	9.9
62	4.5	3.6	5.5	8.9	8.1	0.9	–	0.1	0.1	1.7	8.9	9.0
63	3.7	2.8	5.8	7.6	9.9	2.2	–	–	–	2.7	11.5	7.9
64	3.7	1.7	2.9	6.7	11.5	2.6	–	0.1	0.2	3.8	13.0	6.2
65	2.1	1.3	1.4	5.1	11.5	4.4	0.2	–	0.3	5.8	8.8	4.9
66	1.7	0.4	0.6	1.9	11.5	6.4	0.6	0.2	0.7	6.9	8.9	3.0
67	0.9	0.2	0.1	0.9	9.1	8.1	0.6	0.3	2.0	10.6	7.7	1.6
68	0.3	–	–	0.3	7.7	9.5	1.6	1.1	3.3	12.1	5.7	0.7
69	0.1	–	–	0.1	4.5	11.1	4.2	2.0	5.5	11.7	3.9	0.2
70	–	–	–	–	2.5	14.8	7.7	4.7	10.0	12.7	2.5	0.2
71	–	–	–	–	0.9	12.6	11.3	7.6	13.1	12.1	1.0	–
72	–	–	–	–	0.4	12.0	14.5	12.4	14.5	8.3	0.4	–
73	–	–	–	–	0.1	6.5	16.5	14.5	17.3	5.5	0.1	–
74	–	–	–	–	–	5.1	17.0	17.8	14.3	3.1	0.1	–
75	–	–	–	–	–	2.0	13.0	15.7	10.0	1.3	–	–
76	–	–	–	–	–	0.5	7.8	11.6	5.6	0.1	–	–
77	–	–	–	–	–	0.2	4.0	7.8	2.3	0.1	–	–
78	–	–	–	–	–	–	0.9	3.1	0.6	–	–	–
79	–	–	–	–	–	–	0.2	0.8	0.1	–	–	–
80	–	–	–	–	–	–	–	0.1	–	–	–	–

TABLE 8. Percentage of days with minimum from value stated to 0.9° above.

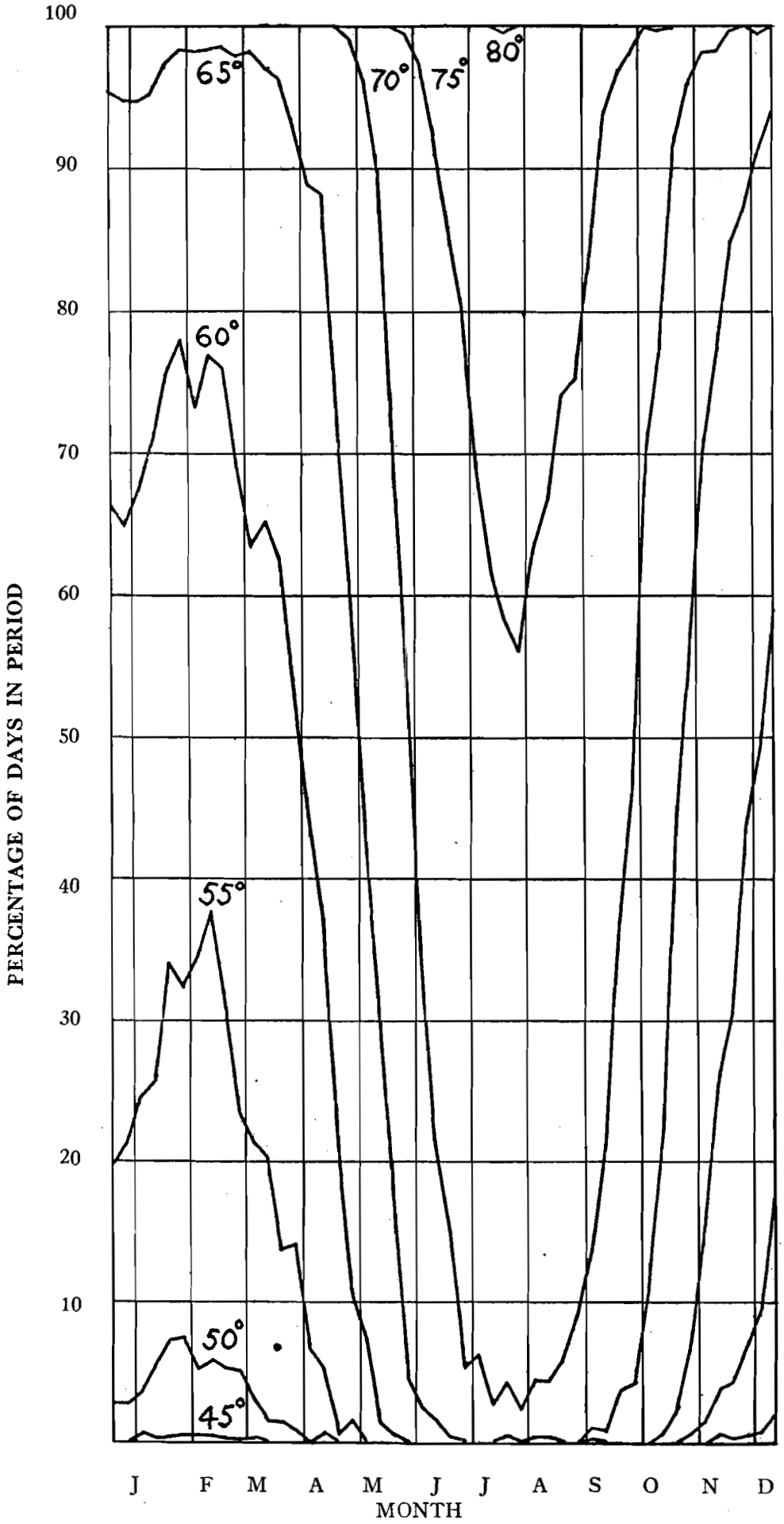

FIGURE 3. Percentage of days in each quarter month with minimum temperature below values indicated.

The curve for 65° does not quite reach 100% in February and March indicating that on almost every day the temperature falls below 65° while throughout July, August and the early part of September it is either along the zero line or less than 1%, showing that in these months the temperature very rarely falls to this value. The curves for temperatures above 65° do not reach the zero in any month, and lie along the 100% line throughout the winter. The curves for temperatures below 65° do not approach the 100% mark in any month, and lie along the zero line for greater and greater periods centred about the summer until the 45° curve shows a zero reading in all months except January, February and March and in each of these indicates less than 1% frequency of days with minimum below 45°.

11. MONTHLY RANGE

The average and extreme ranges in each month are given in Table 9.

The average monthly range is greatest in the winter and least in the summer the five months from December to April all having average ranges exceeding 23°, while July and August both have less than 20°. February has the greatest average range of 24.2° and July the smallest of 19.2°.

	Average A	Average Departure from A	Highest	Date	Lowest	Date
January	23.4	2.3	31.4	1922	17.4	1907
February	24.2	1.9	29.6	1929	19.0	1906
March	23.7	2.2	29.8	1922	17.0	1903
April	23.1	2.6	28.2	1906 1922	16.4	1910
May	21.9	2.1	31.4	1899	16.0	1942
June	20.8	1.8	26.5	1941	15.5	1936
July	19.2	1.9	26.0	1927	15.4	1918
August	19.9	2.1	29.2	1926	15.2	1917
September	20.1	2.0	26.3	1937	14.7	1940
October	20.9	2.3	26.8	1922 1930	15.4	1906
November	21.9	2.7	31.8	1928	15.8	1902
December	23.0	2.6	30.3	1892	16.3	1947

TABLE 9. Monthly range.

Every month has in some year had a range of at least 26° and all the winter months have had 29° or more. The maximum of 31.8° occurred in November, 1928 when there was a maximum temperature of 81.0° and a minimum of 49.2°.

A range less than 15 has occurred only in September which had 14.7° in 1940 but with the exception of February, which has never had a monthly range less than 19°, all months have had an occasion when the extreme range was less than 17.5°.

12. DAILY RANGE

The average daily ranges by months are given in table 10 and the extreme daily ranges in table 11.

	Average A	Average Departure from A	Highest	Date	Lowest	Date
January	10.2	1.1	14.2	1927	7.5	1941
February	10.5	.9	14.1	1928	7.8	1900
March	10.7	1.0	15.0	1927	7.7	1903
April	10.8	.8	15.7	1927	8.5	1934
May	10.8	.9	15.0	1927	8.8	1906
June	10.6	.8	13.8	1928	8.7	1940
July	11.3	1.0	15.2	1928	8.7	1907
August	11.7	1.0	15.6	1927	9.9	1917 1943
September	11.1	1.0	14.7	1928	8.0	1891
October	10.0	1.2	14.0	1927	8.0	1901
November	9.6	.9	13.7	1922	7.7	1891 1895 1941
December	9.7	1.0	13.5	1926	7.4	1947

TABLE 10. Monthly Average Daily Range.

The average daily range is greatest in the summer, August having an average of 11.7° and least in November and December when the daily range averages 9.6° and 9.7° respectively. Every month has at sometime had an average range of 13.5° or more, the greatest being April, 1927 with 15.7°. August has never had an average range less than 9.9° but all other months have had averages less than 9.0°. In the five months from November to March it has been below 8°, the lowest on record being 7.4° in December, 1947.

From Table 11 it is seen that on the average every month has one day with a daily range of 14.8° or more and one day with a range of 7.6° or less.

The average greatest daily range varies slightly from month to month with the highest values in winter and lowest in early summer and Autumn. February and March each average one day with 16.6° range while November has only 14.8° and June and October each 15.2°.

	GREATEST DAILY RANGE					SMALLEST DAILY RANGE				
	Average	Extreme	EXTREME From	To	Date	Average	Extreme	EXTREME From	To	Date
January	16.2	20.6	71.2	50.6	20th, 1927	4.9	2.6	64.6	62.0	8th, 1909
February	16.6	23.2	70.4	47.2	8th, 1922	5.3	2.0	69.0	67.0	14th, 1920
March	16.6	22.0	67.6	45.6	6th, 1927	5.3	3.0	63.0	60.0	2nd, 1892
								64.6	61.6	6th, 1903
								68.0	65.0	22nd, 1922
April	16.3	22.8	77.8	55.0	9th, 1927	5.7	1.9	65.7	63.8	24th, 1936
May	15.8	27.2	76.0	48.8	14th, 1899	5.8	2.5	70.0	67.5	8th, 1937
June	15.2	19.9	83.5	63.6	8th, 1892	6.2	2.4	74.2	71.8	8th, 1942
July	15.5	19.6	87.8	68.2	12th, 1902	7.3	3.4	82.0	78.6	2nd, 1902
August	15.9	22.7	94.0	71.3	13th, 1937	7.6	3.5	75.3	71.8	20th, 1891
September	15.7	21.8	91.8	70.0	9th, 1928	6.4	1.6	80.2	78.6	17th, 1900
October	15.2	20.0	88.4	68.4	29th, 1927	5.3	2.9	72.1	69.2	11th, 1940
November	14.8	19.4	70.4	51.0	25th, 1913	4.8	1.5	70.5	69.0	10th, 1896
December	15.6	20.4	70.2	49.8	20th, 1903	4.8	0.9	62.9	62.0	30th, 1943
			66.4	46.0	27th, 1909					

TABLE 11. Extreme daily ranges.

Every month has had a day with a range of 19° or more and the greatest daily range in the record was 27.2° on 14th May, 1899, when the temperature varied from 48.8° to 76.0°.

The average smallest daily range has its highest values in summer and lowest in autumn and winter. July and August do not average one day with a daily range below 7° while in November, December and January the average lowest is less than 5°.

Every month has had a day with a range of 3.5° or less and the smallest on record is 0.9° on 30th December, 1943 when the extremes were 62.0° and 62.9°.

13. DAY TIME MAXIMUM AND NIGHT TIME MINIMUM

The average daily ranges given in table 10 are based on the differences between 24-hourly maximum and minimum. It is recognised that this method gives average values which are somewhat too great owing to the fact that on occasions the minimum or the maximum may be occurring at the time when the thermometers are read and set, and consequently a single extreme may be counted in each of two days. Because of this it is considered better when the extreme thermometers are read and set both night and morning to determine the range as the difference between the maximum read in the evening, i.e., the day time maximum, and the minimum read in the morning, i.e., the night minimum.

A comparison between the ranges as determined by these two methods is possible with the readings which had been taken at Fort George since 1932 and the results are given in table 12.

	Day Maximum	Night Minimum	Daily Range	Daily Mean
January	-.13	.75	-.9	.3
February	-.13	.81	-.9	.3
March	-.05	.56	-.6	.3
April	-.03	.51	-.5	.2
May	-.03	.27	-.3	.1
June	-.01	.29	-.3	.1
July	-.05	.37	-.4	.2
August	0.00	.47	-.5	.2
September	-.03	.37	-.4	.2
October	-.03	.49	-.5	.2
November	-.03	.48	-.5	.2
December	-.11	.81	-.9	.3

TABLE 12. Departure of average daytime maximum and average night minimum from corresponding 24 hourly maximum and minimum. Also departure of average daily range and mean calculated from daytime maximum and night minimum from the values calculated from 24 hourly maximum and minimum.

The table shows that there is very little difference between the average day-maximum and the average 24-hourly maximum in each month. In December, January and February the day maximum is 0.1° lower than the 24-hourly maximum but in all the other months the difference is 0.05° or less.

The average night minimum, however, is appreciably higher than the average 24-hour minimum the difference ranging from 0.8° in December, January and February to 0.3° in May and June.

The daily range as calculated from the day maximum and the night minimum is consequently smaller than the range deduced from 24 hour extremes by amounts which vary from 0.9° in December, January and February to 0.3° in May and June.

The daily mean also is higher when calculated from day maximum and night minimum but the difference is small ranging from 0.3° in December, January, February and March to 0.1° in May and June.

14. GRASS MINIMUM

Table 13 gives the figures for grass minimum as recorded at Fort George. It is seen that in the five months December to April the average daily grass minimum is 57° or less, February with an average of 52° being the coldest. In July and August the average value reaches its maximum of 71°.

Months	Average Daily (A)	Average Monthly Lowest (B)	Absolute Monthly Lowest	Average of A Below Average Daily Screen Minimum	Average of B Below Average Monthly Screen Minimum
January	56	46	42	3.5	5.5
February	52	43	40	4.0	5.5
March	55	45	41	4.1	5.6
April	57	47	40	3.6	6.9
May	62	53	48	4.3	6.7
June	67	59	50	3.8	7.0
July	71	64	54	3.5	5.7
August	71	66	57	3.8	4.2
September	69	62	53	4.4	6.3
October	66	58	54	4.1	5.9
November	61	54	48	4.0	5.5
December	57	48	42	4.2	5.3

TABLE 13. Grass Minima at Fort George, 1932-47.

February normally has one day with a reading down to 43° and each of the months, December to April, a day with 48° or less. August has a normal minimum of 66° and July and September 64° and 62° respectively.

The five coldest months, December to April, have each recorded 42° or less, the minimum of 40° having occurred in both February and April. Every month has recorded a temperature down to at least 57° but from June to October there has never been a day with the grass minimum below 50°.

The average daily grass minimum is from 3.5° to 4.4° lower than the average screen minimum in each month. The greatest differences are in May and September with 4.3° and 4.4° respectively and the smallest in January and July with 3.5°. The monthly grass minimum averages 4.2° below the monthly screen minimum in August but in all other months is at least 5.3° lower with a maximum difference of 7.0° in June.

As has been stated the Fort George site is on a hillside and considerably lower grass minima are recorded in valleys as is shown by the figures of section 15.

15. GRASS MINIMUM TEMPERATURES IN A VALLEY

As is stated in section 26 the Belmont station was situated near the top of a valley at a height of about 90 feet above sea level. This valley is closed by a ridge to the east but to the westward opens down to the sea about two miles away. Grass minimum observations were not made at this station because the instruments could not be protected from the public. However, some observations of grass minimum were made on the lawn of a house, Kirkdale, at the bottom of the valley about 350 yards to the south-west of the Belmont site. This was at an elevation of about 25 ft. above M.S.L. The bottom of the valley gradually gets lower and is near sea level, about ½ mile south-west of Kirkdale.

Records were kept for the first three months of 1945 and it was found that with few exceptions the readings were lower than at Fort George. The average difference was 1.4°, 1.7° and 1.4° in the three months while the extreme differences were 9.1°, 10.0° and 7.7°. As is shown in section 27 Darrell's Island is warmer at night than Fort George and consequently the average differences between Kirkdale and Darrell's Island were greater being 2.9°, 3.6° and 4.2° respectively in the three months. The lowest readings at the Kirkdale site were 38.5°, 38.2° and 40.8° respectively in the three months.

In view of these figures there is no reason to doubt that the grass minimum in some of the closed valleys will on occasion have fallen below freezing point. This has not been observed officially at any time but old descriptive records of the Colony mention occasions when ice formed on the marshes in low lying valleys.

16. MONTHS WITH ANNUAL EXTREMES

Table 14 gives the number of occasions when each of the various yearly extremes occurred in individual months. Owing to the fact that sometimes two months have the same extreme, it will be found that the totals in some cases exceed 57, the number of years under review.

The year's maximum occurred once in June but with this exception all the maximum values were recorded in July, August or September. In five years the absolute yearly maximum occurs in August in three and once each in July and September. The highest of each of the average daily values occurs in August in four years out of five and in July in the other year except that about once in twenty years they occur in September.

	Years Maximum	Highest Monthly Mean	Highest Monthly Average Daily Maximum	Highest Monthly Average Daily Minimum	Years Minimum	Lowest Monthly Mean	Lowest Monthly Average Daily Maximum	Lowest Monthly Average Daily Minimum
January	—	—	—	—	13	15	14	15
February	—	—	—	—	25	31	33	27
March	—	—	—	—	16	10	9	14
April	—	—	—	—	2	—	—	1
May	—	—	—	—	—	—	—	—
June	1	—	—	—	—	—	—	—
July	12	12	14	13	—	—	—	—
August	36	45	41	44	—	—	—	—
September	11	3	2	3	—	—	—	—
October	—	—	—	—	—	—	—	—
November	—	—	—	—	—	—	—	—
December	—	—	—	—	3	4	4	3

TABLE 14. Number of years when the annual extremes fell in particular months.

The year's lowest values show a greater scatter in time of occurrence. The year's minimum has occurred twice in April and the lowest average daily minimum once. Each of the various minima has occurred once in fifteen to twenty years in December. Apart from these all the lowest values have occurred in January, February or March. The year's minimum and lowest monthly average daily minimum have occurred on nearly half the occasions in February and the lowest mean and lowest average daily maximum on more than half the occiasions. Each of the various lowest values has been recorded in January in approximately one year out of four. In the same proportion of years the lowest absolute minimum and lowest average daily minimum have been in March which has also had the lowest mean and lowest average daily maximum in about one year out of six.

17. THE HOTTEST NIGHTS

Table 15 gives data on the hottest night in each month as indicated by the highest daily minimum.

It is seen that in the three months January to March there is not normally a night on which the temperature does not fall to less than 65° while July, August and September have usually at least one night each on which the temperature remains above 76°.

	Average A	Average Departure from A	Highest	Date	Lowest	Date
January	64.9	1.7	69.0	19th, 1930	61.0	1940
February	63.7	1.5	67.0	27th, 1891 5th, 1903 14th, 1920	59.4	1892
March	64.2	1.2	67.4	28th, 1913	56.6	1915
April	65.6	1.4	69.8	21st, 1934	60.6	1927
May	69.7	1.3	73.7	30th, 1934	65.8	1914
June	74.0	1.2	77.0	29th, 1943	70.4	1913
July	76.7	1.0	79.0	27th, 28th 29th, 1936	73.4	1913
August	77.4	1.0	80.2	6th, 1942	74.2	1928
September	76.6	1.1	79.0	5th, 1939	73.8	1893
October	73.8	1.1	77.4	7th, 1934	70.4	1892
November	69.6	1.5	74.0	1st, 1917	62.6	1922
December	66.4	1.6	70.2	19th 20th 1929	62.6	1909

TABLE 15. Monthly highest daily minimum.

February has never had a night on which the temperature did not fall to at least 67° and in the first four months of the year there has never been a single night in which the temperature did not fall below 70°. In each of the three months, July, August and September, on the other hand, there have been nights on which the temperature did not fall below 79°, the highest being on the 6th August, 1942, hwen the lowest value recorded was 80.2°.

March, 1915, in which no day had a minimum above 56.6° has the lowest value of any month, the lowest in January and February being 61.0° and 59.4° respectively.

The three summer months July, August and September have never passed without at least one day in each in which the temperature did not fall below 73°.

18. THE COLDEST DAYS

Table 16 gives the lowest daily maxima recorded in each month, these being an index of the coldest days.

February averages one day on which the maximum does not reach 59° and both January and March one day with maximum below 61°. These three months have never passed without a day in each when the temperature did not rise above 66° but there has never been a day when the maximum did not reach 55, 52 or 56° respectively in the three months.

	Average A	Average Departure from A	Highest	Date	Lowest	Date
January	60.3	2.2	66.0	1928	55.2	15th, 1914 28th, 1940
February	58.6	2.2	66.2	1927	52.1	10th, 1934
March	60.7	2.0	66.0	1921	56.8	25th, 1911 10th, 1926
April	63.8	2.0	69.3	1947	58.1	9th, 1896
May	68.7	2.3	74.0	1938	63.5	1st, 1896
June	74.4	1.9	78.7	1893	68.0	7th, 1945
July	79.7	1.7	84.4	1901	75.7	5th, 1897
August	80.6	1.8	85.2	1945	74.4	20th, 1918
September	78.2	1.9	82.9	1934	73.4	20th, 1941
October	72.4	1.7	77.8	1927	66.8	30th, 1891
November	66.4	1.8	72.0	1921	59.8	27th, 1917
December	62.2	1.9	68.0	1908 1932	58.0	22nd 1910 31st, 1916 30th, 1933

TABLE 16. Monthly lowest daily maximum.

The lowest maximum on record is 52.1° on the 10th February, 1954. On this day the minimum was 44.8°. There was a N.N.W. wind of strong to gale force throughout the day with hail showers and the temperatures recorded at 8 a.m., 3 p.m. and 8 p.m. were 47.2°, 48.2° and 47.3° respectively. This is probably the coldest day in the 57 years for although the absolute minimum was not as low as has been recorded twice in January (section 9) the readings at fixed hours and the maximum were considerably lower than on these days.

The lowest daily maximum averages, 79.7°, 80.6° and 78.2° in July August and September respectively. There have never been days when the temperature did not reach 75° in July, 74° in August and 73° in September. In August, 1945, there was not one day in which the temperature did not reach 85° or above and there have been occasions when every day in July reached 84.4° and every day in September 82.9°.

The lowest maximum in a given year differs from the average lowest by from 2.0° to 2.3° in the first five months of the year and by 1.7° to 1.9° in the remainder. These figures show there is greater variation from year to year in the coldest day than in the hottest night, the differences being about 50% in the winter and 75% in summer months.

19. DIURNAL VARIATION OF TEMPERATURE

Table 17 gives the average temperature at every hour of the day for each month. The means are for Fort George in the years 1932 to 1944. Records for each hour are not available for all months in this period owing to instrumental failures particularly in 1937. The figures given show the difference from the mean of 24 hour observations.

Hour	Jan.	Feb.	Mar	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	-1.4	-1.4	-1.9	-2.3	-2.8	-2.7	-2.7	-2.7	-2.5	-1.9	-1.7	-1.3
2	-1.5	-1.5	-1.9	-2.4	-2.9	-2.8	-2.8	-2.8	-2.6	-2.0	-1.7	-1.4
3	-1.5	-1.5	-2.0	-2.5	-3.0	-2.9	-2.9	-3.0	-2.7	-2.1	-1.8	-1.4
4	-1.6	-1.6	-2.1	-2.6	-3.0	-2.9	-3.0	-3.1	-2.7	-2.1	-1.8	-1.5
5	-1.6	-1.7	-2.1	-2.6	-3.1	-2.9	-3.1	-3.0	-2.8	-2.2	-1.9	-1.5
6	-1.6	-1.7	-2.1	-2.6	-2.8	-2.6	-2.9	-2.8	-2.8	-2.1	-1.9	-1.5
7	-1.5	-1.7	-1.9	-1.7	-1.6	-1.4	-1.7	-1.6	-1.9	-1.7	-1.7	-1.5
8	-1.0	-1.1	-0.8	-0.2	0.4	0.4	0.4	0.3	-0.0	-0.2	-0.5	-0.7
9	0.4	0.0	0.7	1.1	1.8	1.7	1.7	2.0	1.6	1.5	1.0	0.5
10	1.7	1.2	1.9	2.5	2.9	2.7	2.7	3.0	2.9	2.8	2.3	1.7
11	2.7	2.2	2.9	3.4	3.7	3.4	3.5	3.9	3.9	3.7	3.4	2.5
12	3.2	2.8	3.7	3.9	4.3	3.9	4.0	4.4	4.3	4.1	3.8	3.1
13	3.3	3.1	3.9	4.2	4.6	4.0	4.1	4.8	4.4	3.9	3.7	3.1
14	3.0	3.1	3.8	4.1	4.3	3.9	4.1	4.5	4.2	3.6	3.3	2.8
15	2.5	2.7	3.3	3.7	3.8	3.8	4.0	4.1	3.9	2.9	2.5	2.2
16	1.7	2.0	2.8	2.9	3.2	3.2	3.5	3.2	3.2	2.2	1.4	1.3
17	0.5	1.1	1.7	1.8	2.0	2.1	2.5	2.2	1.8	0.8	-0.1	0.2
18	-0.6	-0.2	0.2	0.2	0.6	0.9	1.0	0.5	0.0	-0.7	-0.9	-0.7
19	-0.9	-0.7	-0.8	-1.1	-1.1	-0.7	-0.7	-1.2	-1.3	-1.2	-1.1	-0.9
20	-1.1	-1.0	-1.4	-1.7	-2.0	-1.8	-1.8	-1.8	-1.8	-1.4	-1.2	-1.0
21	-1.2	-1.1	-1.5	-1.9	-2.2	-2.1	-2.1	-2.1	-2.0	-1.5	-1.3	-1.1
22	-1.3	-1.2	-1.6	-2.0	-2.4	-2.3	-2.3	-2.2	-2.1	-1.7	-1.4	-1.2
23	-1.3	-1.3	-1.7	-2.1	-2.5	-2.4	-2.4	-2.4	-2.3	-1.8	-1.5	-1.2
24	-1.4	-1.3	-1.8	-2.2	-2.6	-2.6	-2.6	-2.6	-2.4	-1.9	-1.6	-1.3

TABLE 17. Diurnal Variation of Temperature. Value at each hour expressed as difference from 24 hourly mean. Fort George.

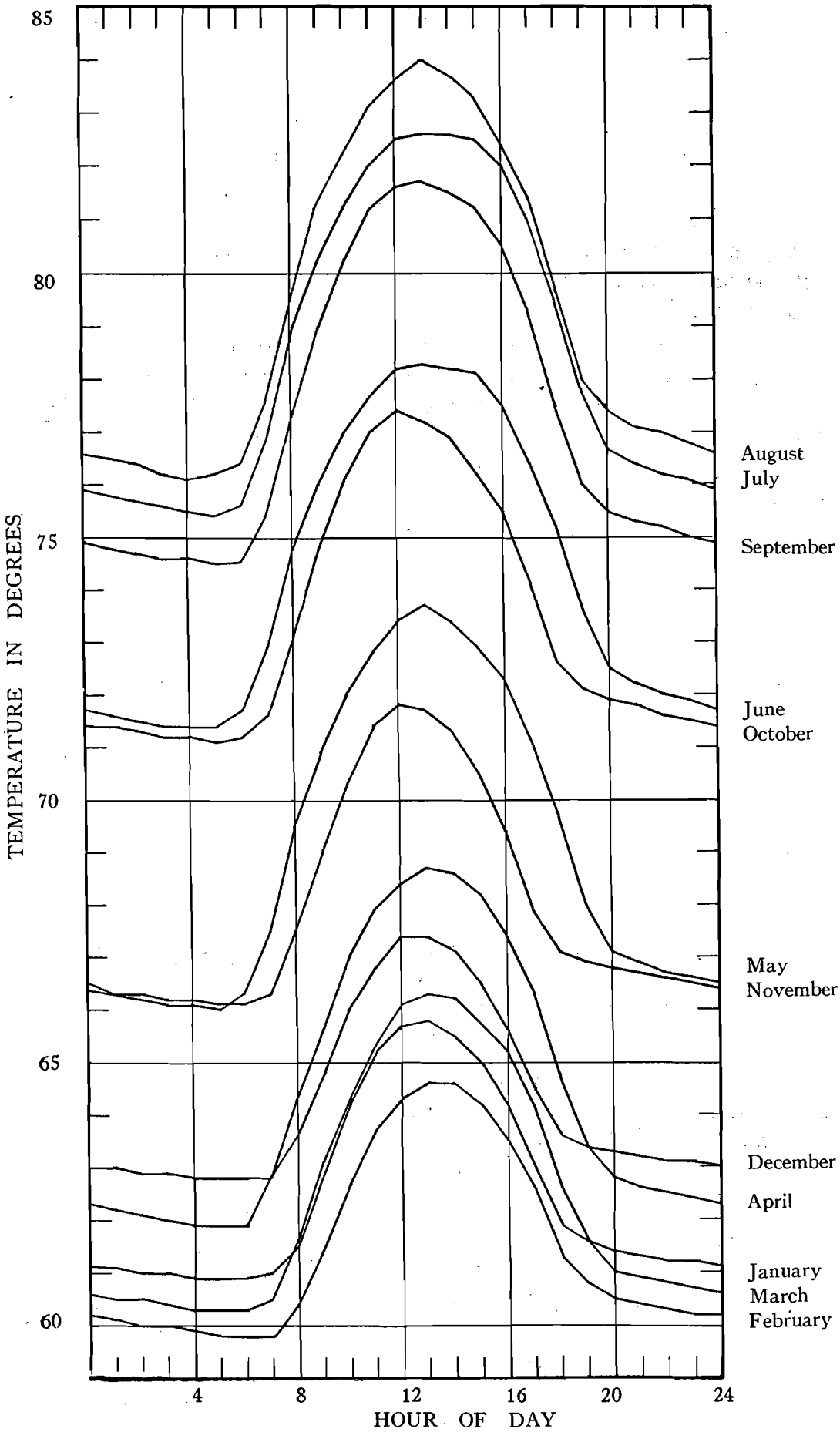

FIGURE 4. Average Temperature at each hour of the day. Diurnal variation at Fort George with 1891-1947 monthly means corrected to 24 hourly mean

The figures do not show any unusual characteristics. In February the mean temperature for the day is recorded about 9 a.m. and 6 p.m. whereas in July the mean occurs about 7.45 a.m. and 5.40 p.m.

In February the hottest hour is 3.1° above the mean and the coldest hour 1.7° below, while in August the hottest hour is 4.8° above and the coldest 3.1° below the average temperature for the day.

Figure 4 gives the average temperature at each hour of the day using the diurnal variation of table 17 and the means for each month given in table 2 corrected to 24 hour means by the figures of table 18. The graph shows that February is colder at all hours than other months, and August is hotter. March is colder than January during the night, almost identical during the morning but reaches a higher value throughout the afternoon. April is colder at night than December but warmer during the day. May and November have very similar temperatures during the night but May is much warmer during the daytime, there being differences of 2° and more in the afternoon. Both these months show a considerable rise above December and April. June and October are another pair with June somewhat hotter than October at all hours. July and September are the highest pair below the August maximum, July being hotter than September.

We notice with each pair that the month with the longest days has the hotter afternoons, this being in each case the time when there is a maximum difference between the two months.

20. DAILY MEANS DETERMINED FROM READINGS AT EVERY HOUR OF THE DAY

Table 18 gives the corrections which must be applied to daily means determined as in table 2 from one-half of daily maximum plus daily minimum to give the correct daily mean of readings at each hour of the day. These figures are based on the same data as the diurnal variation in Table 17.

Throughout the year the average daily maximum is seen to be 5.5° above and the average daily minimum 4.3° below the 24-hour-daily mean. The differences of both maximum and minimum from the mean are greatest in the summer months and least in the early winter. The difference in maximum ranges from 5.0° in December to 6.3° in August and in minimum from 3.7° in November to 4.9° in July.

	Departure from 24 Hourly Average Temperatures			24 Hour Maximum Minus Max Hour	24 Hour Minimum Minus Min. Hour
	Average Daily Maximum	Average Daily Minimum	Monthly Mean ½ (Max. + Min.)		
January	5.1	-4.1	0.5	1.8	-2.5
February	5.1	-4.7	0.2	2.0	-3.0
March	5.4	-4.3	0.5	1.5	-2.2
April	5.7	-4.3	0.7	1.5	-1.7
May	5.7	-4.3	0.7	1.1	-1.2
June	5.6	-4.2	0.7	1.6	-1.3
July	6.0	-4.9	0.5	1.9	-1.8
August	6.3	-4.7	0.8	1.5	-1.6
September	6.1	-4.4	0.9	1.7	-1.6
October	5.5	-4.0	0.7	1.4	-1.8
November	5.1	-3.7	0.7	1.3	-1.8
December	5.0	-3.8	0.6	1.9	-2.3
Mean	5.5	-4.3	0.6	1.6	-1.9

TABLE 18. Difference between daily means determined from 24 hourly values and from ½ (Maximum + Minimum). Fort George, 1932-44.

It is seen that in every month the average maximum exceeds the 24 hour average by an amount greater than that by which the average minimum is below the same average. Consequently the daily mean calculated as a half daily maximum plus daily minimum is greater than the true mean of 24-hour observations. The difference averages 0.6° over the year ranging from the minimum of 0.2° in February to a maximum of 0.9° in September.

The last two columns of table 18 give the differences between the daily maximum and the maximum hourly reading and the difference between the daily minimum and the lowest hourly reading. It is seen that the difference in both cases is greatest in February, in which month the maximum is 2° greater than the temperature at the maximum hour and the minimum is 3° lower than the temperature at the coldest hour. The differences are least in May where the average daily maximum and daily minimum differ from the temperatures at the extreme hours by 1.1° and 1.2° respectively. Over the year the average daily maximum is 1.6° above and the average daily minimum 1.9° below the readings at the corresponding extreme hours.

21. NUMBER OF HOURS PER DAY WITH TEMPERATURE IN CERTAIN LIMITS

Table 19 gives the average number of hours per day with temperature in each degree limit. The figures are based on the hourly readings for Fort George and in each case refer to the individual months between 1932 and 1947 in which the mean temperature was nearest to the 1891 to 1947 average for that month. In eight months the difference from average did not exceed 0.1° but the difference was 0.2° in December, -0.3° in June, 0.3° in October and -0.5° in November.

Departure of selected month from average.	Jan.	Feb.	Mar	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov	Dec.
	-0.1	0.0	0.0	0.1	0.0	-0.3	-0.1	0.1	0.0	0.3	-0.5	0.2
47	0.03											
48	0.03	0.08										
49	0.2	0.1	0.1									
50	0.2	0.4	0.4									0.03
51	0.1	0.7	0.0									0.1
52	0.2	0.6	0.1									0.3
53	0.3	0.7	0.06									0.1
54	0.5	0.6	1.0									0.4
55	0.2	0.8	0.4	0.3								0.7
56	0.5	1.7	1.1	0.5								0.7
57	1.0	1.7	1.8	1.6								0.7
58	1.6	1.7	1.0	0.9	0.2							0.9
59	1.8	0.9	2.0	0.8	0.03							0.6
60	2.0	1.1	1.0	0.9	0.5						0.4	0.4
61	1.7	1.2	3.2	1.7	0.5						0.6	0.7
62	2.5	1.2	1.0	2.5	0.7					0.3	0.6	1.9
63	2.0	1.3	1.1	3.1	1.1					0.3	3.1	3.1
64	1.2	2.0	1.6	2.0	1.5	0.2				0.4	2.2	2.3
65	1.7	2.2	2.1	1.4	1.5	0.1				0.5	2.8	2.4
66	2.4	1.1	1.5	1.0	1.9	0.4				0.7	2.6	1.3
67	1.4	1.3	1.2	1.5	1.8	0.2				0.9	2.7	1.7
68	1.0	1.0	0.9	1.2	2.3	1.0				1.5	2.6	1.2
69	0.8	0.6	1.1	1.6	2.4	1.7		0.1		1.7	1.6	0.9
70	0.4	0.5	0.9	1.4	2.3	1.6		0.1		1.1	1.5	1.8
71	0.2	0.6	0.4	0.9	1.8	1.1	0.06	0.5	0.4	2.0	1.1	0.6
72	0.06	0.04	0.03	0.5	1.2	1.1	0.4	0.4	0.8	1.7	1.0	0.6
73			0.0	0.2	1.1	1.5	1.1	0.6	1.6	1.7	0.6	0.5
74			0.06	0.1	1.0	2.3	1.0	0.9	3.5	2.7	0.2	0.2
75					0.5	1.5	1.4	1.2	4.2	2.8	0.2	0.1
76					0.8	1.7	3.0	2.9	1.9	1.7	0.1	0.1
77					0.4	1.6	4.5	3.1	2.0	0.7	0.1	
78					0.4	1.9	2.8	3.6	1.7	0.6		
79					0.1	1.4	1.7	1.7	1.2	0.7		
80					0.06	0.9	1.0	1.3	1.6	1.0		
81						0.8	1.3	1.2	1.6	0.3		
82						0.6	1.6	1.5	1.6	0.5		
83						0.4	1.4	1.3	1.4	0.4		
84						0.4	1.4	1.5	0.4	0.3		
85						0.5	1.0	1.4	0.07	0.1		
86						0.3	0.4	0.4				
87						0.2	0.06	0.5				
88						0.5	0.06	0.03				
89						0.03	0.00					
90							0.03					

TABLE 19. Average number of hours per day with temperature between value stated and 0.9° above in actual months whose mean temperature was near the 1891-1947 averages.

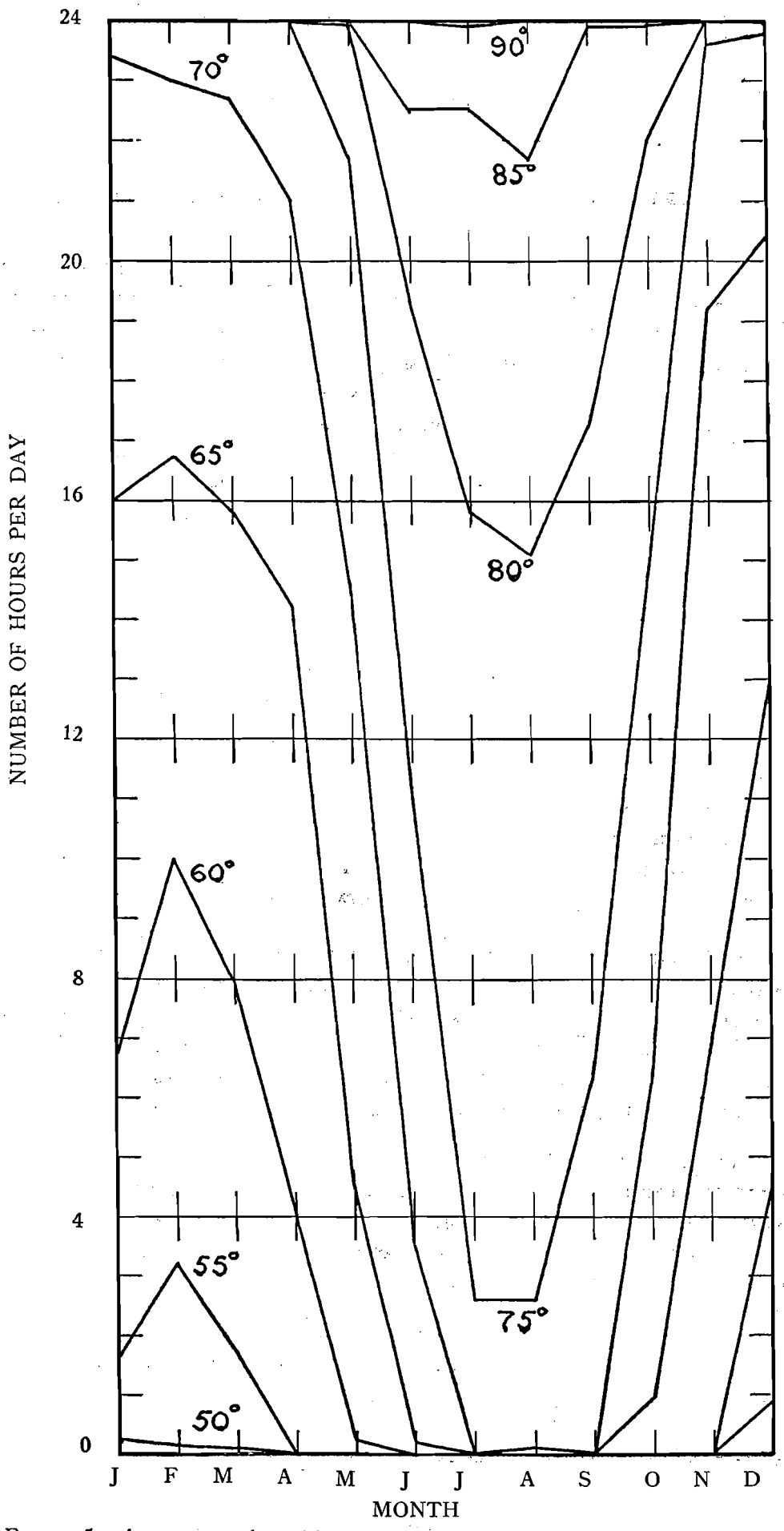

FIGURE 5. Average number of hours per day in each month with temperature below values stated.

Figure 5 is based on Table 19 and gives the number of hours per day with temperature below 50°, 55°, 60°, 60° etc.

The curves show temperatures below 50° only in January, February and March and then for only fifteen minutes or less per day. At the other extreme, temperatures over 90° are shown only in July and for some two minutes a day only. There were actually only two days in January with temperature below 50° and one day in July with temperature over 90°.

Temperatures below 55° are shown only from December to March with a maximum of 3 hours per day in February, below 60° from December to May with a 10 hour maxiumm in February, and below 65° from October to June with almost 17 hours below in February.

The 70° curve touches zero from July to September when temperatures below 70° are very rare while from January to March the temperature is below 70° for approximately 23 hours per day. Temperatures below 75° are shown every day from a minimum duration of 2½ hours in July and August to a maximum of 24 hours per day from January to April, and over 23½ hours per day in November and December.

A temperature of 80° first occurs for brief periods in May and the duration increases to 8 hours per day in July, and 9 hours in August, thereafter decreasing to 2 hours in October and nil in November. June, July and August show 1½ to 2 hours per day with 85° and above and this temperature is also shown for a few minutes in September and October.

Considering the two extremes of the year we see that on an average day in February, the coldest month, there are 14 hours between 55° and 65°, 3 hours below 55° and 7 hours above 65°.

In August the hottest month, the average day has 12½ hours between 75° and 80°, 2½ hours below 75° and 9 hours above 80°.

22. AVERAGES FOR INDIVIDUAL CALENDAR DAYS

The 57-year averages of daily maximum and daily minimum have been worked out for each calendar day of the year and together with the mean temperature for each day computed from these figures are given in tables 20, 21 and 22. Tables 23 and 24 give respectively the absolute maximum and absolute minimum recorded on each calendar day. These five sets of data are also plotted out on figure 6.

Date	Jan.	Feb.	Mar	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov	Dec.
1	63.6	61.6	61.9	64.2	67.1	72.0	77.3	80.3	79.3	76.4	71.0	66.5
2	63.6	61.2	61.9	64.1	67.4	72.6	77.5	80.2	79.5	75.8	70.8	65.9
3	63.8	61.3	61.9	64.3	67.4	72.7	77.7	80.0	79.3	75.5	71.2	65.9
4	63.8	61.9	61.5	63.3	67.6	73.1	77.9	80.2	79.1	75.6	70.7	66.6
5	63.0	61.7	61.7	63.0	68.0	73.2	77.9	80.3	79.2	75.7	70.6	66.5
6	63.0	61.3	61.9	63.8	68.2	73.3	77.9	80.2	79.2	75.7	69.7	66.2
7	62.5	62.3	62.5	63.8	68.5	73.6	77.9	79.9	79.3	75.7	69.7	65.8
8	63.2	62.2	62.8	65.1	68.4	73.9	78.2	80.2	79.0	75.2	69.6	66.0
9	63.4	61.8	62.7	65.2	68.9	74.4	78.4	80.0	78.8	75.5	70.2	65.9
10	63.2	61.9	62.2	64.8	68.9	74.3	78.5	80.2	78.8	75.1	69.9	65.8
11	63.3	62.2	62.2	64.5	68.9	74.2	78.6	80.4	78.4	75.1	69.4	65.4
12	63.6	61.8	62.6	64.4	68.7	74.7	79.1	80.5	78.5	75.0	69.3	64.7
13	63.9	61.1	62.8	64.7	69.1	74.6	79.0	80.3	78.8	75.1	69.2	65.3
14	63.5	61.8	63.2	64.9	69.3	75.0	79.2	80.1	78.8	74.6	68.8	65.4
15	62.5	61.7	63.3	64.9	70.1	75.0	79.1	80.3	78.5	74.3	68.6	64.9
16	62.7	62.1	63.5	65.5	70.0	75.2	79.2	80.0	78.5	73.9	68.5	64.9
17	62.6	61.8	63.0	65.5	70.4	75.6	79.1	79.9	78.0	73.5	68.2	64.7
18	63.3	62.1	63.0	65.6	70.2	75.3	79.2	80.1	78.0	73.6	68.1	64.9
19	63.2	61.7	63.1	65.8	70.5	75.3	79.3	80.0	78.0	73.3	68.3	64.8
20	62.7	61.6	64.1	66.0	70.9	75.8	79.6	79.7	77.9	73.3	67.9	64.5
21	63.1	61.7	64.4	65.6	70.9	75.7	79.3	79.7	77.7	73.1	67.7	64.3
22	63.0	61.9	63.6	65.6	70.9	76.5	79.8	79.9	77.4	72.8	67.6	63.9
23	63.2	62.0	62.7	65.9	70.7	76.3	79.6	79.9	77.7	72.7	67.5	64.0
24	62.9	61.8	63.0	65.9	71.1	76.5	79.8	79.8	77.5	72.7	67.9	64.1
25	62.9	61.7	63.5	65.6	70.9	76.8	79.5	79.6	77.4	72.6	67.5	64.0
26	63.0	61.5	63.4	65.9	71.3	76.7	79.7	79.8	77.3	72.3	66.7	64.0
27	62.8	61.5	63.6	66.4	71.8	77.1	79.8	79.6	76.9	72.2	66.6	63.5
28	62.5	61.5	63.9	66.5	71.7	77.1	79.8	79.3	76.9	72.0	66.5	63.7
29	62.3	— –	63.1	66.6	71.8	77.2	79.8	79.8	76.8	72.3	66.6	63.9
30	62.0	— –	63.8	67.1	71.8	77.2	80.1	79.4	76.7	72.0	66.9	63.7
31	62.3	— –	64.1	— –	72.0	— –	80.5	79.4	— –	71.3	— –	63.4

TABLE 20. Daily Mean Temperatures on Calendar Days. 1891-1947

Date	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	68.9	66.5	67.1	69.6	72.6	77.3	82.7	86.1	85.2	81.8	75.8	71.3
2	68.8	66.4	67.5	69.3	72.6	77.9	82.9	86.1	85.3	81.1	75.7	70.5
3	68.9	66.7	67.2	69.5	72.7	78.2	83.0	85.9	85.0	80.6	76.0	70.7
4	68.7	66.9	66.9	68.6	72.8	78.6	83.2	85.9	84.8	80.9	75.7	71.7
5	67.7	66.5	67.1	68.4	73.2	78.5	83.4	86.4	84.9	81.0	75.5	71.5
6	68.0	66.4	67.2	69.2	73.3	78.7	83.6	86.3	84.9	81.0	74.6	70.8
7	67.3	67.6	67.7	69.2	73.8	78.9	83.4	85.9	84.9	80.7	74.2	70.6
8	68.3	67.4	68.3	70.5	73.6	79.4	83.8	86.1	84.4	80.5	74.5	70.9
9	68.5	66.8	68.0	70.7	73.9	79.8	84.2	85.9	84.4	80.5	75.3	70.5
10	68.6	67.1	67.2	70.1	74.0	79.4	84.2	86.2	84.5	79.9	74.7	70.5
11	68.0	67.5	67.4	69.8	74.1	79.4	84.3	86.2	84.2	80.0	74.1	70.4
12	68.5	66.9	67.9	69.7	74.2	79.9	84.9	86.2	84.0	80.1	74.3	69.4
13	68.7	66.6	67.9	70.2	74.7	80.0	84.8	86.3	84.4	80.3	74.1	70.4
14	68.4	67.2	68.9	70.4	74.9	80.1	84.9	85.9	84.4	79.6	73.7	70.5
15	67.4	67.0	68.4	70.6	75.6	80.3	84.6	86.3	84.0	79.5	73.3	69.8
16	67.9	67.3	68.6	70.8	75.6	80.7	84.9	86.0	83.9	78.7	73.3	69.7
17	67.8	66.8	68.4	70.8	76.1	80.9	85.0	85.9	83.5	78.4	72.9	69.4
18	68.0	67.4	68.2	71.1	75.8	80.3	85.0	86.2	83.6	78.4	72.9	69.5
19	68.2	66.8	68.6	71.2	76.1	80.5	84.9	86.0	83.6	78.2	73.4	69.3
20	67.8	66.7	70.0	71.5	76.4	80.9	85.1	85.5	83.5	78.3	72.5	69.3
21	68.1	67.0	69.5	71.0	76.2	81.0	85.0	85.5	83.1	77.9	72.4	68.9
22	68.4	67.4	68.7	70.9	76.1	81.8	85.5	85.3	83.1	77.5	72.4	68.7
23	68.1	67.1	68.0	71.3	76.0	81.6	85.5	85.5	83.1	77.6	72.5	68.8
24	67.7	67.0	68.7	71.2	76.5	81.8	85.6	85.3	82.9	77.6	72.5	69.1
25	67.9	66.7	68.7	71.2	76.2	82.2	85.5	85.2	82.8	77.5	72.1	69.2
26	68.2	67.3	68.8	71.8	76.6	82.3	85.7	85.6	82.6	77.4	71.5	68.9
27	68.0	66.9	69.1	71.9	76.9	82.3	85.5	85.1	82.4	77.1	71.5	68.6
28	67.5	66.8	69.4	71.8	77.1	82.3	85.6	84.9	82.5	77.2	71.4	68.7
29	67.4	— –	68.6	71.9	77.2	82.5	85.6	85.5	82.1	77.4	71.6	68.8
30	67.5	— –	69.0	72.7	77.2	82.8	85.8	85.3	82.2	76.8	71.6	68.3
31	67.2	— –	69.2	– —	77.1	— –	85.9	85.0	— –	75.8	— –	68.4

TABLE 21. Average Maximum on Calendar days, 1891-1947.

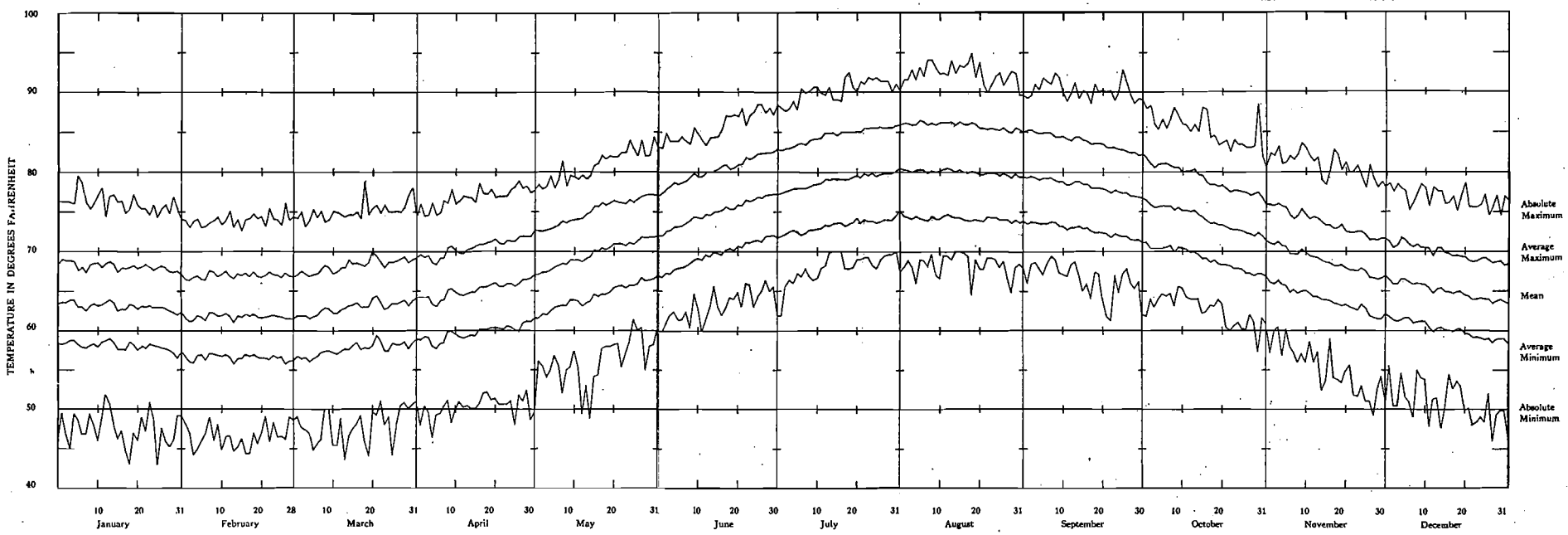

FIGURE 6. Average and extreme temperatures on each calendar day, 1891-1947.

Date	Jan.	Feb.	Mar	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	58.2	56.6	56.7	58.8	61.6	66.8	71.9	74.5	73.5	71.1	66.1	61.8
2	58.4	56.1	56.4	59.2	62.2	67.3	72.2	74.3	73.7	70.4	65.9	61.3
3	58.7	55.9	56.6	59.2	62.0	67.2	72.5	74.1	73.6	70.4	66.4	61.2
4	58.8	56.8	56.0	58.0	62.5	67.7	72.7	74.4	73.5	70.3	65.8	61.4
5	58.2	56.9	56.4	57.7	62.9	67.9	72.4	74.2	73.5	70.4	65.7	61.6
6	57.9	56.2	56.7	58.4	63.1	68.0	72.1	74.0	73.5	70.5	64.8	61.6
7	57.8	57.1	57.3	58.4	63.2	68.2	72.3	73.9	73.7	70.7	65.2	61.0
8	58.1	57.0	57.4	59.8	63.2	68.5	72.7	74.3	73.6	69.9	64.7	61.1
9	58.3	56.8	57.4	59.8	63.8	68.9	72.7	74.1	73.2	70.5	65.1	61.2
10	57.9	56.7	57.2	59.5	63.9	69.1	72.8	74.1	73.1	70.3	65.1	61.2
11	58.5	56.9	57.0	59.2	63.7	68.9	72.9	74.5	72.7	70.2	64.7	60.4
12	58.7	56.6	57.3	59.0	63.2	69.6	73.3	74.7	73.0	69.9	64.3	59.9
13	59.0	55.7	57.7	59.2	63.5	69.3	73.2	74.4	73.1	69.9	64.3	60.3
14	58.5	56.4	57.6	59.4	63.7	69.9	73.5	74.3	73.2	69.6	63.9	60.4
15	57.6	56.4	58.1	59.3	64.6	69.7	73.6	74.3	72.9	69.1	63.9	60.1
16	57.6	56.9	58.5	60.2	64.3	69.6	73.6	74.0	73.0	69.1	63.8	60.0
17	57.5	56.7	57.6	60.2	64.6	70.2	73.2	73.9	72.6	68.6	63.5	59.9
18	58.6	56.9	57.8	60.2	64.6	70.4	73.5	73.9	72.4	68.8	63.4	60.2
19	58.2	56.6	57.7	60.4	64.8	70.1	73.6	74.0	72.4	68.4	63.2	60.2
20	57.5	56.5	58.1	60.4	65.4	70.7	74.2	73.9	72.3	68.3	63.3	59.7
21	58.1	56.5	59.4	60.3	65.6	70.5	73.6	73.8	72.2	68.3	63.0	59.6
22	57.7	56.3	58.6	60.2	65.7	71.2	74.0	74.4	71.7	68.1	62.8	59.1
23	58.3	56.8	57.4	60.6	65.4	71.1	73.8	74.3	72.2	67.8	62.6	59.2
24	58.1	56.5	57.4	60.5	65.7	71.3	73.9	74.3	72.0	67.8	63.3	59.1
25	58.0	56.7	58.3	60.1	65.7	71.4	73.6	74.0	71.9	67.7	62.9	58.8
26	57.8	55.7	58.1	59.9	65.9	71.2	73.7	74.0	71.9	67.2	61.9	59.0
27	57.7	56.1	58.2	61.0	66.7	71.8	74.0	74.0	71.5	67.2	61.7	58.5
28	57.5	56.2	58.5	61.2	66.3	71.9	74.0	73.6	71.4	66.9	61.5	58.8
29	57.2	— –	57.6	61.2	66.4	72.0	73.9	74.0	71.5	67.2	61.5	59.0
30	56.5	— –	58.5	61.6	66.5	71.7	74.5	73.6	71.1	67.1	62.2	59.0
31	57.3	— –	58.9	— –	66.9	— –	75.2	73.8	— –	66.8	— –	58.4

TABLE 22. Average Minimum on Calendar days, 1891-1947.

Date	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	76.2	73.9	74.2	76.0	78.5	83.0	88.0	91.6	89.2	88.0	82.3	78.6
2	76.3	73.0	75.0	74.5	77.8	84.9	87.6	91.6	89.6	88.3	82.0	77.5
3	76.2	73.8	73.1	74.6	78.2	83.8	88.0	92.8	91.0	86.0	83.2	78.5
4	76.0	74.1	73.9	76.1	79.5	83.8	88.8	91.6	90.2	85.4	81.0	77.8
5	79.5	73.0	75.3	74.6	78.0	83.8	87.9	93.2	91.8	86.6	81.2	77.6
6	78.7	73.2	74.3	74.8	79.2	84.5	90.4	92.0	91.4	85.5	82.0	75.2
7	76.2	73.6	75.1	76.4	81.4	83.8	89.8	94.1	91.0	86.6	81.5	76.2
8	75.4	73.8	73.7	76.1	78.2	83.5	90.2	94.1	92.4	88.1	82.2	77.4
9	76.2	74.4	74.0	77.8	79.6	85.6	90.6	93.2	91.8	87.0	83.6	78.5
10	77.0	73.4	75.0	76.0	79.4	84.8	90.6	92.3	90.0	86.0	83.0	78.0
11	78.0	73.9	75.0	76.4	79.1	84.0	89.8	92.4	88.8	85.8	82.0	75.7
12	74.4	75.0	74.6	77.0	79.6	83.3	89.6	92.2	89.8	85.0	81.3	78.0
13	77.0	73.1	74.4	76.8	79.1	84.2	90.6	94.0	91.2	85.9	81.8	77.6
14	77.2	74.0	74.6	76.7	79.6	84.3	89.0	92.4	89.2	85.0	79.0	77.6
15	76.2	72.6	74.6	76.2	80.8	84.4	89.1	93.4	90.2	88.0	78.4	76.0
16	76.4	74.0	75.0	78.6	81.1	85.4	88.8	93.2	90.0	87.8	80.0	76.2
17	74.8	74.2	74.2	77.3	82.1	87.0	91.8	93.6	88.6	84.2	82.8	76.9
18	75.4	74.8	78.8	77.2	81.6	87.0	92.4	94.8	91.0	84.6	82.1	75.1
19	77.2	74.2	74.7	77.8	82.0	87.2	90.6	91.8	90.0	83.4	80.2	77.0
20	75.9	74.4	75.5	76.8	81.8	86.9	90.0	93.7	90.2	83.6	81.2	78.7
21	75.4	73.2	75.8	77.0	81.9	88.0	91.3	90.9	90.0	84.0	79.8	75.6
21	75.4	75.4	74.8	77.0	82.4	85.9	91.0	89.9	90.2	82.6	80.1	75.6
23	74.6	74.1	75.8	77.0	82.4	87.1	91.8	91.0	89.0	84.0	80.8	75.6
24	75.8	74.0	75.0	77.8	84.0	87.5	91.6	92.0	90.0	83.4	79.4	75.9
25	74.3	73.4	75.0	78.2	83.0	88.4	91.8	92.4	92.8	83.4	78.0	77.2
26	75.3	76.1	75.1	78.9	82.0	88.4	91.4	90.8	91.2	83.0	80.8	74.6
27	75.9	74.0	75.0	78.0	84.0	87.4	91.4	91.8	89.6	83.0	79.2	75.5
28	74.8	74.4	75.6	78.2	82.0	88.0	91.4	92.7	88.6	83.2	78.0	77.0
29	76.8	— –	77.1	77.4	82.1	87.2	90.0	92.4	89.2	88.4	78.7	74.0
30	75.4	— –	78.0	77.7	84.4	88.4	91.0	89.6	89.0	82.0	78.1	77.0
31	74.1	— –	74.2	— –	83.2	— –	90.2	89.6	— –	80.6	— –	76.4

TABLE 23. Absolute Maxima on Calendar days. 1891-1947

Date	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	49.4	48.1	49.0	48.0	56.2	59.8	61.8	68.0	66.0	61.8	57.2	55.6
2	46.6	47.0	47.6	50.4	55.5	61.0	65.6	68.8	68.4	64.0	60.0	50.4
3	45.0	44.2	47.4	49.5	54.0	62.0	66.4	68.0	68.6	63.0	60.4	50.4
4	49.4	45.0	47.0	46.4	55.0	62.4	66.0	66.0	67.8	64.0	56.8	54.6
5	48.6	46.0	44.8	49.2	56.8	61.4	67.2	69.0	67.0	64.6	60.2	51.6
6	46.8	47.0	45.6	49.4	55.6	61.4	66.8	68.8	68.6	64.4	58.0	51.0
7	46.8	49.0	46.2	50.3	52.0	62.4	67.8	68.0	69.4	64.6	57.2	49.0
8	49.4	46.0	50.0	51.0	55.0	60.4	66.8	69.6	69.0	63.0	56.0	55.0
9	47.8	48.0	50.0	48.2	55.4	64.6	66.4	67.0	67.2	65.6	57.0	54.0
10	46.0	44.8	45.4	49.8	57.4	63.0	66.6	66.6	67.0	65.4	56.0	53.8
11	48.8	46.5	45.4	51.0	55.2	60.0	67.8	69.6	66.8	64.2	58.6	47.8
12	51.8	46.6	48.8	50.2	49.4	61.4	68.2	69.4	68.4	64.0	56.0	51.2
13	50.6	44.6	43.6	50.4	53.0	63.0	69.8	69.0	68.6	64.0	57.2	51.4
14	48.0	45.2	46.6	50.0	48.8	65.6	70.0	70.0	67.0	64.0	52.4	47.6
15	46.2	46.3	47.6	50.0	54.2	63.0	70.0	70.0	65.0	62.2	53.6	50.2
16	47.2	44.4	48.2	50.6	54.4	62.0	70.0	69.8	66.0	62.4	58.4	54.4
17	44.8	44.4	49.2	52.0	57.8	63.0	67.8	69.4	64.0	63.2	54.0	52.6
18	43.0	47.0	46.0	52.2	58.0	64.2	67.8	64.5	67.4	63.1	53.8	53.5
19	47.0	45.6	44.0	51.2	58.0	64.0	68.0	69.0	67.2	64.0	53.4	53.0
20	46.0	47.0	49.6	51.4	58.2	64.8	69.0	67.8	64.0	63.4	54.8	49.8
21	49.0	49.1	49.2	50.6	58.4	63.0	69.0	67.8	61.8	60.4	55.6	50.2
22	47.4	45.8	51.0	50.6	55.4	66.0	69.2	69.2	61.2	60.0	51.8	48.0
23	50.8	48.3	48.0	50.6	57.0	65.8	69.2	69.2	67.0	60.6	51.6	48.4
24	48.8	46.5	49.0	51.0	58.6	63.0	68.2	69.0	64.8	61.0	53.0	49.0
25	43.0	46.6	44.2	48.0	61.4	64.2	67.8	68.0	67.2	60.2	51.0	48.4
26	47.6	46.2	48.0	51.8	60.0	65.0	68.9	68.8	67.8	60.2	51.0	52.0
27	46.0	49.0	50.4	51.0	60.4	66.4	69.4	66.5	66.0	62.0	49.2	46.0
28	45.2	48.6	50.8	52.4	55.0	65.0	69.6	64.8	65.4	61.0	52.6	49.2
29	46.1	— –	50.0	48.6	58.0	65.6	69.6	68.0	66.2	57.2	54.2	49.8
30	49.2	— –	50.6	49.6	58.2	61.8	70.0	68.4	62.0	61.6	51.0	49.8
31	49.1	— –	51.0	— –	60.0	— –	67.4	67.8	— –	60.6	— –	46.4

TABLE 24. Absolute Minima on Calendar days. 1891-1947

It is seen that there are considerable variations from day to day especially in the extreme maximum and the extreme minimum. The average values also show irregular day to day variations which are, however, much smaller than the variations in the absolute extremes. The variations in average maximum and average minimum are, with few exceptions, of the same sign and magnitude so that the three central curves of figure 6 are nearly identical in form.

Considering now the daily mean temperatures it is seen that the lowest value of 61.1° is recorded on the 13th February but throughout this month every day has a mean temperature between this minimum and 62.3°. The mean temperature begins to rise early in March reaching 65° on the 8th April, 70° on the 15th May, 75° on the 14th July, and 80° on the 30th July. The temperature remains very near 80° until the 24th August, after which it commences to fall, slowly at first but with increasing rapidity until a mean of 75° is reached on the 12th October, 70° on the 6th November, and 65° on the 12th December.

The average maximum temperature lies between 65° and 70° from the 15th December to the 7th April, over 80° from tke 13th June to the 13th October and over 85° from the 22nd July to the 26th August.

The average minimum lies between 55° and 60° from the 20th December to the 15th April and from 70° to 75° from the 17th June to the 7th October.

Maximum temperatures above 80° have occurred from May 7th to November 26th and above 90° from July 6th to September 26th.

Minimum temperatures below 50° have occurred from November 27th to May 14th and below 45° from 18th January to 25th March.

It will be noted that day to day changes in the average values are much more marked in the winter months than in the summer. There is a sharp change from winter type to summer type about the 12th April. The change back from summer type to winter type in the autumn is not so definitely marked but can be placed about the 22nd November, although there are some marked irregularities in the curve prior to this.

The irregularities in day to day average values are sufficiently marked in some cases to raise the question of warm or cold spells. Low values appear for instance about 5th to 7th January, 4th to 5th April, and 6th to 8th November and high values about March 7th to 9th and 19th to 21st, and April 8th and 9th.

In none of these cases does the value differ from the smooth curve by more than one degree. In view of the comparative shortness of the record, it is therefore by no means certain that these apparent oscillations are real but the question is being studied further.

23. INTERDIURNAL VARIATION OF TEMPERATURE

The equability or otherwise of a climate is an important consideration and this is shown by the day to day variation of temperature. Tables 25, 26 and 27 give the values of this interdiurnal variation at Fort George in the 15 years, 1933-1947.

The first three columns of Table 25 give the average day to day variation in each month of Daily Mean, Daily Maximum and Daily Minimum. The values for Daily Maximum and Minimum have been calculated directly from their respective daily values and those for Daily Mean as the average of the results for Maximum and Minimum.

It is seen that both Maximum and Minimum show their greatest variation of 3.6° and 3.1° respectively in February and smallest of 1.4° in June and July. The values from May to September are from 1.4° to 1.8° with rapid changes through Spring and Autumn to the Winter extremes.

The variation in Daily Maximum exceeds that in Daily Minimum by .5° or .6°, from October to February and by .2° in March. In April the Minimum shows .1° greater variation than the Maximum but the Maximum shows greater variation again in May and June by .2°. In July, August and September the Minimum shows greater variation than the Maximum by .4°, .1° and .2° respectively.

Each of the Winter months has normally occasions with over 9° day to day variation in Maximum and in Minimum while in the most equable months of June and July there are normally occasions with varia-

tions of approximately 5°. The greatest variations in the period have been 16.3° in Maximum in February and 17.5° in Minimum in March. The variation in Maximum has not been greater than 8.8° in July but each month from November to April has had over 11°. June has not had more than 6.9° variation in Minimum but January to April have each had at least 13°.

Tables 26 and 27 show the frequency of occurrence of different day to day changes in Maximum and Minimum. Changes less than 2° are not noticeable by the average person while even up to 4° is small and causes very little comment. Changes above 8° are large and such as make the normal person put on or take off clothing to compensate.

In February, the most variable month, the change from previous day is less than 4° on 69% of all days, that is 20 days per month in the case of the minimum, and on 61%, or 17 days per month in the case of the Maximum. Changes of 8° and above occur on 7 and 8% of days respectively or approximately 2 days per month each.

At the other extreme from May to September changes of more than 4° occur on less than 3 days per month and 8° or above no more often than once in 3 years.

In July, August and September changes above 4° are slightly more frequent in Minimum than in Maximum but in all other months the larger changes are more common with the Maximum. The difference is negligible in March and April but from October to February there are 7 to 8% more days with a change in Maximum above 4° than days with this change in Minimum.

	Average			Average Monthly Greatest		Absolute Greatest Monthly	
	Daily Mean	Daily Max.	Daily Min.	Daily Max.	Daily Min.	Daily Max.	Daily Min.
January	2.9	3.1	2.6	9.6	9.0	12.0	13.0
February	3.3	3.6	3.1	10.7	10.1	16.3	14.4
March	2.7	2.8	2.6	9.0	9.1	12.6	17.5
April	2.4	2.3	2.4	7.4	8.2	11.2	13.7
May	1.7	1.8	1.6	6.7	5.8	9.5	8.5
June	1.5	1.6	1.4	6.4	4.7	9.2	6.9
July	1.6	1.4	1.8	5.1	6.0	8.8	9.1
August	1.6	1.6	1.7	6.6	6.0	11.0	9.7
September	1.6	1.5	1.7	6.7	5.6	10.9	9.3
October	2.1	2.4	1.8	7.8	6.1	10.9	10.3
November	2.3	2.6	2.0	8.8	6.1	11.7	8.2
December	2.7	3.0	2.4	9.1	8.2	13.2	12.1
Year	2.2	2.3	2.1	12.1	12.2	16.3	17.5

TABLE 25. Interdiurnal Variation of Temperature.

Limits of Variation Degrees	0.0 1.9	2.0 3.9	4.0 5.9	6.0 7.9	8.0 9.9	10.0 11.9	12.0 13.9	14.0 15.9	16.0 17.9
January	41	29	14	9.0	4.4	1.9	0.2	—	—
February	36	25	21	10	5.7	1.8	0.2	0.2	0.2
March	44	32	17	4.2	2.1	0.8	0.6	—	—
April	52	28	15	3.2	1.5	0.2	—	—	—
May	64	26	7.9	2.3	0.6	—	—	—	—
June	69	23	4.7	2.6	0.6	—	—	—	—
July	74	19	5.8	0.6	0.2	—	—	—	—
August	73	20	5.0	1.3	0.6	0.2	—	—	—
September	70	22	4.5	3.2	0.4	—	—	—	—
October	51	31	12	4.0	1.7	0.2	—	—	—
November	45	35	12	4.3	1.7	0.9	0.2	—	—
December	41	28	18	10	2.1	0.4	0.6	—	—
Year	55	27	11	4.6	1.8	0.5	0.1	.02	.02

TABLE 26. Percentage of days with Interdiurnal Variation of Maximum Temperature between different limits.

Limits of Variation Degrees	0.0 1.9	2.0 3.9	4.0 5.9	6.0 7.9	8.0 9.9	10.0 11.9	12.0 13.9	14.0 15.9	16.0 17.9
January	47	30	13	5.8	3.2	0.6	0.4	—	—
February	40	29	15	8.7	4.8	1.4	0.2	0.2	—
March	47	30	15	6.2	1.6	0.6	0.2	0.0	0.2
April	52	29	11	5.2	1.7	0.7	0.4	—	—
May	69	23	5.7	1.4	0.4	—	—	—	—
June	70	25	4.5	0.2	—	—	—	—	—
July	63	24	11	1.3	0.6	—	—	—	—
August	66	24	7.5	1.5	0.6	—	—	—	—
September	64	27	71.	1.3	0.4	—	—	—	—
October	63	26	8.4	1.7	0.2	0.2	—	—	—
November	56	32	9.7	2.2	0.2	—	—	—	—
December	51	30	13	4.4	1.3	0.2	0.4	—	—
Year	57	28	10	3.3	1.3	0.3	0.1	.02	.02

TABLE 27. Percentage of occasions with Interdiurnal Variation of Minimum Temperature between different limits.

24. SECULAR VARIATION OF TEMPERATURE

Figure 7 shows the departure from the 1891-1947 annual averages of the average daily maximum, mean and minimum in each year.

The mean temperatures in the earliest three years were below average but then for fifteen years until 1908 the means remained very near the average. For nine years from 1908 means were markedly below average with lowest values of 1.6° below in 1915 and 1916. The following period up to 1928 has values close to average with lower values in the earlier years. In 1928 there is a sudden increase and with the sole exception of 1940 all succeeding years have been above average with the highest values of 1.6° above in 1937 and 1938.

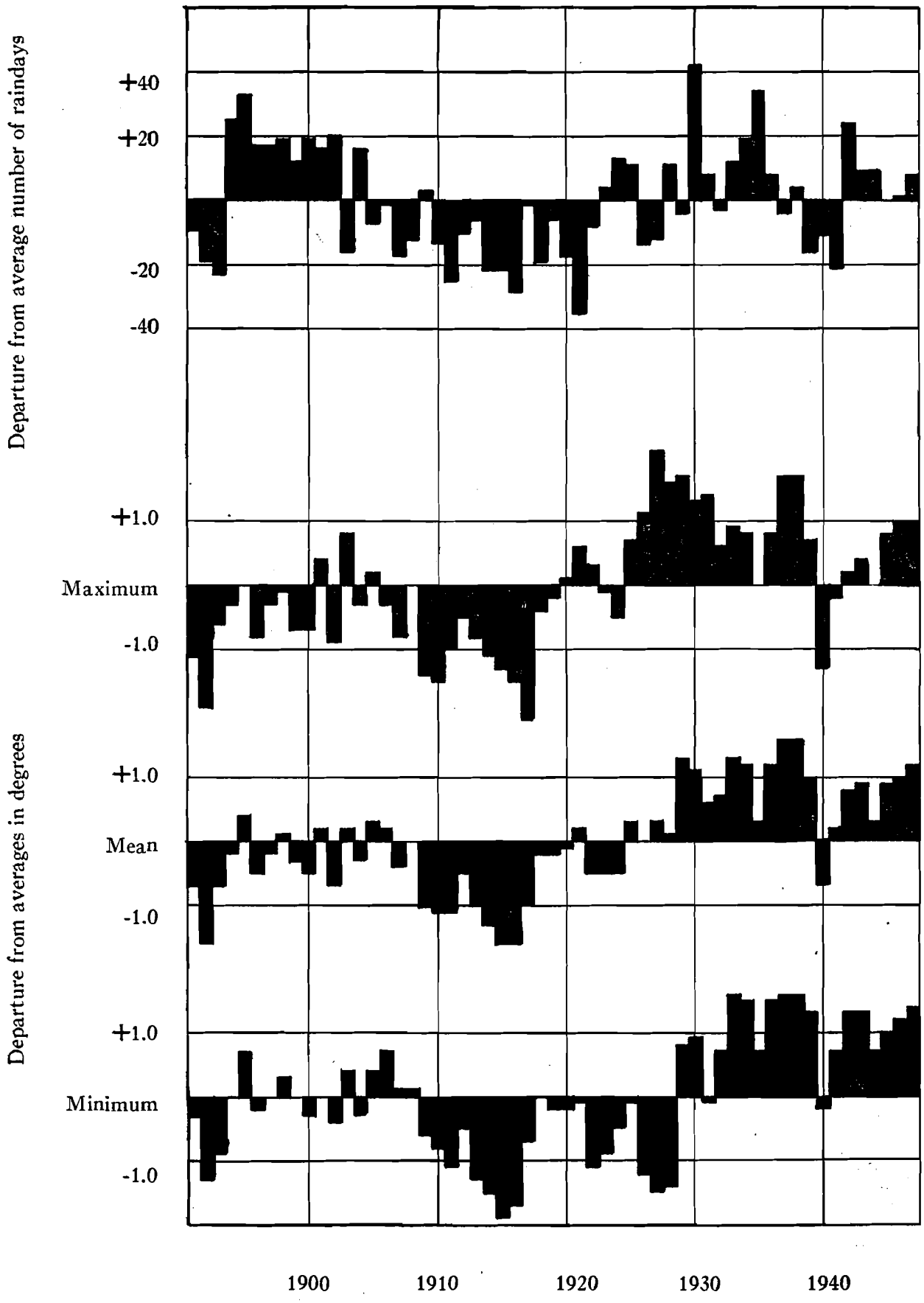

FIGURE 7. Departure from 1891-1947 averages of annual average daily maximumn mean and minimum, and annual total of rain days in each year 1891 to, 1947.

The means given are determined as average of daily maximum and daily minimum and the diagrams of these two show that with minor exceptions the departures of the average daily maximum and the average daily minimum agreed fairly well in phase and amplitude up to 1920 which period included the coldest years. The lowest minimum was 1915 and the lowest maximum 1917. From 1921 to 1924 the departures of maximum were small and irregular but from 1925 onwards all years except 1940 and 1941 had values of maximum above average. The minimum, however, did not exceed average in any year after 1908 until 1929. It was near average in 1918 to 1921 but then decreased again in the same years in which the maximum was increasing until in 1927 the maximum had its largest positive departure of 2.1° and the minimum a large negative departure of 1.5°. Because of this 1927 was, as shown in Table 10 a year in which many absolute extremes of range were recorded.

Since 1929 the average minimum has been above average except in 1931 and 1940 when it was only 0.1° and 0.2° respectively below, this being much smaller than the -1.3° departure of the maximum in 1940.

In view of the known changes of site in 1927 and 1932 it must be considered whether the increase in both maximum and minimum during the 1920 and 1930 decade was merely the differences between the sites. As is shown elsewhere there is no adequate simultaneous comparison of the sites.

The increase in both maximum and minimum were, however, clearly established before 1932 when Fort George was opened, so this site change cannot be responsible. There is perhaps more doubt about the 1927 change but the increase in maximum was apparent in 1925 and that in the minimum not until 1929 so it is unlikely that this site change is responsible either.

In order to check on the reality of the temperature change other climate elements were examined for a change in the 1920 to 1930 decade. The number of raindays is the element least likely to be affected by these changes of site within Bermuda and the top curve in Figure 7 shows the departures each year from the mean number of rain days. There is a general similarity between this curve and those of temperature with a smaller than average number of annual raindays from 1905 to 1921 and more than average thereafter, except for a reduction in 1939 to 1941 corresponding to the temperature reduction and another in 1926 to 1927 in the years when minimum temperature reached a low level.

This curve may therefore be considered as support for the reality of the temperature change from below normal values in 1909 to 1918 through a transition period 1919 to 1928 to above normal values in 1928 to 1938 followed by average conditions again about 1940 and increasing values since.

In order to see if this variation of annual temperature has been primarily due to an oscillation in some seasons of the year with little change in the other seasons, figure 8 gives the departures over the period for each season of the year, each taken as a 3 month period with winter from January to March.

The diagrams show that over the whole period each season showed the same general trend as the annual values. However, in some years there were appreciable differences in the departures from season to season and a high or low annual value was mainly due to a corresponding change in only one or two seasons of the year.

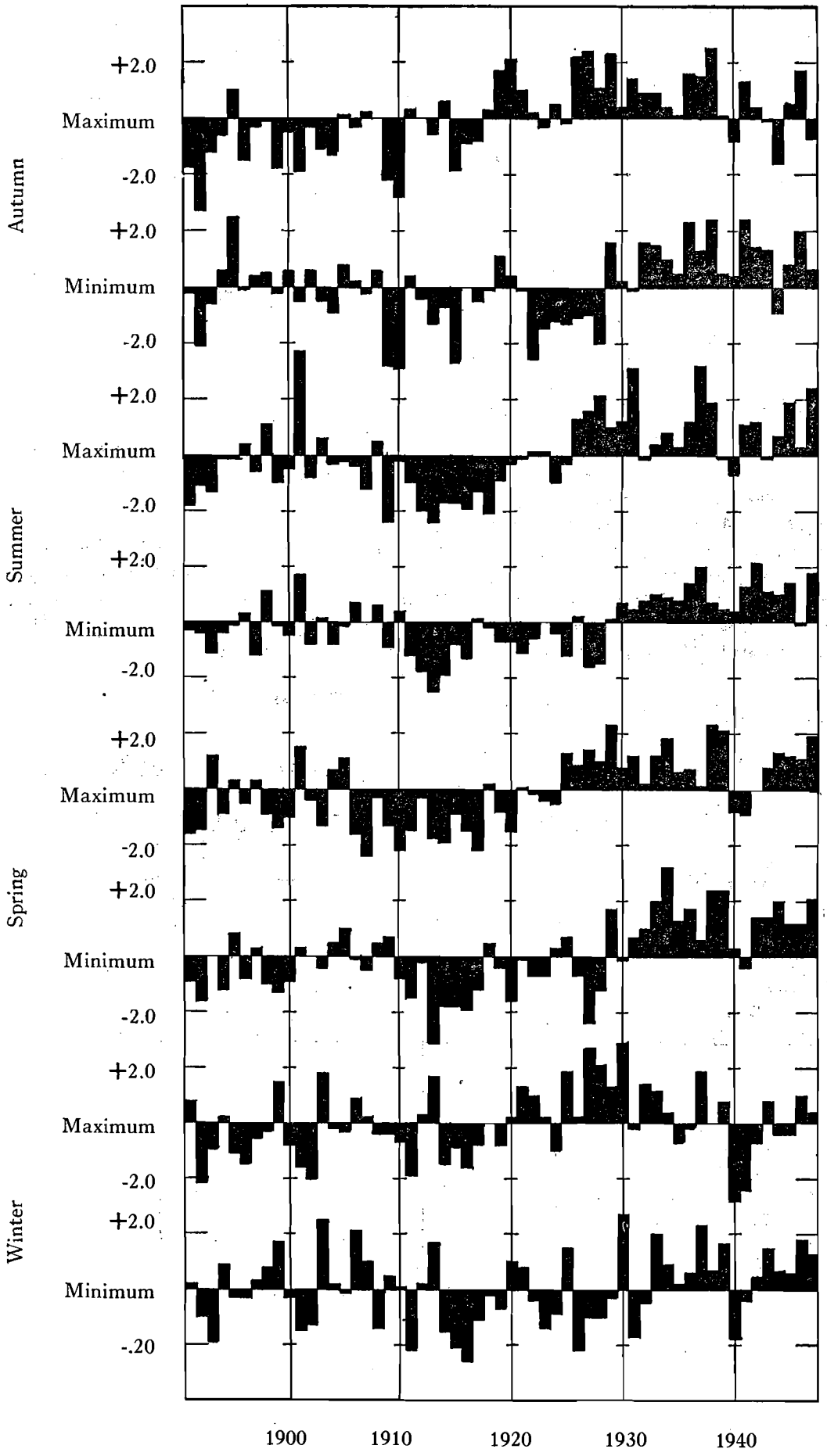

FIGURE 8. Departure from 1891-1947 seasonal averages of average daily maximum and minimum in each season from 1891-1947.

Thus the low annual values in the first 3 years of our records were chiefly due to low values in summer and autumn in these three years with both the other two seasons also low in 1892. The low annual values of both maximum and minimum from 1909 to 1917 were mainly due in 1909 and 1910 to exceptionally low values in the Autumn, while from 1911 to 1917 they were occasioned primarily by consistently low Spring and Summer values, although below average values occurred also in Autumn and Winter in most of these years. The years 1919 and 1920 were marked by above average temperatures in Autumn, the maximum being noticeably above, while Spring and Summer were below average. The low annual minima from 1922 to 1928 were primarily due to consistently low values in Autumn although sub-average values occurred in many of the other seasons.

The high maxima of 1925 to 1930 are well marked in all seasons. From 1933 to 1939 the minimum was appreciably above average in each season every year. Maxima were also above average in most of these years with a peak in or near 1938. 1940 had below average maxima in all seasons the winter being particularly cold with 2.8° below average. This was surpassed only once during the whole 57 years, in the Autumn of 1892 when the maximum were 3.3° below average.

The largest positive departure of minimum in any season occurred in Spring 1934 which was 3.2° warmer than the average while the largest negative departure was 3.1° in Spring 1912.

The largest positive departure of maximum was 3.7° in summer 1901 and as already stated the largest negative departure was 3.3° in Autumn 1892.

Considering the whole period it appears that variations in annual temperatures are not due to departures from average in any particular one of the four seasons more than the others although there is an indication that low annual values are in most cases accompanied by low values in autumn.

25. COMPARISON OF OBSERVATIONS AT PROSPECT AND FORT GEORGE

Table 28 gives a summary of the comparisons made between the site in use at Prospect in the early part of 1932 and the present site at Fort George after the latter became the official observatory.

			MEAN DAILY	
	8 a.m.	8 p.m.	Max.	Min..
January	- .5	-1.0	—	—
February	- .7	-1.5	—	—
March	.4	-1.7	—	—
April	- .1	-1.5	—	1.3
May	-1.3	- .6	—	.8
June	- .1	-2.5	—	—
July	- .1	-1.4	—	—
August	.6	-1.1	1.8	—
September	.1	-1.5	.9	—
October	- .1	-1.6	—	—
November	- .1	-1.3	—	—
December	-1.1	-1.4	—	—
Average	-.3	-1.4	1.0	1.1

TABLE 28. Comparison of Prospect and Fort George, 1932-3. Figures give average differences Prospect Minus Fort George.

It will be seen that the comparison was unfortunately not of very long duration consisting of two months during which minimum thermometers were read at Prospect followed by twelve months with readings at 8 a.m. and 8 p.m. during which, for two months only, readings of maximum thermometers were taken in addition. The readings at fixed hours 8 a.m. and 8 p.m. both give higher readings at Fort George than at Prospect. The average differences being 0.3° at 8 a.m. and 1.4° at 8 p.m. The maximum and minimum readings, however, in the two months available, were higher at Prospect by 1.0° and 1.1° respectively.

These four sets of readings are not consistent and while they indicate that the average difference is probably less than 1° they cannot be taken to indicate that either site is the warmer. It is felt therefore that the comparison was too short, especially as to the extreme thermometers, and that no correction factor between the sites can be reliably based on the figures.

Further the comparison was made between Fort George and the hospital site which had been in use for only five years and there is no comparison with the earlier site at Observatory Cottage which was in use from 1891 to 1927.

In the absence of reliable comparisons therefore and as the three sites were, so far as can be judged, not dissimilar the long period averages given elsewhere have been computed directly from the recorded figures at each station.

26. COMPARISONS OF OBSERVATIONS AT BELMONT AND FORT GEORGE

Observations were made at Belmont for a complete three year period from 1941 to 1944 and the readings are comparable with the simultaneous readings at Fort George. The instruments were exposed on an area adjacent to the entrance drive of Belmont Hotel, the Meteorological Office being accommodated in a cottage belonging to the hotel. The site had a slight slope to the west and the instruments were below the crest of the ridge and reasonably free from obstruction. Table 29 give average differences between Belmont and Fort George over the three years.

				Average Daily			Monthly	
	8 a.m.	2 p.m.	8 p.m.	Max.	Min.	Mean	Max.	Min.
January	-.4	.5	0.0	.4	-1.7	- .7	.2	-4.3
February	-.3	0.0	.1	0.0	-1.0	- .5	.5	-3.8
March	.1	-.4	.4	-.4	- .8	- .6	-1.6	-2.0
April	-.1	-.7	0.0	-.8	-1.8	-1.3	- .3	-4.5
May	-.4	-1.1	.4	-.9	-1.4	-1.1	- .2	-4.0
June	0.0	-.4	.3	-.3	-1.0	- .7	.4	-2.6
July	.1	-.3	.5	-.6	- .4	- .5	-1.3	-3.0
August	.2	-.4	.2	0.0	-1.0	- .5	.2	-3.9
September	0.0	-.3	.1	-.4	-1.1	- .7	.3	-1.4
October	-.1	-.2	.1	-.2	- .8	- .5	- .8	-6.6
November	-.8	0.0	-.1	.1	-1.7	- .8	- .6	-6.5
December	-.4	.5	-.3	.4	-1.8	- .7	- .5	-4.4
Average	-.2	-.2	.2	-.2	-1.2	- .7	- .3	-3.9

Table 29. Comparison of Fort George and Belmont Observations September, 1941 to August, 1944. Figures give difference of Belmont readings from corresponding Fort George Observations in the same months.

It is seen that there is little regular difference in the average at fixed hours or in the maximum reading. In each of these four cases the differences were sometimes positive and sometimes negative but on the average the 8 p.m. readings were .2° higher at Belmont while 8 a.m., 2 p.m. and maximum were each .2° lower. With these latter two the differences were more marked in May than in other months.

There are, however, appreciable differences in the minima, Belmont being the colder site in each month. The daily minimum averaged 1.2° lower at Belmont ranging from an average of .4° lower in July to 1.8° lower in April and December. The monthly minimum averaged 3.9° lower, with October and November showing monthly minima 6½° lower than at Belmont, and September the smallest difference of 1.4°.

The reason for this difference is that the Belmont site was actually in a valley, although near the top of the surrounding slope, while Fort George is on a side of an isolated hill. On occasions temperatures as much as 8° lower than at the Belmont site were observed with a sling thermometer lower down the valley no further than 50 yards from the instrument enclosure. The results of a series of readings of grass minimum made for some months on the lawn of a house near the bottom of the valley have already been described in section 15.

27. COMPARISONS OF OBSERVATIONS AT DARRELL'S ISLAND AND FORT GEORGE

The observations taken for 21 months at Darrell's Island make an interesting comparison between a small island in the Great Sound and a station on a hill in one of the main islands. The instrument enclosure on the island was 10 ft. above mean sea-level and from 30-50 ft. from the water edge except on the side where a narrow neck of land joined the site to the main part of Darrell's Island.

	Average Daily						Monthly		
	8 a.m.	2 p.m.	8 p.m.	Max.	Min.	Mean	Grass Min.	Max.	Min.
January	1.3	- .5	1.5	- .9	1.3	.2	1.4	- .9	3.4
February	1.1	- .7	1.3	-1.3	1.1	-.1	1.1	-2.1	1.1
March	.8	-1.7	1.5	-1.9	1.1	-.4	1.2	- .8	2.3
April	.5	-1.9	1.8	-1.9	1.9	0.0	2.0	-1.7	1.4
May	- .1	-1.9	1.7	-2.2	1.9	-.1	3.7	-3.1	1.9
June	.1	-1.7	1.6	-1.8	1.8	0.0	2.9	-3.2	.9
July	- .2	-2.6	1.6	-2.8	1.8	-.5	1.8	-3.7	2.2
August	.6	-2.5	1.7	-2.9	1.5	-.7	2.3	-3.4	2.0
September	.7	-2.6	2.3	-2.9	1.8	-.5	2.9	-4.3	1.5
October	1.1	-1.1	2.0	-1.6	1.5	-.1	1.6	-2.9	2.8
November	1.3	- .6	1.9	-1.3	1.3	0.0	.4	-1.5	1.5
December	1.1	- .1	1.3	- .7	1.5	.4	.9	-1.1	1.7
Average	.8	-1.4	1.7	-1.7	1.4	-.1	1.9	-2.2	1.9

Table 30. Comparison of Fort George and Darrell's Island Observations September, 1944 to May, 1946. Figures give differences of Darrell's Island readings from corresponding Fort George Observations in same months.

Table 30 gives a summary of the differences between the two sites. As is to be expected the maximum temperature is lower and the minimum higher at Darrell's Island but the mean temperature is almost the same. There is considerable seasonal variation in the difference in maximum. In December and January Fort George is only .7° and .9° respectively higher than Darrell's Island but in the three summer months July, August and September the difference increases to 2.8° and 2.9°. The daily minimum also shows a seasonal variation though this is much less marked. In February and March Darrell's Island minimum averages 1.0° higher than Fort George while in the four months from April to July the difference is 1.9° and 1.8°. The grass minimum averages almost 2° lower at Fort George, the difference ranging from less than 1° in November and December to 3.7° in May. The average daily mean is about one-half degree lower at Darrell's Island in July, August and September but in the other months this difference is smaller and irregular.

In the five months from May to September the monthly maximum is more than 3° higher at Fort George than at Darrell's Island, the average differences decrease to a minimum of about 1° in the winter although February shows a 2° difference. The monthly minimum averages almost 2° lower at Fort George than at Darrell's Island and no regular seasonal variation is shown in this difference.

The difference between the two sites is primarily a reduction in the daily range at Darrell's Island due to its proximity to the sea. The average daily range is 4.6°, 4.4° and 4.7° less in the three summer months July, August and September decreasing to 2.2° less in December and January.

This reduction in the daily oscillation produces the difference found in 8 a.m., 8 p.m. and 2 p.m. observations. At 8 a.m. there is very little difference between the sites in the early summer while in the winter Darrell's Island is rather more than 1° warmer. At 2 p.m. Darrell's Island is the colder in all months but the difference is small in the winter, only 0.1° in December, while in the three summer months it is 2.5° and 2.6° which is almost the same as the difference between the daily maxima. At 8 p.m. Darrell's Island is the warmer again in all months by an amount which varies from 1.3° in December and February to 2.3° in September.

28. SEA TEMPERATURES

Until the Station was set up at Darrell's Island no records of sea temperature had been kept by the Meteorological Office and consequently no long period records are available for analysis. Observations of sea temperature were begun in January, 1945 and continued for seventeen months until the station was closed. Although this was a very short period it enables us to make some interesting comparisons between the observed sea and air temperatures. Figure 9 gives the difference between the mean sea temperature in each month and the average daily maximum, mean, and minimum at both Fort George and Darrell's Island. The curves show the differences between Darrell's Island and Fort George which have been already discussed, namely that the maximum is higher and the minimum is lower at Fort George while there is little difference between the mean temperatures at the two sites.

In December and January the mean air temperature and the sea temperature are almost identical while the maximum air temperatures are from 3° to 4° higher. In February and March the sea begins to become warmer than the air and there is a marked change in April making the sea 3 degrees warmer than the mean air temperature. The

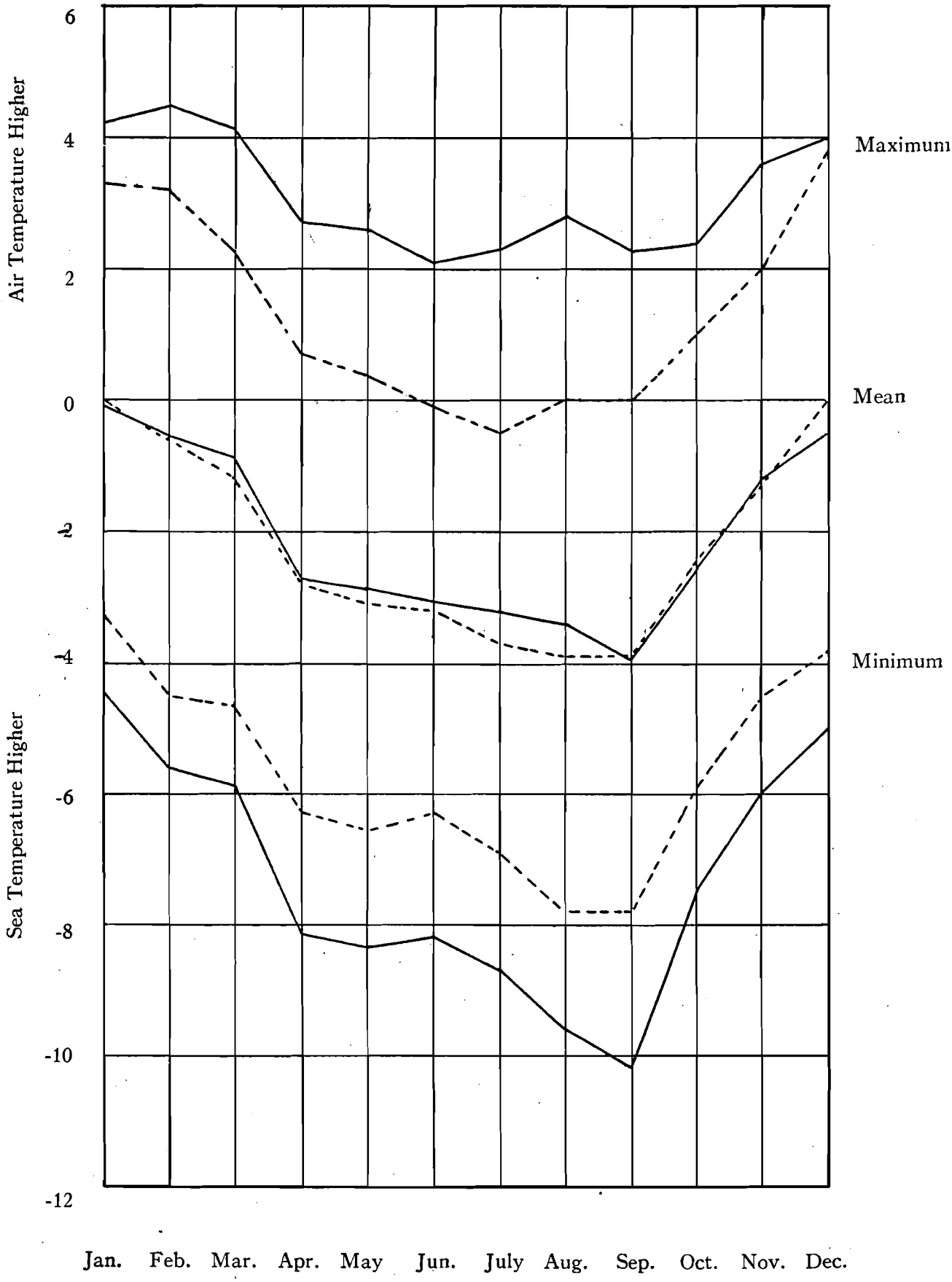

FIGURE 9. Difference from sea temperature of maximum, minimum and mean air temperatures at Fort George (solid lines) and Darrell's Island (broken lines). Monthly averages January, 1945 to May, 1946.

sea continues to warm more than the air throughout the summer until in September the sea is almost 4 degrees above the mean air temperature. After September the sea cools more rapidly than the air until the two are of the same temperature by the end of the year.

It is interesting to note that at Darrell's Island the daily maximum temperature which is 3.8° above the sea temperature in December becomes .5° less than the sea temperature in July but from May to September the air maximum at the island and the sea temperature follow each other closely and their monthly means agree within 0.5°.

In the actual daily observations the lowest values were measured during the first week in February, 1945 when for six days the sea temperature was below 60°, the lowest reading being 56°. At this same period the air temperature fell to 46° at both Fort George and Darrell's Island. During the summer sea temperatures of 87° were recorded on four days, when the maximum air temperature was 85° at Darrell's Island and 88° at Fort George.

The mean air temperature in 1945 and 1946 was slightly above the 1891-1947 average but there is no reason to assume that the differences between the air and sea temperature were greatly different from the usual value. It is possible therefore by combining the differences between the sea temperature and the Fort George mean shown in figure 9 with the long period mean temperatures for each day shown in figure 6 to deduce the probable average range of sea temperature in each month. These are given in table 31 and show that the sea temperature ranges

January	64-62
February	62-61-62
March	62-66
April	66-70
May	70-75
June	75-81
July	81-83
August	83-84-83
September	83-80
October	80-73
November	73-67
December	67-64

TABLE 31. Average Sea Temperatures.

from the minimum of 61° to 62° during February to a maximum of 83° to 84° in August. The sea temperature is fairly steady in these two months but in all others shows the changes due to the annual variation. The maximum rises occur in May and June during which the sea temperature increases by 5° and 6° respectively while the biggest decreases of 7° and 6° are in October and November respectively.

I have to thank Mr. P. L. Moulding for assistance in the extraction and checking of much of the data discussed in this note.

Meteorological Office,
Bermuda.
25th June, 1948.

APPENDIX

AVERAGES 1901-1930

Date	Daily Max.	Daily Min.	Daily Mean	Monthly Range	Daily Range
January	68.2	57.5	62.8	23.9	10.7
February	67.3	56.4	61.9	24.1	10.9
March	68.4	57.2	62.8	24.0	11.1
April	70.5	59.3	64.9	23.4	11.2
May	74.8	63.9	69.3	21.8	10.8
June	79.9	69.1	74.5	20.8	10.8
July	84.2	72.7	78.4	18.9	11.4
August	85.4	73.7	79.5	19.5	11.8
September	83.6	72.2	77.9	20.1	11.4
October	79.1	68.5	73.8	20.7	10.6
November	73.4	63.0	68.1	22.6	10.4
December	69.6	59.6	64.7	22.4	10.3