

M. McCaffery

Decimal Index
551. 524. 36
551. 582. 2 (414)

METEOROLOGICAL OFFICE
CLIMATOLOGICAL SERVICES (M.O.3)
CLIMATOLOGICAL MEMORANDUM No. 41

MEAN WINTER TEMPERATURES IN EDINBURGH 1764/65-1962/63

by A. B. Thomson

Records of temperature are available from various sites in Edinburgh continuously from 1764 and the mean monthly temperatures have been published in the Smithsonian World Weather Records up to 1950. In these publications the means have been reduced to a common height of 250 feet except for the years 1941-50. The latter means and those for subsequent years up to February 1963 have been reduced to this height and the average temperature computed for the three-monthly period December-February in each of the 199 winters from 1764/65-1962/63.

The means for each of the three months, December, January, February and for each winter (period December-February) are given in Table 1 and are shown as frequency distributions, in ranges of 0.5° F., in Table 2. The means and standard deviations (σ) calculated from these distributions are as follows:-

	<u>December</u>	<u>January</u>	<u>February</u>	<u>Winter</u>
Mean Temperature (°F)	38.9	37.4	38.6	38.3
Standard Deviation (°F)	3.0	3.2	3.1	2.2

As the mean for January and the standard deviation for winter are about 1° F. below the others, it was decided, for comparative purposes, to sub-divide each series at its mean $\pm \frac{1}{2}\sigma$ and mean $\pm 1\frac{2}{3}\sigma$ to provide the classifications "moderate", "mild", "very mild", "cold" and "very cold" months and winters. This procedure gave the following ranges in degrees F.:-

	<u>December</u>	<u>January</u>	<u>February</u>	<u>Winter</u>
Very mild	> 44.0	> 42.7	> 43.8	> 41.9
Mild	40.5-44.0	39.1-42.7	40.2-43.8	39.5-41.9
Moderate	37.4-40.4	35.8-39.0	37.0-40.1	37.0-39.4
Cold	33.8-37.3	32.1-35.7	33.4-36.9	34.5-36.9
Very cold	< 33.8	< 32.1	< 33.4	< 34.5

The range for cold and mild months is thus about 3½° F. and for cold and mild winters about 2½° F.; for moderate months about 3° F. and for moderate winters 2½° F. The ranges quoted and adopted for winter are not strictly in accordance with the divisions indicated by mean $\pm \frac{1}{2}\sigma$ and mean $\pm 1\frac{2}{3}\sigma$ but they are very close to them and are used in preference to the latter to coincide with the 0.5° ranges in figure 3 which is dealt with later in the text. On the basis of the above classifications, figures 1 and 2 were prepared. It should be noted that December on figure 1 and winter on figures 2 and 3 are entered to the year in which January of the winter in question, falls; also that "mild" includes "very mild" and "cold" includes "very cold".

Winter Months (December, January and February)

During the 199 years, 23 months had a mean temperature of 32° F. or below, viz. 3 Decembers, 15 Januarys and 5 Februarys. There were 13 months with mean temperatures 44° F. or above viz. 7 Decembers, 3 Januarys and 3 Februarys. A marked similarity occurred in the pattern of both cold (or very cold) and mild (or very mild) Decembers, Januarys and Februarys (see figure 1). They had a common pattern of coldness in the early part of the series and mildness in the past 100 years or so. There were a number of noteworthy sequences:-



<u>December</u>	1796-1820	none mild
	1831-1839	none cold
	1902-1924	only one cold
	1938-1960	only one cold

The years stated are the actual years in which December occurred.

<u>January</u>	1771-1781	none mild
	1805-1820	none mild
	1898-1939	none cold

<u>February</u>	1786-1794	none cold
	1798-1814	none mild
	1835-1845	none mild
	1905-1928	only two cold

Broadly, the first quarter of the 19th century had cold months and the first quarter of the 20th century had mild months. The most remarkable runs were those of 25 Decembers (1796-1820), none of which was mild and 42 Januarys (1898-1939), none of which was cold.

In the 199 years, cold Decembers exceeded the mild ones in number but there were more mild Januarys and Februarys than cold ones. As a consequence of the definition of "moderate" months viz. mean $\pm \frac{10}{2}$, the moderate type were the most numerous in all three months and were fairly regularly spaced averaging 3-4 in each decade. The number of occurrences is shown below:-

	<u>Cold and Very Cold</u>	<u>Mild and Very Mild</u>	<u>Moderate</u>
December	63	60	76
January	55	66	78
February	61	65	73

In the details below "cold" includes "very cold" and "mild" includes "very mild" months:-

December

63 cold Decembers were followed by 28 cold, 11 mild and 24 moderate Decembers.

60 mild Decembers were followed by 17 cold, 20 mild and 23 moderate Decembers.

January

54 cold Januarys (excluding January 1963) were followed by 17 cold, 20 mild and 17 moderate Januarys.

66 mild Januarys were followed by 11 cold, 25 mild and 30 moderate Januarys.

February

60 cold Februarys (excluding February 1963) were followed by 17 cold, 18 mild and 25 moderate Februarys.

65 mild Februarys were followed by 24 cold, 24 mild and 17 moderate Februarys.

December/January

63 cold Decembers were followed by 24 cold, 14 mild and 25 moderate Januarys.

60 mild Decembers were followed by 10 cold, 26 mild and 24 moderate Januarys.

January/February

55 cold Januarys were followed by 28 cold, 11 mild and 16 moderate Februarys.

66 mild Januarys were followed by 11 cold, 28 mild and 27 moderate Februarys.

December-January/February

After the 24 Decembers and Januarys, which were both cold, there followed 13 cold, 4 mild and 7 moderate Februarys.

After the 26 Decembers and Januarys which were both mild, there followed 5 cold, 11 mild and 10 moderate Februarys.

The above details are summarized in table form below:-

	Total		Cold	Mild	Moderate
	Cold	Mild			
December/December	63		28	11	24
		60	17	20	23
January/January	54		17	20	17
		66	11	25	30
February/February	60		17	18	25
		65	24	24	17
December/January	63		24	14	25
		60	10	26	24
January/February	55		28	11	16
		66	11	28	27
December-January/February	24		13	4	7
		26	5	11	10

One would not expect that the characteristics (cold or mild) of a particular month would have any influence on the characteristics of its namesake of twelve months later. This is largely borne out by the table above except that the odds are against mild Decembers after cold Decembers and cold Januarys after mild ones.

The last three entries in the table indicate persistence of type, especially after cold Januarys and cold December-Januarys together.

Table 3 indicates the 10 coldest and 10 mildest Decembers, Januarys and Februarys, listed in order of their mean temperatures and also in order of date; also the 20 coldest and 20 mildest in order of date. In some cases the lists exceed 10 and 20 to accommodate months with identical mean temperatures.

In the three groups of the 10 coldest months, only 7 of the 30 entries occurred in the past 100 years, viz. 2 Decembers, 1 January and 4 Februarys. Only 2 of these coldest months have occurred in the present century, February 1947 and February 1963.

The intervals, i.e. the number of years between one cold month and the next cold month of the same name, show no definite pattern. However, only once (December 1859/December 1860) has the interval in these three coldest groups been one year, and only twice has it been as short as two years (December 1859/60 and January 1774/76). The interval has been as long as 30 years four times, once in January (1838/1881) and thrice in February 1795/1838, 1864/1895 and 1895/1947). The last one spanned 52 years and followed immediately after one of 31 years. The actual intervals for the three groups of 10 coldest months listed in Table 3 were as follows:-

<u>December</u>	9, 3, 5, 23, 25, 15, 1, 14, 4
<u>January</u>	2, 4, 15, 14, 5, 6, 3, 15, 43
<u>February</u>	7, 13, 10, 43, 17, 9, 31, 52, 16

Obviously, the more months which are classified as "coldest" i.e. the higher the threshold mean temperature, the greater will be the number of short intervals, but even extending the lists to include the 21 coldest Decembers, 20 coldest Januarys and 21 coldest Februarys makes intervals of 3 years or less only 8 in December, 6 in January and 3 in February. The intervals for the extended lists are:-

<u>December</u>	5, 4, 3, 5, 3, 2, 6, 5, 3, 4, 25, 2, 13, 1, 14, 4, 1, 3, 10, 58
<u>January</u>	5, 2, 2, 4, 4, 11, 14, 5, 6, 3, 3, 3, 7, 12, 29, 2, 14, 46, 22
<u>February</u>	1, 6, 13, 10, 28, 4, 11, 5, 10, 2, 5, 4, 1, 30, 5, 29, 13, 5, 8, 8

It seems unlikely therefore that the interval will be short after a month as severe as any in the coldest groups, for example after months as severe as December 1950, January 1963 or February 1963.

It is noteworthy that of the 62 coldest Decembers, Januarys and Februarys, only 1 December, 2 Januarys and 6 Februarys of the present century appear in the lists, and only one of them was more severe than any earlier month of the same name. This was February 1947 whose mean temperature of 29.5⁰F. was the lowest on "record" for February but only fractionally below that for the next coldest one viz. February 1838 (29.8).

The run of the intervals show that the years 1786-1821 and 1876-1884 had the greatest concentration of severe Decembers, 1767-1784 and 1820-1829 the greatest concentration of severe Januarys and 1853-1865 the greatest concentration of severe Februarys.

Considering now the three mildest groups in table 2, 20 of the 31 mildest months occurred in the past 100 years, viz. 6 Decembers, 9 Januarys and 5 Februarys; thus only 2 of the 11 mildest Januarys came in the first half of the 199 year-series. About one half of the 31 entries in the mildest category lie in the 20th century.

The intervals in the three mildest groups were:-

<u>December</u>	53, 1, 14, 41, 2, 24, 10, 8, 11
<u>January</u>	52, 36, 8, 8, 18, 5, 2, 9, 2, 10
<u>February</u>	8, 3, 7, 49, 45, 27, 25, 2, 16

The short intervals of 3 years or less are thus 2 in each of the three months. February was noteworthy in having 4 consecutive prolonged intervals.

The intervals in the extended lists of the 20 (at least) mildest were:-

<u>December</u>	11, 6, 33, 14, 1, 14, 8, 33, 2, 5, 16, 3, 7, 1, 2, 7, 1, 6, 5, 1, 2
<u>January</u>	38, 10, 2, 29, 7, 2, 6, 6, 2, 18, 5, 2, 2, 7, 2, 4, 6, 5, 8
<u>February</u>	8, 3, 4, 3, 49, 21, 1, 1, 9, 2, 2, 9, 12, 11, 4, 16, 9, 2, 16

The short intervals (3 years or less) number 8 in December, 6 in January and 7 in February. Thus with 6 short intervals out of 27 in the "10-groups" and 21 short intervals out of 59 in the "20 groups", the odds are against a month of the mildness of those listed, for example as mild as December 1956, January 1957 or February 1961, being quickly followed by a similarly mild month of the same name.

The greatest concentration of mildest-Decembers occurred in the period 1931-1956, mildest-Januarys in the period 1921-1938 and mildest-Februarys in the periods 1787-1797, 1867-1869 and 1878-1882.

Winters

The series of 199 mean winter temperatures given in Table 1 is shown on figure 3 as year-histograms, the actual years being entered on the diagram in their relevant mean temperature groups. The frequency distribution of the means is given in Table 2, the mean of the series being 38.3 F. and the standard deviation 2.2 F.

Much the coldest winters were 1780 and 1879 - the mildest 1779, 1790 and 1932. There were 29 winters with mean temperature below 36° F. and 19 of 41° F. or above. It is evident from figure 3 that, in the present century, only 15 winters had a mean value less than 38.0 (mean of the series, 38.3) and, since 1840, only 36 with a mean less than 38.0. In general, winters with mean temperature above the average of the 199 year-series have predominated over the past 100 years. The frequencies in three 50-year periods and one 49-year period of mean winter temperature below 36° F. and 41° F. or above are:-

<u>Period</u>	<u>Mean below 36° F.</u>	<u>Mean 41° F. or above</u>
1765-1814	15	3
1815-1864	8	3
1865-1914	4	4
1915-1963	2	9

There were thus 23 winters (mean below 36°) in the first 100 years against 6 in the second half of the series; on the other hand winters with means 41° F. or above were 6 to 13 in these two periods.

There were two outstanding sequences viz. 1797-1820 and 1903-1935. In terms of the classifications for "cold" and "mild" already set out, there were no mild winters in the first sequence and only 2 cold ones in the second sequence.

In the 199 years, there were 59 "cold winters", 69 "mild" and 71 "moderate" ones. The last seem fairly regularly spaced throughout the series (see figure 2) and number 3 or 4 in each decade.

The 59 cold winters were followed by 16 cold, 15 mild and 28 moderate winters while the 69 mild ones were followed by 20 cold, 26 mild and 23 moderate winters. The chances of a cold or of a mild winter following a cold winter both seem to be about one in four but there is a suggestion that a mild winter is more likely to be followed by a mild one than by a cold one.

The 10 coldest and 10 mildest, together with the 20 coldest and 20 mildest winters are listed in Table 3.

It will be seen that only one (1963) of the 10 coldest and two (1947 and 1963) of the 20 coldest winters occurred in the present century; indeed, only 3 winters in the 10-group and 5 in the 20-group occurred in the past 100 years.

The intervals (i.e. the number of years between one cold winter and the next) for the two groups of coldest winters were:-

10 coldest winters

6, 15, 19, 9, 15, 22, 19, 2, 82

20 coldest winters

8, 2, 4, 4, 1, 10, 14, 5, 2, 4, 3, 15, 7, 15, 19, 2, 14, 52, 16

Thus, amongst the coldest 10 winters only 1 of the 9 intervals was as short as 3 years, and among the 20 coldest winters only 5 were as short as 3 years. The intervals have been as long as 82 years (1881 to 1963) and 52 years (1895-1947). The odds were therefore against a short interval after a winter as severe as any in the 20 coldest group, for examples as cold as 1947 or 1963. The run of the intervals show that 1774-1785 and 1809-1823 had the greatest "density" of these coldest winters. Both these periods had also a great density of cold Januarys.

The two 20th century winters (1947 and 1963) appearing in the 20 coldest group were less cold than a number on the list, and were respectively the twelfth and seventh coldest of these 20 winters. It cannot be said therefore that present day winters generally have become more severe than earlier ones in the series.

Five of the 10 mildest winters and 9 of the 20 mildest ones occurred in the present century, while in the 20 mildest group 14 of the 20 occurred in the past 100 years.

The intervals for the mildest groups were:-

10 mildest winters

11, 6, 48, 2, 79, 7, 3, 8, 6

20 mildest winters

11, 6, 48, 2, 12, 5, 6, 13, 2, 14, 23, 2, 2, 7, 2, 1, 8, 6, 8

There are only 2 short intervals of 3 years or less in the first group and only 6 short ones in the second group. One can say therefore that the odds are against a quick return of winters as mild as those in these two groups, for example as mild as 1949 and 1957.

The years with the greatest "density" of these mildest winters were 1921-35 which was also a period with a large density of mild Januarys.

Trend of Mean Temperature

The decadal mean temperatures for December, January, February and the winter are shown in figure 4 and in Table 4. There were fairly wide fluctuations in the means in the first 50 years of the series but thereafter until 1939 the trend was mainly upward. The winter means show an interruption in the general rise between 1860 and 1880 mainly because of a decline in the December decadal means during this period and in the January mean for 1860-1869. The reversal of the upward trend about 1939 is quite marked except in December in which the turning point came somewhat later.

The wide variations in some of the monthly and winter mean temperatures were unlikely to have arisen from chance. For examples we can test the winter means statistically. The standard deviation for the difference between consecutive winter means is $\sigma \sqrt{2} = 3.1^{\circ}\text{F.}$, provided they are independent and independence can be reasonably assumed as the serial correlation (0.075) between consecutive means is very small. Ten differences exceeded twice this figure - including one case of more than three times - and were thus significant. The ten pairs and their differences were:-

<u>Winters</u>	<u>Difference ($^{\circ}\text{F.}$)</u>
1779-1780	10.5
1780-1781	6.5
1789-1790	7.0
1794-1795	6.7
1795-1796	8.5
1822-1823	6.3
1844-1845	6.7
1845-1846	6.9
1878-1879	8.0
1881-1882	7.1

Again, the standard deviation for the difference between the means for any two 10-year periods is $\sigma \sqrt{1/5} = 0.98^\circ \text{F}$. Differences exceeding twice this value occurred between the decadal means prior to 1840 and those in the period 1920-40 and included a number exceeding three times this figure. Large differences were $3 - 3\frac{1}{2}^\circ$ between the decades 1780-89, 1800-09, 1810-19 on the one hand and the decades 1920-29, 1930-39 on the other hand. The rise in the mean values between the first group of years and the latter group is therefore significant.

There seems no means of judging the future trend. The downward course of the winter curve which began about 1939 may continue gently or the pace may quicken, or the curve may begin to rise again as occurred after the fall in the winter curve from 1799-1820. It would be unreasonable to attempt prediction unless the agencies which caused the wide fluctuations referred to can be ascertained and assessed, but if they continue to act in a broadly similar way, it can be assumed that the extremes of coldness and mildness experienced during the past 200 years are unlikely to be spectacularly eclipsed in future winters. It would be unrealistic, however, to discount the possibility of a recurrence of the low temperature levels of the last half of the 18th and first half of the 19th centuries, and in particular the quite alarming sequence of low winter means between 1799 and 1820.

Conclusions

1. Average temperatures for the 199 Decembers, Februarys and winters (December, January, February) were approximately the same and about one degree F. above that for January.
2. The standard deviations of mean temperature (about 3°F .) were about the same for each of the three winter months, and one degree F. higher than for the winter as a whole.
3. About 4 per cent of the winter months had a mean temperature of 32°F . or below. January with 15 such occurrences had a higher number than December (3) or February (5).
4. About 2 per cent of the winter months had a mean temperature of 44°F . or above, December with 7 occurrences having about double the number in January (3) and February (3).
5. The winter months had a common pattern of coldness in the first 100 years of the series and mildness thereafter.
6. There were noteworthy runs when the general pattern of coldness or mildness was the same for consecutive months of the same name, in particular Decembers from 1796 to 1820 (none mild or very mild), Januarys from 1898 to 1939 (none cold or very cold) and Februarys from 1905 to 1928 (only two cold).
7. The frequencies of cold and of mild months of the same name in the series were about the same, the greatest difference being in January - 55 cold and 66 mild, indicating that January mean temperatures depart appreciably from a normal distribution.
8. Whether a particular winter month was cold or mild seems to have had little influence on the character of its namesake of 12 months later, except that the odds were against mild Decembers after cold ones and cold Januarys after mild ones.
9. The odds were in favour of persistence of type from month to month, cold Decembers, for example, were more likely to be followed by cold Januarys than by mild ones; similarly, Decembers and Januarys, both of which were cold, were more likely to be followed by cold Februarys than by mild ones.

10. The intervals, or the number of years between one of the 20 coldest months and the next coldest month of the same name, were seldom as short as 3 years. This was also the case with the 20 mildest months. A quick return of a month as cold as January 1963, or of one as mild as February 1961 seems therefore unlikely.
11. With one exception (February 1947) there was no evidence that the worst winter months of the 20th century were more severe than others of earlier years. Indeed, the winter months of the 20th century were in general milder than earlier ones in the series, but the absolute mildest December and absolute mildest January both occurred in the 19th century and the corresponding February in the 18th century.
12. Winters with mean temperature above the average of the 199 year-series predominated during the past 100 years. There were 6 winters with mean values below 36 F. in the past 100 years against 23 in the first half of the series. The corresponding numbers of winters with means 41 F. or above were 13 and 6.
13. The winter following a cold one had an equal chance of about one in four of being cold or mild but there was a tendency for a mild winter being followed by another mild one.
14. Only 5 of the 20 coldest winters occurred in the past 100 years, and only 2 of them (1947 and 1963) fell in the present century. As they were respectively the twelfth and seventh coldest of these 20 winters, the worst winters of the present day are not, in general, more severe than earlier ones.
15. The odds were against a quick return (interval of 3 years or less) of a winter as severe as any amongst the 20 coldest winters of the series, there being only 5 intervals amongst the 20 coldest as short as 3 years, 4 as short as 2 years and one as short as 1 year. Similarly, the odds were against a quick return of a very mild winter.
16. The periods 1774-1785 and 1809-1823 had the greatest density of the 20 coldest winters, i.e. they were the two periods with the shortest intervals. Both these periods had also a large density of the coldest Januarys.
17. The period 1921-35 had the greatest density of the 20 mildest winters; it was also a period with a large density of the mildest Januarys.
18. Wide fluctuations occurred in the mean temperatures for the months and for the winters and also in their decadal means during the first 50 years of the series, but thereafter the trend was upward until it was reversed about 1939.
19. The large variations between consecutive winter means and also between some of the early and late decadal means were unlikely to have arisen through chance. Until the causes which brought about these large differences are ascertained and assessed, any attempt to predict the future trend of winter temperature is unjustified. However, it is clear that the winters of the first 40 years of this century should not be used as a yard-stick to determine the likely severity of future winters, and that it would be unwise to ignore the possibility of a return to the more extreme regimes which have been recorded during the last 200 years.

TABLE 1

Mean Winter Temperatures in Edinburgh 1764/65 - 1962/63

(December entered to year in which January occurs)

Year	December °F	January °F	February °F	Winter °F	Year	December °F	January °F	February °F	Winter °F
1765	36.1	39.8	32.9	36.3					
66	35.6	34.7	34.5	34.9					
67	37.6	31.7	41.1	36.8					
68	39.3	33.2	38.2	36.9					
69	39.1	35.3	36.6	37.0					
1770	40.4	39.9	41.1	40.5	1810	36.6	36.8	36.2	36.5
71	37.6	33.8	38.2	36.5	11	35.7	33.6	37.7	35.7
72	41.7	32.6	32.6	35.6	12	35.9	36.3	39.4	37.2
73	39.6	38.5	36.2	38.1	13	34.9	35.6	39.7	36.7
74	36.5	30.1	36.7	34.4	14	37.3	26.5	35.1	33.0
75	37.7	38.3	39.9	38.6	15	36.6	33.5	41.6	37.2
76	39.1	29.2	36.7	35.0	16	33.8	35.4	35.8	35.0
77	38.1	35.4	35.2	36.2	17	35.2	38.7	40.3	38.1
78	38.8	37.8	39.5	38.7	18	35.6	37.2	35.5	36.1
79	43.4	37.6	47.2	42.7	19	38.9	37.7	36.4	37.7
1780	33.1	28.4	35.1	32.2	1820	33.3	30.4	40.0	34.6
81	39.5	36.3	40.3	38.7	21	39.1	39.1	40.2	39.5
82	41.1	39.4	34.7	38.4	22	41.1	39.0	40.6	40.2
83	35.9	37.1	38.9	37.3	23	36.1	31.1	34.4	33.9
84	37.1	32.2	34.8	34.7	24	37.3	39.8	39.0	38.7
85	34.0	38.2	32.8	35.0	25	38.4	39.1	39.0	38.8
86	36.1	36.0	37.0	36.4	26	39.0	31.6	41.8	37.5
87	36.3	40.0	43.8	40.0	27	41.0	35.4	34.0	36.8
88	36.8	38.8	37.2	37.6	28	42.2	39.4	40.1	40.6
89	32.2	34.6	40.2	35.7	29	43.4	32.1	38.8	38.1
1790	43.9	39.4	44.7	42.7	1830	36.0	34.3	36.0	35.4
91	37.9	38.8	39.3	38.7	31	35.4	34.7	38.6	36.2
92	32.7	34.8	39.8	35.8	32	41.8	39.1	40.6	40.5
93	37.6	37.4	40.1	38.4	33	40.6	34.7	39.5	38.3
94	40.6	38.2	43.0	40.6	34	40.3	41.4	40.5	40.7
95	40.2	29.9	31.6	33.9	35	42.2	37.9	39.6	39.9
96	42.9	43.8	40.5	42.4	36	38.8	38.1	37.2	38.0
97	31.8	40.7	43.8	38.8	37	38.9	35.0	38.9	37.6
98	40.0	38.4	38.9	39.1	38	41.0	30.6	29.8	33.8
99	35.8	37.2	36.2	36.4	39	40.5	35.5	37.8	37.9
1800	35.1	35.3	36.3	35.6	1840	38.1	39.2	37.5	38.3
01	36.2	39.1	39.9	38.4	41	36.6	33.4	37.9	36.0
02	34.0	36.9	37.8	36.2	42	38.9	35.0	40.0	38.0
03	37.9	35.6	37.7	37.1	43	45.6	39.4	34.3	39.8
04	38.5	40.2	36.4	38.4	44	47.8	41.2	36.2	41.7
05	36.2	37.2	38.9	37.4	45	33.0	36.6	35.4	35.0
06	36.7	35.1	36.7	36.2	46	38.7	42.1	44.9	41.9
07	39.9	36.3	35.7	37.3	47	34.4	36.2	35.7	35.4
08	35.1	35.2	35.5	35.3	48	39.6	33.6	40.4	37.9
09	35.4	30.3	38.7	34.8	49	40.5	36.8	42.1	39.8

TABLE 1 (continued)

Year	December F.	January F.	February F.	Winter F.	Year	December F.	January F.	February F.	Winter F.
1850	36.8	31.5	41.8	36.7	1910	36.9	37.0	39.3	37.7
51	39.7	40.6	40.8	40.4	11	41.9	40.2	40.0	40.7
52	40.7	39.0	40.2	40.0	12	41.9	37.5	39.9	39.8
53	42.2	38.8	33.8	38.3	13	42.0	37.7	40.4	40.0
54	37.0	36.9	39.9	37.9	14	40.3	38.7	43.2	40.7
55	39.9	37.5	30.6	36.0	15	39.2	38.3	38.4	38.6
56	37.3	36.8	41.4	38.5	16	38.7	44.3	37.8	40.3
57	40.4	37.9	41.1	39.8	17	38.3	35.8	36.3	36.8
58	46.5	40.6	36.2	41.1	18	37.8	36.9	43.4	39.4
59	39.6	39.9	39.8	39.8	19	42.2	37.7	35.2	38.4
1860	33.3	34.5	33.6	33.8	1920	39.4	39.2	42.3	40.3
61	33.4	36.3	39.0	36.2	21	39.8	42.8	41.3	41.3
62	37.0	38.1	40.3	38.5	22	43.4	37.2	39.0	39.9
63	42.4	38.7	41.2	40.8	23	41.5	42.7	39.5	41.2
64	41.4	36.0	33.3	36.9	24	38.4	39.9	38.8	39.0
65	39.4	35.0	33.4	35.9	25	44.9	41.0	38.9	41.6
66	43.2	40.0	37.6	40.3	26	36.5	40.8	41.9	39.7
67	41.8	32.8	42.8	39.1	27	41.0	39.8	40.7	40.5
68	40.4	38.0	43.0	40.5	28	35.5	40.6	40.4	38.8
69	41.4	40.2	42.4	41.3	29	38.9	36.4	34.5	36.6
1870	36.9	36.5	34.8	36.1	1930	40.9	39.6	35.7	38.7
71	35.2	35.4	41.8	37.5	31	41.0	37.8	38.5	39.1
72	37.7	38.5	40.6	38.9	32	42.9	44.0	40.7	42.5
73	39.5	40.6	36.0	38.7	33	42.5	37.9	39.5	40.0
74	42.0	40.7	39.0	40.6	34	39.1	41.6	42.9	41.2
75	31.8	40.9	37.4	36.7	35	44.7	40.4	40.8	42.0
76	40.0	40.4	37.1	39.2	36	36.9	37.2	36.3	36.8
77	40.4	39.2	41.2	40.3	37	41.9	40.4	38.9	40.4
78	40.0	38.5	42.4	40.3	38	37.1	41.0	41.1	39.7
79	31.0	31.2	34.8	32.3	39	39.4	37.8	42.3	39.8
1880	34.8	37.0	43.2	38.3	1940	38.9	32.7	36.9	36.2
81	37.8	29.1	35.7	34.2	41	39.9	32.4	36.6	36.3
82	38.7	42.0	43.3	41.3	42	42.5	35.4	33.9	37.3
83	33.6	39.1	41.2	38.0	43	43.7	39.2	43.7	42.2
84	41.1	41.3	40.7	41.0	44	39.9	42.1	39.1	40.4
85	38.0	37.0	40.6	38.5	45	39.7	34.0	44.5	39.4
86	39.0	34.8	35.2	36.3	46	41.4	38.0	40.9	40.1
87	35.2	39.2	39.7	38.0	47	38.3	36.4	29.5	34.7
88	36.8	39.3	35.9	37.3	48	40.6	38.5	39.7	39.6
89	41.4	39.7	37.4	39.5	49	42.5	41.4	42.1	42.0
1890	39.6	41.6	37.8	39.7	1950	40.7	40.2	38.7	39.9
91	35.3	36.8	43.4	38.5	51	33.9	37.8	37.1	36.3
92	39.7	36.6	37.4	37.9	52	41.1	34.2	38.8	38.0
93	34.8	37.6	39.8	37.4	53	38.1	40.8	41.7	40.2
94	42.0	38.0	40.4	40.1	54	43.7	38.2	36.1	39.3
95	40.9	31.8	31.2	34.6	55	42.5	35.8	33.5	37.3
96	37.7	41.2	42.0	40.3	56	40.4	37.6	34.7	37.6
97	39.0	35.0	41.4	38.5	57	42.7	41.4	39.5	41.2
98	39.8	44.6	39.8	41.4	58	41.1	37.8	38.1	39.0
99	44.0	38.1	39.6	40.6	59	39.7	34.4	40.7	38.3
1900	35.9	39.2	34.1	36.4	1960	41.1	38.6	37.8	39.2
01	44.3	38.5	37.1	40.0	61	37.9	37.9	43.4	39.7
02	37.3	38.7	34.7	36.9	62	35.6	39.7	39.8	38.4
03	39.6	37.6	43.3	40.2	63	37.8	32.4	32.2	34.1
04	37.4	39.7	36.7	37.9					
05	39.6	39.8	39.9	39.8					
06	42.6	40.1	37.2	40.0					
07	38.1	39.0	37.6	38.2					
08	39.5	38.0	41.1	39.5					
09	39.1	39.6	39.1	39.3					

TABLE 2

Mean Temperatures in Edinburgh - 1764/65-1962/63 (199 years)

F r e q u e n c y

<u>°F.</u>	<u>December</u>	<u>January</u>	<u>February</u>	<u>Winter (December-February)</u>
26.5 -		1		
27.0 -		-		
27.5 -		-		
28.0 -		1		
28.5 -		-		
29.0 -		2		
29.5 -		1	2	
30.0 -		3	-	
30.5 -		1	1	
31.0 -	1	2	1	
31.5 -	2	4	1	
32.0 -	1	4	1	2
32.5 -	1	3	3	-
33.0 -	5	2	2	1
33.5 -	3	4	4	4
34.0 -	3	4	4	3
34.5 -	3	7	8	6
35.0 -	7	13	5	7
35.5 -	9	5	9	6
36.0 -	7	9	13	17
36.5 -	12	10	7	13
37.0 -	9	10	10	11
37.5 -	12	18	11	12
38.0 -	8	13	4	20
38.5 -	11	13	13	17
39.0 -	14	19	10	11
39.5 -	20	12	20	18
40.0 -	11	11	15	20
40.5 -	9	8	13	12
41.0 -	14	8	11	9
41.5 -	7	2	6	3
42.0 -	8	3	7	4
42.5 -	8	2	2	3
43.0 -	4	-	9	
43.5 -	3	1	3	
44.0 -	2	2	-	
44.5 -	2	1	3	
45.0 -	-		-	
45.5 -	1		-	
46.0 -	-		-	
46.5 -	1		-	
47.0 -	-		1	
47.5 -	1			
Total	199	199	199	199

TABLE 3

Mean Temperature in Edinburgh 1764-1962

December

10 Coldest (in order of Mean Temperature)

<u>Year</u> ^x	<u>°F.</u>
1878	31.0
1796	31.8
1874	31.8
1788	32.2
1791	32.7
1844	33.0
1779	33.1
1819	33.3
1859	33.3
1860	33.4

10 Mildest (in order of Mean Temperature)

<u>Year</u>	<u>°F.</u>
1843	47.8
1857	46.5
1842	45.6
1924	44.9
1934	44.7
1900	44.3
1898	44.0
1789	43.9
1942	43.7
1953	43.7

x Year stated is the year in which December falls

10 Coldest (in order of date)

<u>Year</u>	<u>°F.</u>
1779	33.1
1788	32.2
1791	32.7
1796	31.8
1819	33.3
1844	33.0
1859	33.3
1860	33.4
1874	31.8
1878	31.0

10 Mildest (In order of date)

<u>Year</u>	<u>°F.</u>
1789	43.9
1842	45.6
1843	47.8
1857	46.5
1898	44.0
1900	44.3
1924	44.9
1934	44.7
1942	43.7
1953	43.7

21 Coldest (in order of date)

<u>Year</u>	<u>°F.</u>	<u>Year</u>	<u>°F.</u>
1779	33.1	1819	33.3
1784	34.0	1844	33.0
1788	32.2	1846	34.4
1791	32.7	1859	33.3
1796	31.8	1860	33.4
1799	35.1	1874	31.8
1801	34.0	1878	31.0
1807	35.1	1879	34.8
1812	34.9	1882	33.6
1815	33.8	1892	34.8
		1950	33.9

22 Mildest (in order of date)

<u>Year</u>	<u>°F.</u>	<u>Year</u>	<u>°F.</u>
1778	43.4	1921	43.4
1789	43.9	1924	44.9
1795	42.9	1931	42.9
1828	43.4	1932	42.5
1842	45.6	1934	44.7
1843	47.8	1941	42.5
1857	46.5	1942	43.7
1865	43.2	1948	42.5
1898	44.0	1953	43.7
1900	44.3	1954	42.5
1905	42.6	1956	42.7

TABLE 3 (continued)

Mean Temperature in Edinburgh 1765-1963

January

10 coldest (in order of Mean Temperature) 11 Mildest (in order of Mean Temperature)

<u>Year</u>	<u>°F.</u>	<u>Year</u>	<u>°F.</u>
1814	26.5	1898	44.6
1780	28.4	1916	44.3
1881	29.1	1932	44.0
1776	29.2	1796	43.8
1795	29.9	1921	42.8
1774	30.1	1923	42.7
1809	30.3	1944	42.1
1820	30.4	1846	42.1
1838	30.6	1882	42.0
1823	31.1	1934	41.6
		1890	41.6

10 Coldest (in order of date)

11 Mildest (in order of date)

<u>Year</u>	<u>°F.</u>	<u>Year</u>	<u>°F.</u>
1774	30.1	1796	43.8
1776	29.2	1846	42.1
1780	28.4	1882	42.0
1795	29.9	1890	41.6
1809	30.3	1898	44.6
1814	26.5	1916	44.3
1820	30.4	1921	42.8
1823	31.1	1923	42.7
1838	30.6	1932	44.0
1881	29.1	1934	41.6
		1944	42.1

20 Coldest (in order of date)

20 Mildest (in order of date)

<u>Year</u>	<u>°F.</u>	<u>Year</u>	<u>°F.</u>	<u>Year</u>	<u>°F.</u>	<u>Year</u>	<u>°F.</u>
1767	31.7	1823	31.1	1796	43.8	1916	44.3
1772	32.6	1826	31.6	1834	41.4	1921	42.8
1774	30.1	1829	32.1	1844	41.2	1923	42.7
1776	29.2	1838	30.6	1846	42.1	1925	41.0
1780	28.4	1850	31.5	1875	40.9	1932	44.0
1784	32.2	1879	31.2	1882	42.0	1934	41.6
1795	29.9	1881	29.1	1884	41.3	1938	41.0
1809	30.3	1895	31.8	1890	41.6	1944	42.1
1814	26.5	1941	32.4	1896	41.2	1949	41.4
1820	30.4	<u>1963</u>	32.4	1898	44.6	1957	41.4

TABLE 3 (continued)

Mean Temperature in Edinburgh 1765-1963

February

10 Coldest (in order of Mean Temperature)

<u>Year</u>	<u>°F.</u>
1947	29.5
1838	29.8
1855	30.6
1895	31.2
1795	31.6
<u>1963</u>	32.2
1772	32.6
1785	32.8
1765	32.9
1864	33.3

10 Mildest (in order of Mean Temperature)

<u>Year</u>	<u>°F.</u>
1779	47.2
1846	44.9
1790	44.7
1945	44.5
1787	43.8
1797	43.8
1943	43.7
1891	43.4
1961	43.4
1918	43.4

10 Coldest (in order of date)

<u>Year</u>	<u>°F.</u>
1765	32.9
1772	32.6
1785	32.8
1795	31.6
1838	29.8
1855	30.6
1864	33.3
1895	31.2
1947	29.5
<u>1963</u>	32.2

10 Mildest (in order of date)

<u>Year</u>	<u>°F.</u>
1779	47.2
1787	43.8
1790	44.7
1797	43.8
1846	44.9
1891	43.4
1918	43.4
1943	43.7
1945	44.5
1961	43.4

21 Coldest (in order of date)

<u>Year</u>	<u>°F.</u>	<u>Year</u>	<u>°F.</u>
1765	32.9	1855	30.6
1766	34.5	1860	33.6
1772	32.6	1864	33.3
1785	32.8	1865	33.4
1795	31.6	1895	31.2
1823	34.4	1900	34.1
1827	34.0	1929	34.5
1838	29.8	1942	33.9
1843	34.3	1947	29.5
1853	33.8	1955	33.5
		<u>1963</u>	32.2

20 Mildest (in order of date)

<u>Year</u>	<u>°F.</u>	<u>Year</u>	<u>°F.</u>
1779	47.2	1880	43.2
1787	43.8	1882	43.3
1790	44.7	1891	43.4
1794	43.0	1903	43.3
1797	43.8	1914	43.2
1846	44.9	1918	43.4
1867	42.8	1934	42.9
1868	43.0	1943	43.7
1869	42.4	1945	44.5
1878	42.4	1961	43.4

TABLE 3 (continued)

Mean Temperature in Edinburgh 1765-1963

Winter (Dec. + Jan. + Feb./3)

10 Coldest (in order of Mean Temperature) 10 Mildest (in order of Mean Temperature)

<u>Year</u> [*]	<u>°F.</u>	<u>Year</u>	<u>°F.</u>
1780	32.2	1779	42.7
1879	32.3	1790	42.7
1814	33.0	1932	42.5
1838	33.8	1796	42.4
1860	33.8	1943	42.2
1823	33.9	1935	42.0
1795	33.9	1949	42.0
<u>1963</u>	34.1	1846	41.9
1881	34.2	1844	41.7
1774	34.4	1925	41.6

* Winter stated is the year in which January falls

10 Coldest (in order of date)

10 Mildest (in order of date)

<u>Year</u>	<u>°F.</u>	<u>Year</u>	<u>°F.</u>
1774	34.4	1779	42.7
1780	32.2	1790	42.7
1795	33.9	1796	42.4
1814	33.0	1844	41.7
1823	33.9	1846	41.9
1838	33.8	1925	41.6
1860	33.8	1932	42.5
1879	32.3	1935	42.0
1881	34.2	1943	42.2
<u>1963</u>	34.1	1949	42.0

20 Coldest (in order of date)

20 Mildest (in order of date)

<u>Year</u>	<u>°F.</u>	<u>Year</u>	<u>°F.</u>	<u>Year</u>	<u>°F.</u>	<u>Year</u>	<u>°F.</u>
1766	34.9	1820	34.6	1779	42.7	1898	41.4
1774	34.4	1823	33.9	1790	42.7	1921	41.3
1776	35.0	1838	33.8	1796	42.4	1923	41.2
1780	32.2	1845	35.0	1844	41.7	1925	41.6
1784	34.7	1860	33.8	1846	41.9	1932	42.5
1785	35.0	1879	32.3	1858	41.1	1934	41.2
1795	33.9	1881	34.2	1863	40.8	1935	42.0
1809	34.8	1895	34.6	1869	41.3	1943	42.2
1814	33.0	1947	34.7	1882	41.3	1949	42.0
1816	35.0	<u>1963</u>	34.1	1884	41.0	1957	41.2

TABLE 4

Decadal Mean Temperature in Edinburgh 1764/65-1962/63

(Winters and Decembers are reckoned as occurring in the years in which the Januarys fall)

<u>Period</u>	<u>December</u>	<u>January</u>	<u>February</u>	<u>Winter</u>
(1765-1769)*	37.5	34.9	36.7	36.4
1770-1779	39.3	35.3	38.3	37.6
1780-1789	36.2	36.1	37.5	36.6
1790-1799	38.3	37.9	39.8	38.7
1800-1809	36.5	36.1	37.4	36.7
1810-1819	36.1	35.1	37.8	36.3
1820-1829	39.1	35.7	38.8	37.9
1830-1839	39.5	36.1	37.9	37.8
1840-1849	39.3	37.4	38.4	38.4
1850-1859	40.0	37.9	38.6	38.8
1860-1869	39.4	36.9	38.7	38.3
1870-1879	37.5	38.2	38.5	38.1
1880-1889	37.6	37.9	39.3	38.3
1890-1899	39.3	38.1	39.3	38.9
1900-1909	39.3	39.0	38.1	38.8
1910-1919	39.9	38.4	39.4	39.2
1920-1929	39.9	40.0	39.7	39.9
1930-1939	40.6	39.8	39.7	40.0
1940-1949	40.7	37.0	38.7	38.8
1950-1959	40.4	37.8	37.9	38.7
(1960-1963)**	38.1	37.1	38.3	37.9

* 5 years

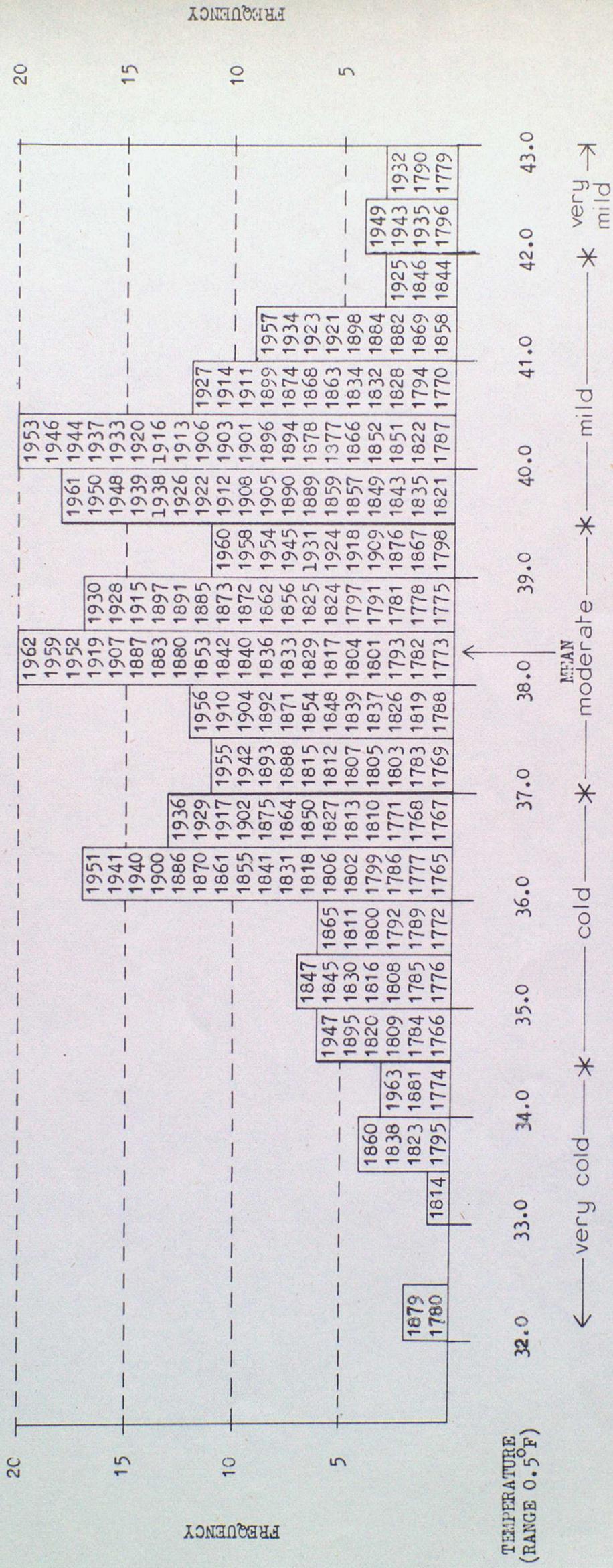
** 4 years

FIGURE 3

EDINBURGH WINTER TEMPERATURES

1764/65-1962/63

The winter temperature (Dec + Jan + Feb)/3 is found for each year and classified in ranges of 0.5°F. The column between, say 35.0 and 35.5 comprises winters with temperatures from 35.0-35.4 inclusive. Each winter is denoted by the year in which January falls. Much the coldest winters were 1779/80 and 1878/79 and the mildest 1778/79, 1789/90 and 1931/32. There were 29 winters with mean temperature below 36°F and 19 of 41°F or above.



Frequencies

Mean for 199 winters 38.3°F
 Standard Deviation 2.2°F
 Mean for Decembers 38.9°F
 Standard Deviation 3.0°F
 Mean for Januarys 37.4°F
 Standard Deviation 3.2°F
 Mean for Februarys 38.6°F
 Standard Deviation 3.1°F

During the 199 years there have been 23 months with mean temperature 32°F or below - 3 Decembers, 15 Januarys and 5 Februarys, and 13 months with mean temperature 44°F or above - 7 Decembers, 3 Januarys and 3 Februarys.

DECADAL MEAN TEMPERATURES IN EDINBURGH: 1765-1963

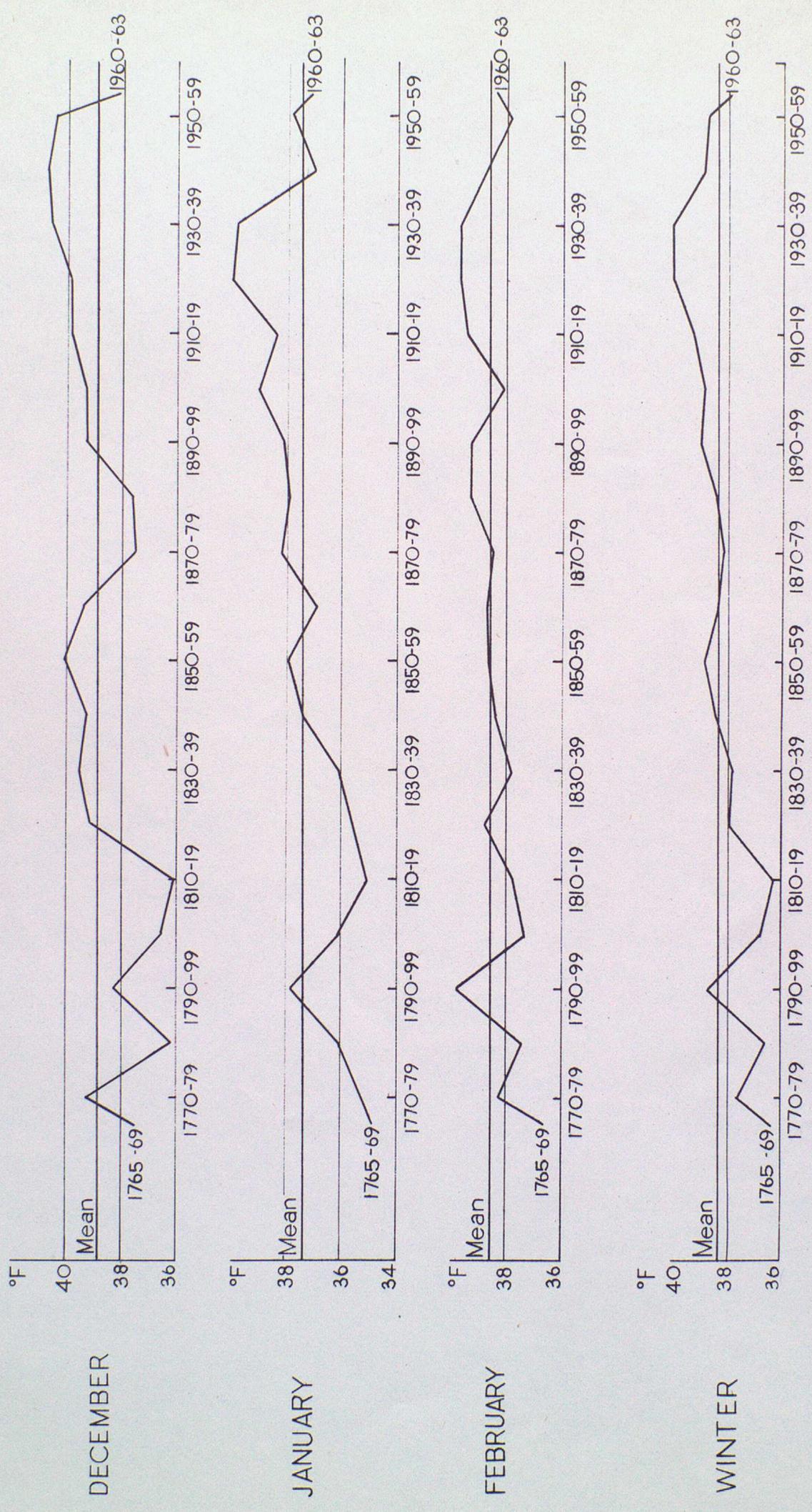


Figure 4