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A COMPARISON
OF
MINIMUM TEMPERATURES
FOR
the periods 17h. to 9h. and 17h. to 17h.

BY

M. A. GIBLETT, M.Sc.

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Prefatory Note.

By the Superintendent, Climatology Division.

The problem with which the following notes are principally concerned was investigated at my request in connection with a suggested revision of the scheme of observations at Health Resorts, from which reports are received at the Meteorological Office by telegram for communication to the newspapers. It is convenient to be able to refer to a minimum temperature reported in the afternoon as the lowest temperature last night. If, however, the minimum is as a matter of fact the lowest value for 24 hours up to 17h., it may have occurred only a short time before the thermometer was read. The proposal to have the minimum temperature for the interval 17h. to 9h., which can honestly be regarded as the " lowest last night," included in the telegrams was under consideration when Mr. Giblett's memoir was prepared and was adopted as from April 3rd, 1921.

To utilise such minima for statistical summaries in which the average minimum temperature is given is a break with tradition, but it appeared to be a wise step, and from April, 1921, the minima given in the *Monthly Weather Report* for stations coming under the scheme, refer to the interval 17h. to 9h.[1]

It is recognised that normal values obtained from stations giving minimum temperatures for 24 hours will not serve without correction as normal minima for the night hours alone. The magnitude of the correction required is here shown to be of the order 0·4°F. in midwinter, though very small in summer.

The last paragraphs of the paper afford an answer to the objection to the scheme of taking the minimum up to 9h. that low temperatures occurring soon after that hour (and, therefore, to be attributed to the end of the fall of temperature which is characteristic of night and early morning) are not reported, though they may be expected to be frequent. Table VII. shows that the event is comparatively rare and that when the minimum up to 17h. is below that up to 9h., it is usually on account of a fall of temperature which culminates after 13h. 30m.

[1] From the same month the maximum temperatures utilised for the Health Resorts have referred to the day hours 9h. to 17h. A like change had been made in the extremes reported by the Telegraphic Stations of the Forecast Service a month earlier.

It may be remarked that the Tables prepared in this investigation do not suffice to answer the question how far the normal minimum for the interval 17h. to 17h. differs from that for other intervals such as 0h. to 24h., 7h. to 7h., 9h. to 9h. and 21h. to 21h., all of which are in use at British Stations, as may be seen by examination of the *Monthly Weather Report* or the *Book of Normals*. Mr. Giblett's work is useful, however, as showing how published Hourly Values can be used to settle such questions. No doubt the normal value of the minimum temperature for 17h. to 17h. is higher than that computed for any of the intervals named. In the case of such a period as 7h. to 7h. it happens very frequently that the same cold morning affects two consecutive minima and, therefore, lowers the average unduly

F.J.W.W.

1.—The Problem.

In climates such as that of the British Isles, large non-periodic variations of temperature may be superposed upon the regular diurnal variation, especially in the winter months. As a result of this the time of occurrence of the minimum temperature for a civil day may be considerably displaced from its normal position, viz.: just about sunrise. Further, since in practice midnight is not a convenient time for minima to be recorded at observing stations, the observations are taken at some other time and the minima refer to periods other than civil days. In view, then, of the variability in the time of incidence of the minimum, it becomes of importance to determine to what extent the results obtained depend on the system of recording chosen.

In connection with a certain inquiry of this nature in the Meteorological Office, the following problem presented itself for solution. If in one of two systems the minimum is recorded at 9h.[1] for the period 17h. to 9h. while in the other it is recorded at 17h. for the period 17h. to 17h., how often will the minima differ and by how much, and will there be an appreciable difference between the monthly and yearly means of one system and those of the other? The results being of interest, they are set out in these notes.

2.—The Data Used.

The material employed consisted of five years records, 1906-10, from the Meteorological Office Observatories at Richmond (Kew Observatory) and Falmouth, viz.:—

(*a*) Tabulations of hourly values[2] of temperature from the photographic thermographs.

[1] The hours are numbered consecutively from 0 to 23 commencing from midnight.

[2] "*Hourly Readings* obtained from the self-recording instruments at four Observatories in connexion with the Meteorological Office." Meteorological Office publication.

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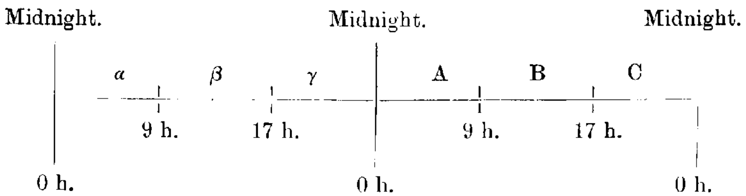
(*b*) Tabulations of the minima for calendar days with their times of occurrence,[1] also from the photographic thermographs.

3.—Method of Procedure.

(*a*) **Notation Used.**—Let α, β, γ, A, B, C denote the six periods into which two consecutive civil days are divided by the hours 0h., 9h., 17h., thus :—



Let $\alpha+\beta$ denote the period from 0h. to 17h. of the first day, and so on.

Let $\overline{\alpha+\beta}$ denote the minimum temperature occurring in this period.

Then $\overline{\alpha+\beta}=\overline{\beta}$ expresses the fact that the minimum temperature during the period $\alpha+\beta$ occurred during the period β. $\overline{\gamma+A}$ will sometimes be referred to as the "night" minimum and $\overline{B}$ as the "day" minimum.

Now of the two systems of recording minima referred to in the statement of the problem in §1, the first gives $\overline{\gamma+A}$ and the second $\overline{\gamma+A+B}$. In all "normal" cases $\overline{\gamma+A+B}=\overline{\gamma+A}$. In the other cases $\overline{\gamma+A+B}=\overline{B}$ (*i.e.*, when $\overline{B}$ is lower than $\overline{\gamma+A}$). The latter are those under consideration.

It was proposed firstly to find the frequency of occurrence of $\overline{\gamma+A+B}=\overline{B}$ and then to analyse these cases in detail and to note for each the value of $\overline{\gamma+A}-\overline{B}$. This quantity having been tabulated for the "abnormal" cases, the required difference between the mean values of $\overline{\gamma+A}$ and $\overline{\gamma+A+B}$ over any period is readily obtainable, since on the "abnormal" days $\overline{\gamma+A}-\overline{\gamma+A+B}=\overline{\gamma+A}-\overline{B}$, while on the remaining "normal" days $\overline{\gamma+A}-\overline{\gamma+A+B}=O$.

The first object might have been achieved by a direct examination of the tabulations of hourly values, but it was found more convenient to classify the data. The additional information provided by the tabulated values of $\overline{\alpha+\beta+\gamma}$ and $\overline{A+B+C}$ together with their times of occurrence enabled each day to be classified according to the following scheme due to Mr. Whipple.

[1] These are given on the manuscript sheets of the *Hourly Readings* in the Meteorological Office.

(*b*) **Classification of the days.**

Class 1, $\overline{A+B+C}=\overline{A}$, $\therefore \overline{\gamma+A+B}=\overline{\gamma+A}$.

Class 2, $\overline{A+B+C}=\overline{B}$,
- Class 2·1, $\overline{\alpha+\beta+\gamma}=\overline{\gamma}$
  - Class 2·11, $\overline{\gamma}<\overline{B}$, $\therefore \overline{\gamma+A+B}=\overline{\gamma+A}$.
  - Class 2·12, $\overline{\gamma}>\overline{B}$, $\therefore \overline{\gamma+A+B}=\overline{B}$.
- Class 2·2, $\overline{\alpha+\beta+\gamma}\neq\overline{\gamma}$, then examine hourly values
  - Class 2·21, $\overline{\gamma}<\overline{B}$, $\therefore \overline{\gamma+A+B}=\overline{\gamma+A}$.
  - Class 2·22, $\overline{\gamma}>\overline{B}$, $\therefore \overline{\gamma+A+B}=\overline{B}$.

Class 3, $\overline{A+B+C}=\overline{C}$,
- Class 3·1, $\overline{\alpha+\beta+\gamma}=\overline{\gamma}$
  - Class 3·11, $\overline{\gamma}<\overline{C}$, $\therefore \overline{\gamma+A+B}=\overline{\gamma+A}$.
  - Class 3·12, $\overline{\gamma}>\overline{C}$, then examine hourly values
    - Class 3·121, $\overline{\gamma+A+B}=\overline{\gamma+A}$.
    - Class 3·122, $\overline{\gamma+A+B}=\overline{B}$.
- Class 3·2, $\overline{\alpha+\beta+\gamma}\neq\overline{\gamma}$, then examine hourly values
  - Class 3·21, $\overline{\gamma+A+B}=\overline{\gamma+A}$.
  - Class 3·22, $\overline{\gamma+A+B}=\overline{B}$.

Decimal notation is used in this scheme, classes 2·1 and 2·2 being sub-divisions of class 2, while classes 2·21, 2·22 are sub-divisions of class 2·2, and so on.

The primary object was to separate all the days into the two kinds, (*a*) those on which $\overline{\gamma+A+B} = \overline{\gamma+A}$, "normal" days from the present point of view, and (*b*) days on which $\overline{\gamma+A+B} = \overline{B}$ "abnormal" from the present standpoint.

Each day was examined separately, and the classes were taken in order. If (class 1) the tabulated data showed $\overline{A+B+C}=\overline{A}$, *i.e.*, the time of occurrence of $\overline{A+B+C}$ was before 9h., it was concluded at once that the day was "normal," *i.e.*, $\overline{\gamma+A+B} = \overline{\gamma+A}$, for clearly $\overline{A}$ must have been lower than $\overline{B}$, and therefore $\overline{\gamma+A}$ lower than $\overline{B}$.

If, however, (class 2) the time of occurrence of $\overline{A+B+C}$ showed that $\overline{A+B+C}=\overline{B}$, then a conclusion as to whether $\overline{\gamma+A+B}=\overline{\gamma+A}$ or $\overline{\gamma+A+B}=\overline{B}$ was not possible at once. If further $\overline{\alpha+\beta+\gamma}=\overline{\gamma}$ (class 2·1), then $\overline{\gamma}$ and $\overline{B}$ were known and clearly $\overline{\gamma+A+B}=\overline{\gamma+A}$ or $\overline{\gamma+A+B}=\overline{B}$ according as $\overline{\gamma}<\overline{B}$ (class 2·11) or $\overline{\gamma}>\overline{B}$ (class 2·12); but if $\overline{\alpha+\beta+\gamma}\neq\overline{\gamma}$ (class 2·2) then $\overline{\gamma}$ was not known and an examination of the hourly values was necessary to decide whether $\overline{\gamma}<\overline{B}$ (class 2·21) and therefore $\overline{\gamma+A+B}=\overline{\gamma+A}$ or $\overline{\gamma}>\overline{B}$ (class 2·22) and therefore $\overline{\gamma+A+B}=\overline{B}$.

Lastly, should $\overline{A+B+C}=\overline{C}$ then the examination was made according to class 3 and its sub-divisions.

Although the scheme may at first sight appear rather complicated, it was found in practice that the data could be classified very quickly and not only was time saved, especially because so many days fell at once into class 1, but the treatment besides being systematic, yielded certain additional information of value.

Each day having been assigned to one of the classes 1, 2·11, 2·12, 2·21, 2·22, 3·11, 3·121, 3·122, 3·21, 3·22, those sought, viz., days on which $\overline{\gamma+A+B}=\overline{B}$, fell into the four classes 2·12, 2·22, 3·122, 3·22. For these days the values of $\overline{\gamma+A}$ and $\overline{B}$ were then tabulated, together with their times of occurrence, and the difference $\overline{\gamma+A}-\overline{B}$ taken.

It should here be noted that in cases in which reference to the hourly tabulations was necessary, the minima obtained were the lowest temperatures occurring at exact hours and therefore not exactly the true minima. No reference was made to the actual curves for this purpose. The small error thus introduced does not materially affect the results given.

Further, all times quoted are G.M.T., equation of time not having been applied in any case, and no allowance having been made for the difference of about 20 minutes between G.M.T. and mean time on the Falmouth meridian.

4.—The Solution.

(*a*) **The frequency of occurrence of $\overline{\gamma + A + B} = \overline{B}$.**—Table 1 gives for Kew and Falmouth the monthly and yearly distribution of the number of occasions during the five years 1906-10 on which $\overline{\gamma + A + B} = \overline{B}$, *i.e.*, on which the lowest temperature during the 24 hours from 17h. one day to 17h. the next, occurred after 9h. or the "day" minimum was lower than the "night." The figures referred to are those in the first of the two rows against each year.

TABLE I.—NUMBER OF OCCASIONS ON WHICH $\overline{\gamma + A + B} = \overline{B}$ IN THE 5 YEARS 1906–10.

Monthly and Yearly Distribution.

KEW.

—	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
1906 ...	3	2	3	0	0	1	1	0	0	2	4	7	23
	2	1	2	0	0	0	0	0	0	0	3	5	13
1907 ...	5	1	0	2	3	1	1	0	0	2	4	6	25
	2	0	0	2	3	0	1	0	0	0	2	4	14
1908 ...	6	0	1	1	0	0	0	2	1	1	3	9	24
	3	0	1	1	0	0	0	1	0	0	1	3	10
1909 ...	8	1	2	0	0	0	0	0	0	5	1	6	23
	2	1	0	0	0	0	0	0	0	2	0	2	7
1910 ...	5	3	1	2	2	1	1	1	0	3	1	4	24
	4	2	1	2	1	1	1	1	0	0	1	0	14
Totals five years.	27	7	7	5	5	3	3	3	1	13	13	32	119
	13	4	4	5	4	1	2	2	0	2	7	14	58

FALMOUTH.

1906 ...	3	4	1	1	0	1	0	0	0	2	6	7	25
	2	4	1	1	0	0	0	0	0	1	3	5	17
1907 ...	6	1	1	1	2	0	1	0	0	1	3	2	18
	2	1	0	0	1	0	0	0	0	0	2	1	7
1908 ...	7	1	2	1	0	1	1	1	2	0	5	8	29
	3	1	1	1	0	1	0	0	1	0	1	3	12
1909 ...	4	3	2	2	1	1	0	0	1	5	4	8	31
	1	0	1	1	0	0	0	0	0	3	2	5	13
1910 ...	3	5	2	1	1	1	1	0	1	5	7	8	35
	2	3	0	1	0	0	0	0	0	4	4	5	19
Totals five years.	23	14	8	6	4	4	3	1	4	13	25	33	138
	10	9	3	4	1	1	0	0	1	8	12	19	68

The figures in the second row against each year show the result of omitting from the first row all cases in which the value obtained for $\overline{\gamma + A} - \overline{B}$ was less than 1°F

As pointed out in §3, in many cases the value for a minimum such as $\overline{\gamma+A}$ or $\overline{B}$ was taken from the hourly tabulations and therefore was not the true minimum but somewhat higher, being the lowest temperature occurring at an exact hour. In this work the error is negligible. It may be noted that it is always of the same sign, the minimum not being taken quite low enough in each case. Hence the error tends to be reduced when the difference $\overline{\gamma+A}-\overline{B}$ of two minima is taken. Little would have been gained by the very considerable work of remeasuring the thermograph curves for the purpose in view. In Table I. a second row of figures has been given against each year showing the result of omitting from the first row all cases in which the value obtained for the difference $\overline{\gamma+A}-\overline{B}$ of the minima before and after 9h. was less than 1°F.

As regards the variation from year to year as shown by Table I. there is nothing significant to be noted. The very close agreement between the yearly totals for Kew is probably accidental. Further, while the general similarity between the results for Kew and Falmouth is striking, there is no obvious relation between the year to year variations at the two places. The monthly values show, as might be expected, the greatest frequencies for every year in the winter months. However, the fact that all the cases are not confined to those months, but that some are noted in all months of the year, is in itself interesting. Figure 1 shows graphically the monthly distribution of the 5-year totals for Kew and Falmouth, and Figure 2 the result of omitting those cases in which the value obtained for the difference $\overline{\gamma+A}-\overline{B}$, of the minima before and after 9h. was less than 1°F. Figure 3 has been added to illustrate the effect of omitting cases in which the difference was less than 2°F.

In Figure 1 there is a slow fall of frequency during the Spring and Summer months to a minimum in August in the case of Falmouth and September in the case of Kew, then a rapid rise to a maximum in December at both places. The high frequency is well maintained in January at Kew but the fall is rapid to February in the case of Kew and March of Falmouth. These characteristics are also evident in Figures 2 and 3. In all three figures there is noteworthy tendency for the Falmouth frequencies to be more scattered on either side of the December maximum than in the case of Kew. This is connected doubtless with the more continental characteristics of the Kew climate.

The general agreement between the actual frequencies for Kew and Falmouth is very close. The maximum of 32 for Kew and 33 for Falmouth (Figure 1) shows that the minimum temperature for the 24 hours 17h. to 17h. occurred after 9h. on an average 6 or 7 times in each December. The highest actually recorded was (Table I.) 9 in December, 1908, at Kew, and the lowest 2

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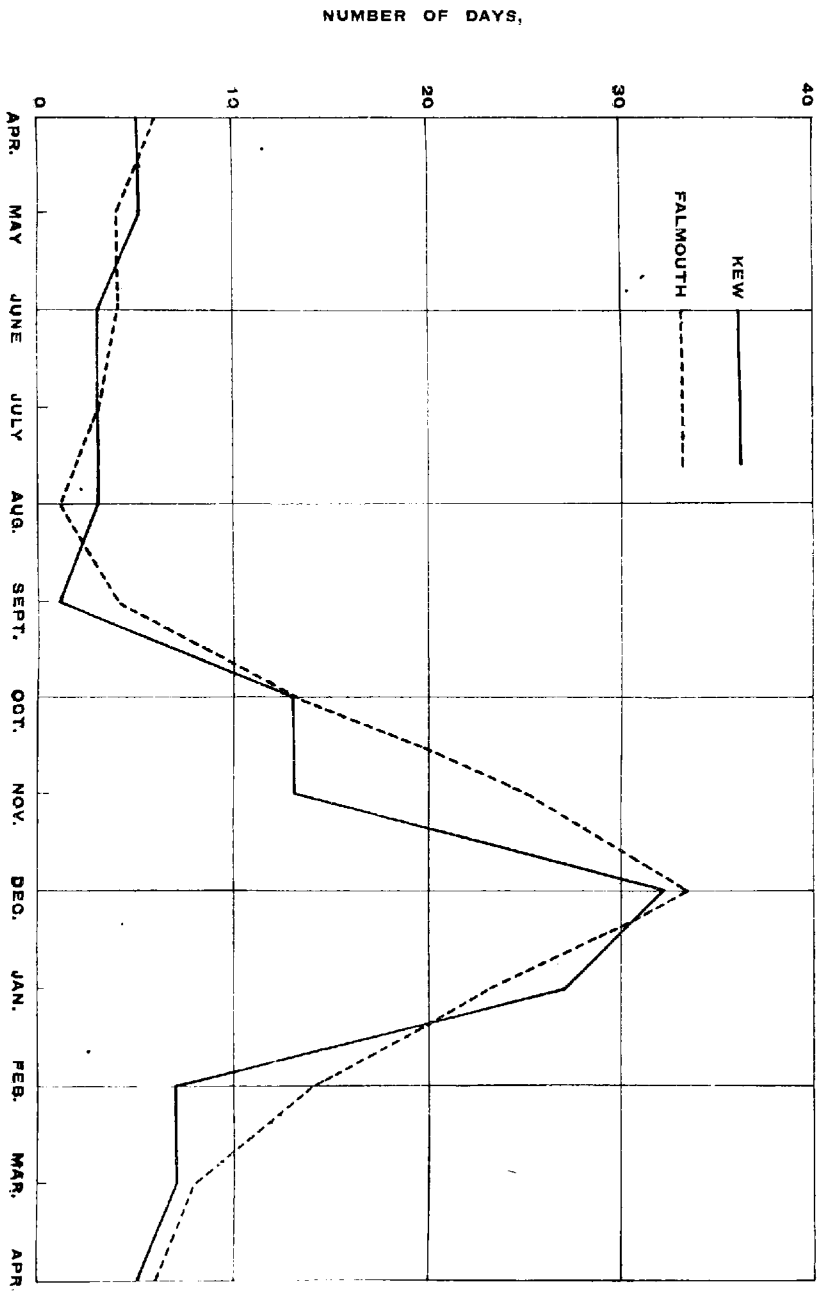
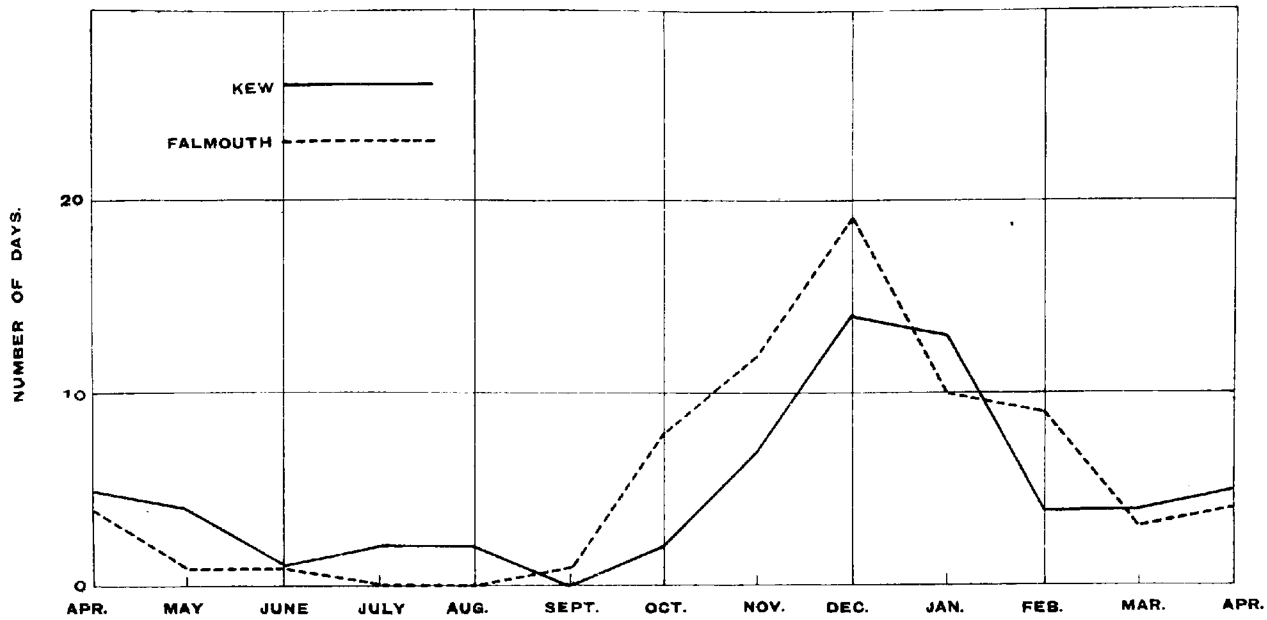


NUMBER OF DAYS ON WHICH $\overline{\gamma + A + B} = \bar{B}$ IN THE 5 YEARS 1906—10. (§ 4 a).

NUMBER OF DAYS ON WHICH $\overline{\gamma + A + B} = \overline{B}$ IN THE 5 YEARS 1906–10, OMITTING CASES IN WHICH $\overline{\gamma + A} - \overline{B} < 1°F$ (§ 4 a).



in December (1907) at Falmouth. Further, excluding cases of very small differences between $\overline{\gamma + A}$ and $\bar{B}$ (less than 1°F.), the average December frequency is reduced to about 3 for Kew and 4 for Falmouth.

The general conclusion is that occasions on which the "day" minimum falls below the "night" are by no means uncommon in December and January, and that they may occur in any month of the year, though the average did not exceed once a month from April to September at Kew and May to September at Falmouth for the years under discussion.

(*b*) **The magnitude of the difference $\overline{\gamma + A - B}$ for the cases in which $\overline{\gamma + A + B} = \bar{B}$.**—Table II. shows how the 5-year totals of Table I. were distributed according to the magnitude of the difference $\overline{\gamma + A - B}$ between the "night" and "day" minima. It will be seen that small differences (less than 1°F.) were most numerous. On one occasion in March at Kew, the "day"

TABLE II.—NUMBER OF OCCASIONS ON WHICH $\overline{\gamma + A + B} = \bar{B}$ IN THE 5 YEARS 1906–10 ARRANGED ACCORDING TO THE MAGNITUDE OF $\overline{\gamma + A - B}$.

Monthly Distribution.

$\overline{\gamma + A - B}$.	Jan.	Feb.	Mar.	Apl.	May.	Jun	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total 5 yrs.
KEW.													
< 1° F.	14	3	3	—	1	2	1	1	1	11	6	18	61
1—1·9	7	2	1	3	2	1	2	1	—	1	5	4	29
2—2·9	4	2	1	—	2	—	—	1	—	—	1	6	17
3—3·9	1	—	—	2	—	—	—	—	—	1	—	2	6
4—4·9	—	—	—	—	—	—	—	—	—	—	—	1	1
5—5·9	—	—	1	—	—	—	—	—	—	—	1	1	3
6—6·9	1	—	—	—	—	—	—	—	—	—	—	—	1
7—7·9	—	—	—	—	—	—	—	—	—	—	—	—	0
8—8·9	—	—	1	—	—	—	—	—	—	—	—	—	1
Total 5 years	27	7	7	5	5	3	3	3	1	13	13	32	119
FALMOUTH.													
< 1° F.	13	5	5	2	3	3	3	1	3	5	13	14	70
1—1·9	4	3	2	2	—	—	—	—	1	4	5	11	32
2—2·9	5	5	—	1	1	1	—	—	—	1	4	3	21
3—3·9	—	—	1	—	—	—	—	—	—	1	1	2	5
4—4·9	1	—	—	—	—	—	—	—	—	2	1	1	5
5—5·9	—	1	—	—	—	—	—	—	—	—	—	—	1
6—6·9	—	—	—	1	—	—	—	—	—	—	1	—	2
7—7·9	—	—	—	—	—	—	—	—	—	—	—	2	2
Total 5 years	23	14	8	6	4	4	3	1	4	13	25	33	138

minimum fell below the "night" minimum by between 8° and 9°F., while at Falmouth a difference of between 7° and 8°F. was recorded on two occasions in December. The general agreement between Kew and Falmouth was again marked, and the record differences just referred to were very much the same at both stations though occurring on different occasions.

Differences of less than 3°F. may be regarded as fairly common both at Kew and Falmouth, the 5-year totals being 107 at Kew (*i.e.*, an average of about 21 times a year), and 123 at Falmouth (about 25 times a year). The 5-year totals of cases with differences greater than 3°F. were 12 for Kew and 15 for Falmouth, an average of 2 or 3 cases a year. No such case occurred at Kew or Falmouth during the months May to September inclusive. A difference exceeding 9°F. was not recorded at all during the 5 years, but that a difference as great as 8°F. may occur is striking.

(*c*) **The effect on the means.**—Monthly and yearly means deduced from minima obtained by observations according to the first system, *i.e.*, $\overline{\gamma+A+B}$, may fall below those deduced from minima obtained by the second system, *i.e.*, $\overline{\gamma+A}$, because of the occurrence, as established above, of numerous cases in which $\overline{\gamma+A+B}=\overline{B}$. The amounts by which the means differed during the five years under consideration are shown in Table III. for

TABLE III.—DIFFERENCE BETWEEN MEAN VALUE OF $\overline{\gamma+A+B}$ AND THAT OF $\overline{\gamma+A}$ IN DEGREES FAHRENHEIT.

Monthly and Yearly Distribution.

KEW.

Year.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
1906 ...	0·12	0·07	0·37	0·00	0·00	0·01	0·03	0·00	0·00	0·03	0·35	0·52	0·13
1907 ...	0·31	0·01	0·00	0·15	0.22	0·03	0·06	0·00	0·00	0·04	0·12	0·35	0·11
1908 ...	0·26	0·00	0·03	0·10	0·00	0·00	0·00	0·11	0·03	0 02	0·08	0·34	0·08
1909 ...	0·16	0·09	0·04	0·00	0·00	0·00	0·00	0·00	0·00	0·17	0·02	0·19	0·06
1910 ...	0·25	0·16	0·19	0·10	0·07	0·03	0·03	0·05	0·00	0·04	0·06	0·09	0·09
5 years ...	0·22	0·07	0·13	0·07	0·06	0·01	0·02	0·03	0·01	0·06	0·13	0·30	0·09

FALMOUTH.

1906 ...	0·16	0·46	0·03	0·09	0·00	0·01	0 00	0·00	0·00	0·15	0·38	0·62	0·16
1907 ...	0·15	0·04	0·06	0·04	0·03	0·07	0·00	0·00	0·01	0·02	0·11	0·10	0·05
1908 ...	0·23	0·04	0·07	0·04	0·00	0·07	0·01	0·03	0·04	0·00	0·20	0 33	0·09
1909 ...	0·08	0·01	0·10	0·06	0·01	0·02	0·00	0·00	0·03	0·30	0·12	0·51	0·10
1910 ...	0·20	0·26	0·03	0·21	0·03	0·01	0·02	0·00	0·01	0·28	0·36	0·38	0·15
5 years ...	0·16	0·16	0·06	0·09	0·01	0·04	0·01	0·01	0·02	0·15	0 23	0·39	0·11

Professional Notes No. 22.

NUMBER OF DAYS ON WHICH $\overline{\gamma + A + B} = \overline{B}$ IN THE 5 YEARS 1906–10, OMITTING CASES IN WHICH $\overline{\gamma + A} - \overline{B} < 2°F$ (§ 4 a).

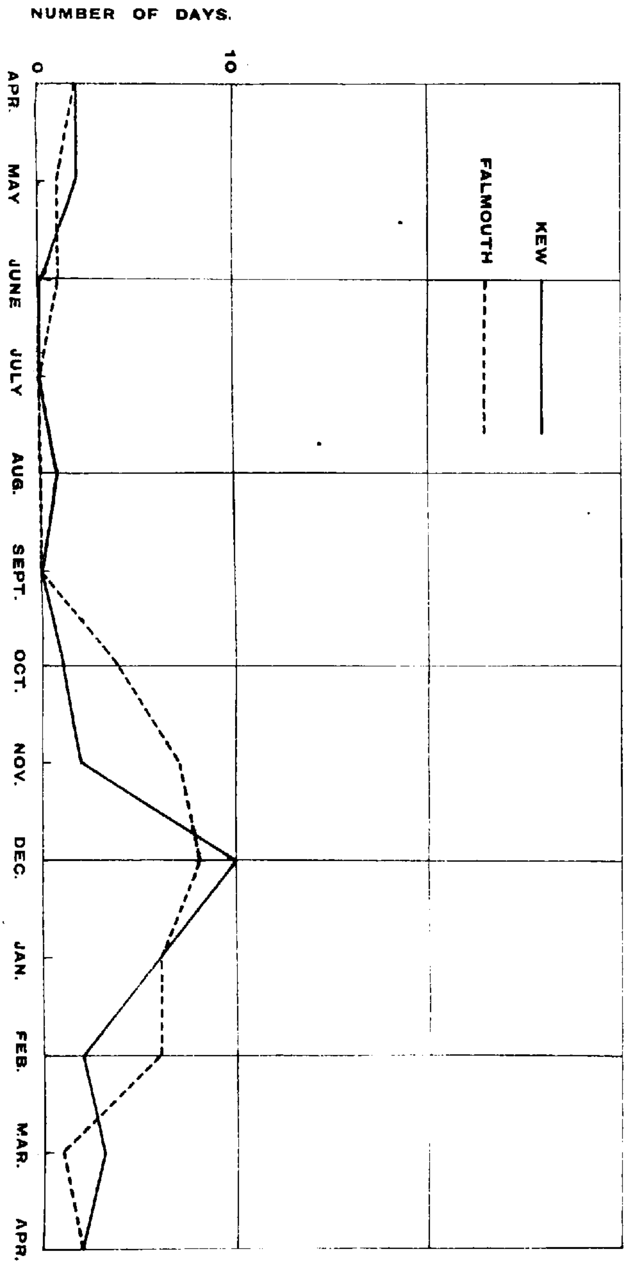


Figure 4.

Professional Notes No. 22.

DIFFERENCE BETWEEN MONTHLY MEANS, TAKEN OVER THE 5 YEARS, 1906—10, OF $\overline{\gamma + A + B}$ AND $\overline{\gamma + A}$ (§ 4 c).

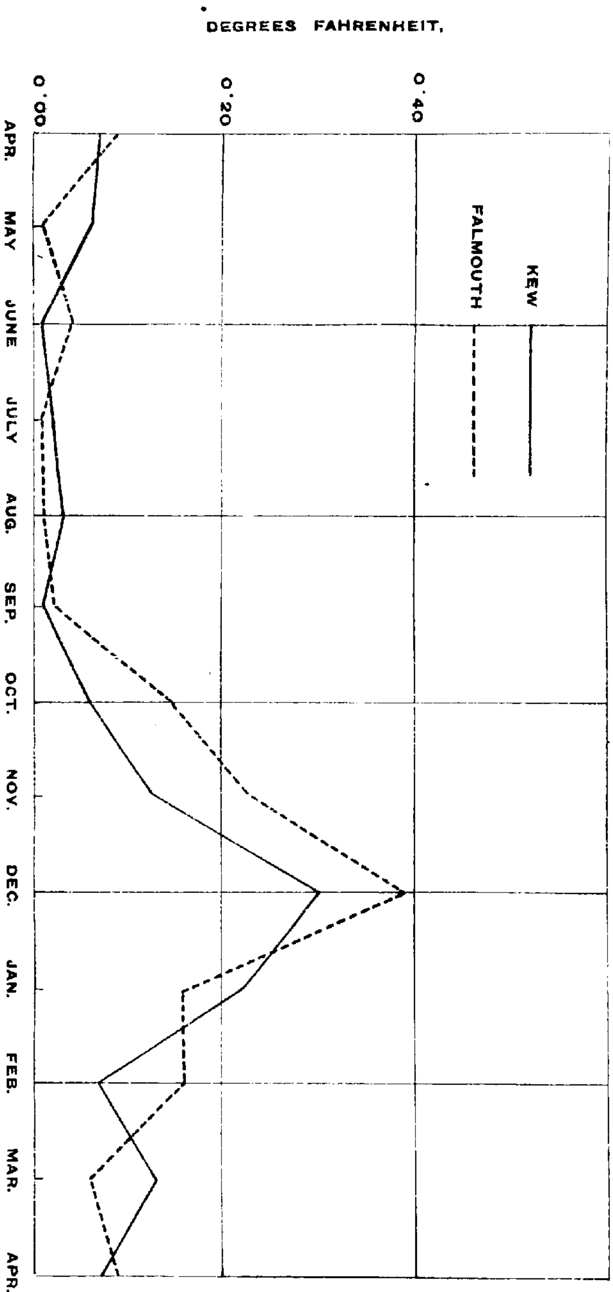
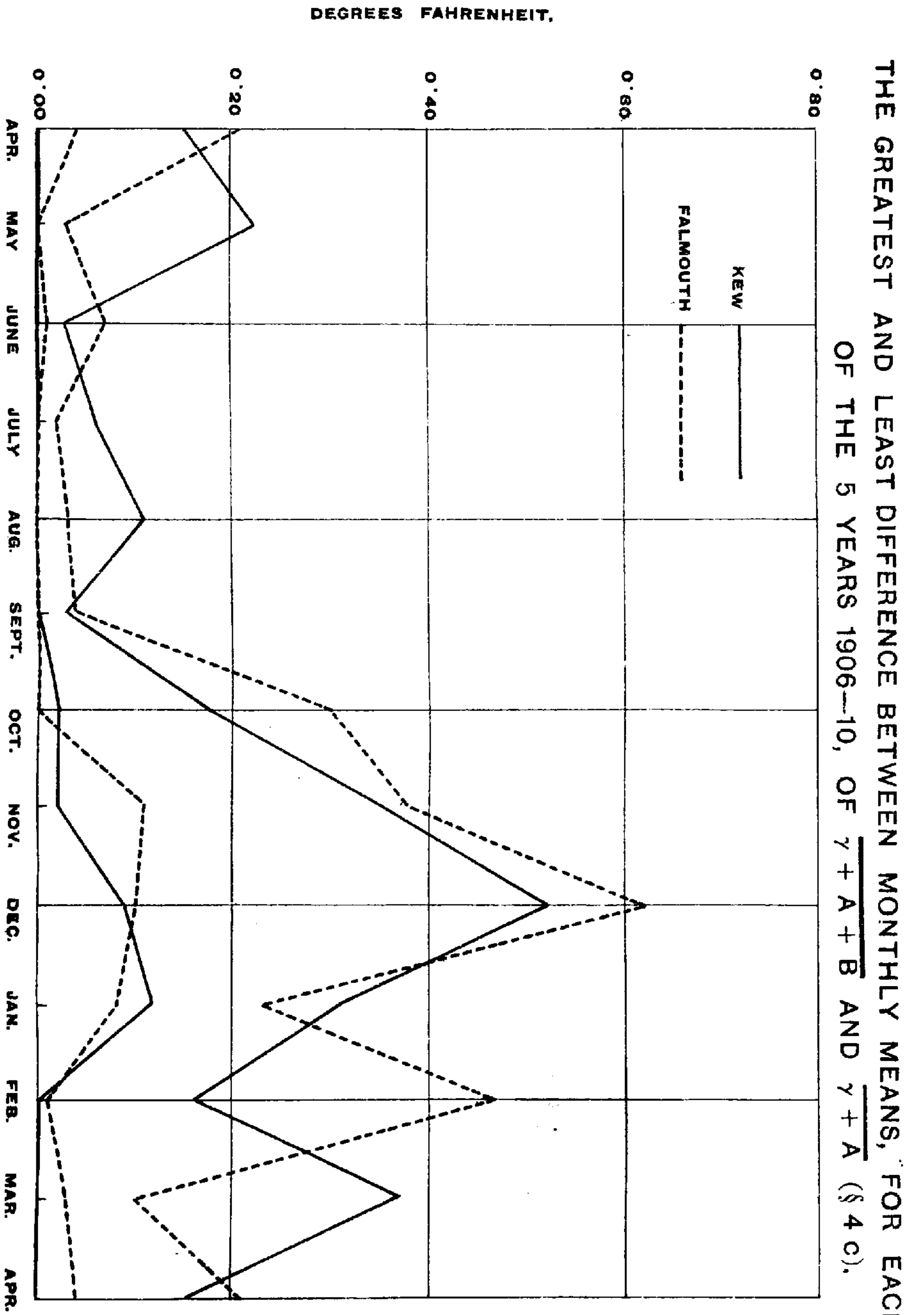


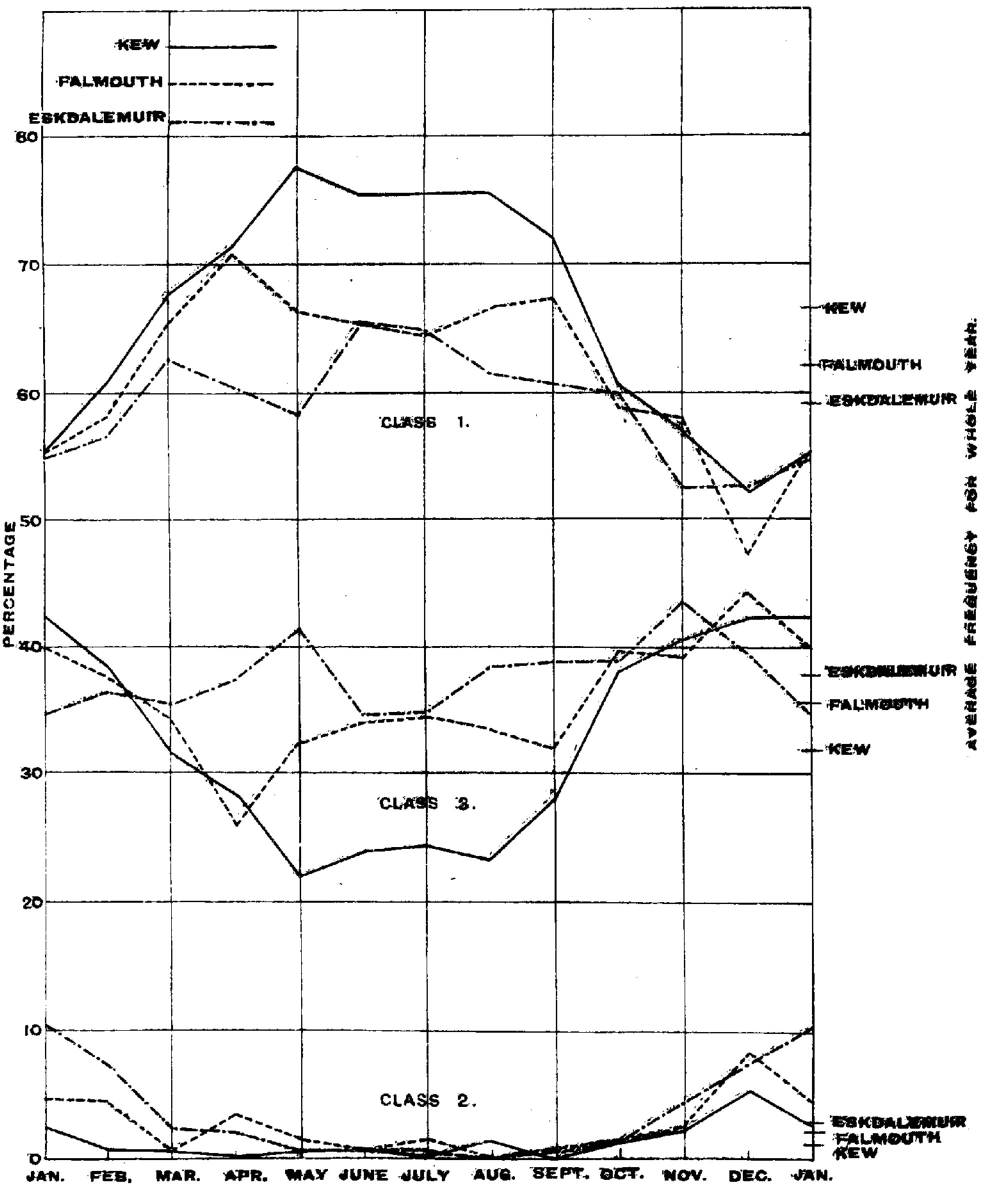
Figure 5.

Professional Notes No. 22.



Professional Notes No. 22.

PERCENTAGE FREQUENCY OF OCCURRENCE OF DAYS OF CLASSES 1, 2 AND 3 IN THE 5 YEARS 1906—10. (§ 5 b).



Kew and Falmouth. The figures given were actually obtained from the values of $\overline{\gamma + A - B}$ tabulated, as mentioned in § 3 (*a*), for those days on which $\overline{\gamma + A + B} = \overline{B}$.

The means are given in the tables to the second decimal place, but should not be regarded as accurate to that degree on account of the considerations of §4 (*a*).

The tables show that while in certain cases the difference between the means is negligible yet it may, as in December, 1906, amount to more than 0·5°F. The greatest difference shown is 0·62°F. at Falmouth in that year. There is again, in general, a great resemblance between the results for the two stations.

Taking the monthly means over the whole five years, as shown graphically in Figure 4, there is a marked annual variation, the greatest differences being found in the winter months, especially December. At both stations the difference is still small in September and does not commence to rise to the winter maximum until October.

In Figure 5 are plotted the extreme values of the monthly means of Table III., irrespective of the year in which they occurred.

This completes the information required as a solution to the problem set out in §1.

Another problem, not dealt with here, arises when it is desired to know what is the effect of attributing the values of $\overline{\gamma + A + B}$ in the first system or $\overline{\gamma + A}$ in the second, to the civil days on which the observations are taken, *i.e.*, of taking these as the values of $\overline{A + B + C}$. The error is probably appreciable. Ellis,[1] using Greenwich data, has compared the mean maxima and minima for civil days (*a*) with those for the 24 hours commencing 9h. on the previous day, and (*b*) with those for the 24 hours commencing 21h. of the previous day. For the minima he found that in winter the civil day mean may be somewhat above the other. In (*a*) the mean for the 4 years 1886-89 gave for December an excess of 0·05°F. and for January 0·27°F., while in (*b*) the three years 1886-88 gave for December an excess of 0·10°F. and for January zero. In all other months the civil day mean was the lower, the greatest difference occurring in September, viz. : 1·05°F. in (*a*) and 0·57°F in (*b*). In the present work September is the month when the effects investigated are least while they are greatest in the winter months.

[1] "On the Difference produced in the Mean Temperature derived from Daily Maximum and Minimum Readings, as depending on the time at which the Thermometers are read."—*Q.J.R. Met. Soc.*, Vol. XVI. 1890, pp. 213–220.

In the following paragraphs are included some further notes on points arising in connection with the present investigation.

5.—Further Notes.

(*a*) **The frequency of occurrence of the various classes of days.**—Table IV shows how the days of the five years 1906-10 were distributed amongst the classes of the scheme detailed in paragraph .

TABLE IV.—NUMBER OF TIMES OF OCCURRENCE OF DAYS OF THE VARIOUS CLASSES IN THE 5 YEARS 1906–10.

Monthly Distribution.

KEW.

Class.	Jan.	Feb.	Mar.	Apl.	May.	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total 5 yrs.
1 ...	85·5	85·5	105	107	120	113	117	117	108	94	85·5	81	1218·5
2·11 ...	0	0	0	0	0	0	0	0	0	0	0·5	0	0·5
2·12 ...	3	0	1	0	0	0	0	0	0	0	0	3·5	7·5
2·21 ...	0	0	0	0	0	0	0	0	0	0	1	1	2·0
2·22 ...	1	1	0	0	1	1	0	2	0	2	2	4	14·0
3·11 ...	0	1	0	0	0	0	0	0	0	3	1·5	1	6·5
3·121 ...	15·5	12·5	10	5	5	5·5	5	5	5	13	12·5	13	107·0
3·122 ...	10·5	2	1	2	0	1	1	0	0	3	2	5	27·5
3·21 ...	27	35	33	33	25	28·5	30	30	36	32	36	27	372·5
3·22 ...	12·5	4	5	3	4	1	2	1	1	8	9	19·5	70·0
Total 5 years.	155	141	155	150	155	150	155	155	150	155	150	155	1826

FALMOUTH.

Class.	Jan.	Feb.	Mar.	Apl.	May.	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total 5 yrs.
1 ...	85·5	82	101	106	103	98	99·5	103	101	91·5	87	73·5	1131·0
2·11 ...	0·5	1	0	0	0	0	0	0	0	0	0	1	2·5
2·12 ...	6	2	0	0	0	0	2	0	0	1	1	5	17·0
2·21 ...	0	0	0	1	0	0	0	0	0	0	2	1	4·0
2·22 ...	1	3	1	4	2	1	0	0	1	1	1	6	21·0
3·11 ...	0·5	2	0	0	0	0·5	1	3	3	2	2	5	19·0
3·121 ...	15·5	14	14·5	4	10	10	6	13	7·5	17	11	14	136·5
3·122 ...	4	4	2	0	1	0	1	0	0	4	8	10	34·0
3·21 ...	30	28	31·5	33	38	37·5	45·5	35	34·5	31·5	23	27·5	395·0
3·22 ...	12	5	5	2	1	3	0	1	3	7	15	12	66·0
Total 5 years.	155	141	155	150	155	150	155	155	150	155	150	155	1826

3(*b*). The decimals appearing in the tables are occasioned by the fact that on some days equal minima occurred at two different times and it was necessary to assign them as 0·5 to each of two classes.

The five-year totals of the various classes are very similar at Kew and Falmouth. Taking first the "abnormal" days, *i.e.*, days on which $\overline{\gamma+A+B}=\overline{B}$, these constitute classes 2.12, 2.22, 3.122, 3.22. Class 3.22 is by far the greatest. A reference to the scheme of §3 (*b*) shows that these are "abnormal" cases in which $\overline{A+B+C}=\overline{C}$, and $\overline{a+\beta+\gamma}\neq\overline{\gamma}$, *i.e.*, in which the civil day minimum occurs after 17h. with that of the previous day before 17h.

Class 3.122 contains about half as many days as the last at Falmouth and less than half at Kew. These are the "abnormal" cases in which $\overline{A+B+C}=\overline{C}$, $\overline{a+\beta+\gamma}=\overline{\gamma}$, and $\overline{\gamma}>C$, *i.e.*, the civil day minimum occurs after 17h. while that of the previous day also occurs after 17h. but is not so low.

Class 2.22 is still smaller. In these "abnormal" cases $\overline{A+B+C}=\overline{B}$ and $\overline{a+\beta+\gamma}\neq\overline{\gamma}$, *i.e.*, the civil day minimum occurs between 9h. and 17h. and that of the previous day before 17h.

Finally Class 2·12 is the smallest. Here $\overline{A+B+C}=\overline{B}$, $\overline{a+\beta+\gamma}=\overline{\gamma}$, and $\overline{\gamma}>\overline{B}$, *i.e.*, the civil day minimum occurs between 9h. and 17h., while that of the previous day occurs after 17h. and is not so low.

It should be noted, however, that while classes 2.12 and 2.22 are actually much smaller than 3.122 and 3.22 they contain nearly all the cases coming under class 2, while 3.122 and 3.22 contain considerably less than half the total number of cases in class 3.

Taking now the "normal" days, viz., those on which $\overline{\gamma+A+B}=\overline{\gamma+A}$, at Kew three-quarters and at Falmouth two-thirds fall into class 1, where $\overline{A+B+C}=\overline{A}$, *i.e.*, the civil day minimum occurs before 9h.

Of the remainder, class 3.21 claims the most days. These are "normal" cases in which $\overline{A+B+C}=\overline{C}$ and $\overline{a+\beta+\gamma}\neq\overline{\gamma}$, *i.e.*, the civil day minimum occurs after 17h. and that of the previous day before 17h.

Class 3.121 contains fewer days. These are "normal" cases in which $\overline{A+B+C}=\overline{C}$, $\overline{a+\beta+\gamma}=\overline{\gamma}$ and $\overline{\gamma}>\overline{C}$ *i.e.*, the civil day minimum occurs after 17h., while that of the previous day occurs likewise after 17h. and is not so low.

Classes 2.21 and 2.11 contain very few days indeed, class 2.21 tending to preponderate. Thus when $\overline{A+B+C}=\overline{B}$, the chance of having $\overline{\gamma+A+B}=\overline{\gamma+A}$ is very small.

(*b*) **Note on the time of occurrence of civil day minima.**—Table V. shows the frequency of occurrence of civil day minima before 9h., between 9h. and 17h., and after 17h., the three classes

The five-year totals of the various classes are very similar at Kew and Falmouth. Taking first the "abnormal" days, *i.e.*, days on which $\overline{\gamma+A+B}=\overline{B}$, these constitute classes 2.12, 2.22, 3.122, 3.22. Class 3.22 is by far the greatest. A reference to the scheme of §3 (*b*) shows that these are "abnormal" cases in which $\overline{A+B+C}=\overline{C}$, and $\overline{\alpha+\beta+\gamma}\neq\overline{\gamma}$, *i.e.*, in which the civil day minimum occurs after 17h. with that of the previous day before 17h.

Class 3.122 contains about half as many days as the last at Falmouth and less than half at Kew. These are the "abnormal" cases in which $\overline{A+B+C}=\overline{C}$, $\overline{\alpha+\beta+\gamma}=\overline{\gamma}$, and $\overline{\gamma}>\overline{C}$, *i.e.*, the civil day minimum occurs after 17h. while that of the previous day also occurs after 17h. but is not so low.

Class 2.22 is still smaller. In these "abnormal" cases $\overline{A+B+C}=\overline{B}$ and $\overline{\alpha+\beta+\gamma}\neq\overline{\gamma}$, *i.e.*, the civil day minimum occurs between 9h. and 17h. and that of the previous day before 17h.

Finally Class 2·12 is the smallest. Here $\overline{A+B+C}=\overline{B}$, $\overline{\alpha+\beta+\gamma}=\overline{\gamma}$, and $\overline{\gamma}>\overline{B}$, *i.e.*, the civil day minimum occurs between 9h. and 17h., while that of the previous day occurs after 17h. and is not so low.

It should be noted, however, that while classes 2.12 and 2.22 are actually much smaller than 3.122 and 3.22 they contain nearly all the cases coming under class 2, while 3.122 and 3.22 contain considerably less than half the total number of cases in class 3.

Taking now the "normal" days, viz., those on which $\overline{\gamma+A+B}=\overline{\gamma+A}$, at Kew three-quarters and at Falmouth two-thirds fall into class 1, where $\overline{A+B+C}=\overline{A}$, *i.e.*, the civil day minimum occurs before 9h.

Of the remainder, class 3.21 claims the most days. These are "normal" cases in which $\overline{A+B+C}=\overline{C}$ and $\overline{\alpha+\beta+\gamma}\neq\overline{\gamma}$, *i.e.*, the civil day minimum occurs after 17h. and that of the previous day before 17h.

Class 3.121 contains fewer days. These are "normal" cases in which $\overline{A+B+C}=\overline{C}$, $\overline{\alpha+\beta+\gamma}=\overline{\gamma}$ and $\overline{\gamma}>\overline{C}$ *i.e.*, the civil day minimum occurs after 17h., while that of the previous day occurs likewise after 17h. and is not so low.

Classes 2.21 and 2.11 contain very few days indeed, class 2.21 tending to preponderate. Thus when $\overline{A+B+C}=\overline{B}$, the chance of having $\overline{\gamma+A+B}=\overline{\gamma+A}$ is very small.

(*b*) **Note on the time of occurrence of civil day minima.**— Table V. shows the frequency of occurrence of civil day minima before 9h., between 9h. and 17h., and after 17h., the three classes

1, 2, and 3, being shewn without sub-divisions. These results are shown graphically in Fig. 6, but before plotting them it was thought desirable to eliminate differences due to inequalities in the length of the months by expressing the frequencies as percentages. These are shown in Table VI. with the addition of the corresponding figures for Eskdalemuir for the six years 1911-16 deduced from results in a paper by Dr. Crichton Mitchell.[1]

TABLE V.—NUMBER OF TIMES OF OCCURRENCE OF DAYS OF CLASSES 1, 2, 3, IN THE 5 YEARS 1906–10.

Monthly Distribution.

KEW.

—	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Class 1 ...	85·5	85·5	105	107	120	113	117	117	108	94	85·5	81
Class 2 ...	4	1	1	0	1	1	0	2	0	2	3·5	8·5
Class 3 ...	65·5	54·5	49	43	34	36	38	36	42	59	61	65·5
Total ...	155	141	155	150	155	150	155	155	150	155	150	155

FALMOUTH.

—	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Class 1 ...	85·5	82	101	106	103	98	99·5	103	101	91·5	87	73·5
Class 2 ...	7·5	6	1	5	2	1	2	0	1	2	4	13
Class 3 ...	62	53	53	39	50	51	53·5	52	48	61·5	59	68·5
Total ...	155	141	155	150	155	150	155	155	150	155	150	155

TABLE VI.—FREQUENCY OF OCCURRENCE OF DAYS OF CLASSES 1, 2, 3, IN THE 5 YEARS 1906–10, EXPRESSED AS PERCENTAGES.

Monthly Distribution.

KEW.

—	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Class 1 ...	55·2	60·6	67·8	71·3	77·4	75·3	75·5	75·5	72·0	60·7	57·0	52·3	66·7
Class 2 ...	2·6	0·7	0·6	0·0	0·6	0·7	0·0	1·3	0·0	1·3	2·3	5·5	1·3
Class 3 ...	42·2	38·7	31·6	28·7	22·0	24·0	24·5	23·2	28·0	38·0	40·7	42·2	32·0
Total ...	100	100	100	100	100	100	100	100	100	100	100	100	100

[1] "On the Diurnal Incidence of Maximum and Minimum temperatures at Eskdalemuir." *Journal of the Scottish Meteorological Society.* Vol. XVII., 3rd Ser. No. XXXIV.

A Comparison of Minimum Temperatures for the periods 17h. to 9h. and 17h. to 17h.

FALMOUTH.

—	Jan.	Feb.	Mar.	Apl.	May.	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Class 1 ...	55·2	58·2	65·2	70·7	66·4	65·3	64·3	66·5	67·3	59·0	58·0	47·4	62·0
Class 2 ...	4·8	4·3	0·6	3·3	1·3	0·7	1·3	0·0	0·7	1·3	2·7	8·4	2·4
Class 3 ...	40·0	37·5	34·2	26·0	32·3	34·0	34·5	33·5	32·0	39·7	39·3	44·2	35·6
Total ...	100	100	100	100	100	100	100	100	100	100	100	100	100

ESKDALEMUIR.[1]

Class 1 ...	55·0	56·6	62·6	60·4	58·3	65·1	64·8	61·7	60·6	59·9	52·5	52·9	59·2
Class 2 ...	10·4	7·1	2·2	2·0	0·6	0·6	0·5	0·0	0·5	1·1	4·2	7·6	3·0
Class 3 ...	34·6	36·3	35·2	37·6	41·1	34·3	34·7	38·3	38·9	39·0	43·3	39·5	37·8
Total ...	100	100	100	100	100	100	100	100	100	100	100	100	100

In Figure 6 the highest set of curves refers to days of Class 1 with minima before 9h., the lowest set to days of Class 2 with minima between 9h. and 17h. and the middle set to days of Class 3 with minima after 17h. If every day had the normal diurnal range, and there was no very large day to day change of temperature, Class 1 would contain 100 per cent. of the days Actually Class 3 contains a considerable percentage.

The curves show a marked annual range at Kew and Falmouth, but it is not so marked at Eskdalemuir. The percentages of class 1 are very much the same at all three places from October to March, but Kew asserts itself in the summer months, Falmouth falling intermediate between it and Eskdalemuir. Kew and Falmouth both show a secondary maximum in the summer for class 3, and corresponding secondary minima for class 1. The average frequency of the three classes for the whole year is shown on the right of the diagram.

(*c*) **Some particular cases of** $\overline{\gamma+A}+\overline{B}=\overline{B}$.—Reference to Table II shows that both at Falmouth and Kew there were, during the 5 years 1906–10, 5 days on which $\overline{\gamma+A}+\overline{B}=\overline{B}$, with $\overline{\gamma+A}-\overline{B}$ as great or greater than 5°F. These cases seem worth considering in more detail. They were :—

Kew.	Class.	$\overline{\gamma+A}-\overline{B}$	Falmouth.	Class.	$\overline{\gamma+A}-\overline{B}$
(2) Mar. 2nd 1906	3.22	8·3°F.	(1) Feb. 23rd 1906	3.22	5·3°F.
(3) Nov. 30th 1906	3.22	5·8°F.	(3) Nov. 30th 1906	3.22	6·7°F.
(4) Dec. 5th 1906	3.22	5·1°F.	(4) Dec. 5th 1906	2.22	7·7°F.
(5) Jan. 2nd 1907	3.22	6·0°F.	(6) Dec. 12th 1909	3·122	7·2°F.
(7) Mar. 18th 1910	2.12	6·0°F.	(8) Apr. 13th 1910	3.22	6·4°F.

[1] Deduced from Dr. Crichton Mitchell's results "On the Diurnal Incidence of Maximum and Minimum Temperatures at Eskdalemuir." *Journal of the Scottish Meteorological Society*, Vol. XVII., 3rd Series, No. XXXIV.

The values for $\overline{\gamma+A}-\overline{B}$ may be somewhat in error in the decimal place as they depend on minima taken from hourly tabulations. (N.B. in class 2, $\overline{B}$ was the tabulated value of $\overline{A+B+C}$, in other cases it was taken from hourly tabulations; $\overline{\gamma+A}$ was usually taken from hourly tabulations).

(1) The occasion of February 23rd, 1906, was one on which a small depression passed east-south-eastwards across the south-west of England to France, the centre passing very near Falmouth, probably slightly to the north. The temperature at Falmouth in the warm current in front of the depression remained uniform throughout the night and up to noon on the 23rd when, with the passage of the centre, there was a sudden fall of temperature of several degrees followed by a slow steady fall. This made $\overline{B}=39°$F. at 17h. while the value of $\overline{\gamma+A}$ was 44·3°F. Thus $\overline{\gamma+A+B}=\overline{B}$ and $\overline{\gamma+A}-\overline{B}=5{\cdot}3°$F. Kew was north of the track of the depression and experienced a cold easterly current throughout the whole day which was "normal" there and of class 3.21. The thermograms illustrating this case are given in Fig. 7

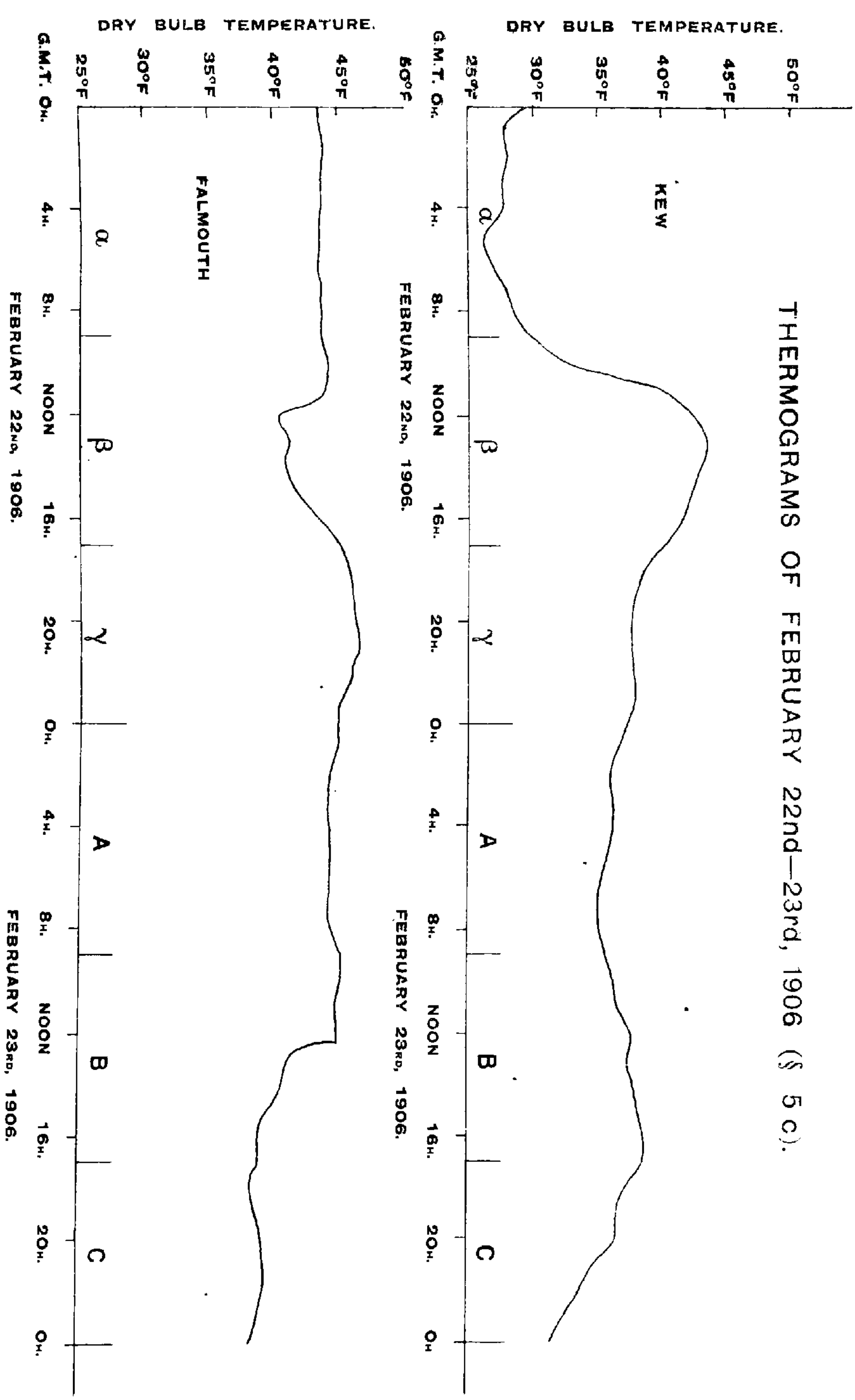
(2) On this occasion a warm westerly current, associated with a depression off the Norwegian coasts, maintained the Kew temperature between 44°F. and 50°F. during the whole of March 1st, the general tendency being a slow rise. However, a cold current of air from a northerly point invaded the British Isles and reaching Kew between 10h. and 11h. on March 2nd caused the temperature there, which had reached 50°F., to drop suddenly several degrees and then to fall progressively during the remainder of the day. The accompanying barometric distribution was that of a V-shaped secondary passing south-eastwards across the British Isles, the main depression moving away eastwards across Scandinavia. The effect was that of the passage over the station of a " squall line " of the main depression.

Under these conditions $\overline{\gamma+A}$ was 48·0°F. at 17h. on March 1st while $\overline{B}$ was 39·7°F. at 16h. on March 2nd. Thus $\overline{\gamma+A+B}=\overline{B}$ and $\overline{\gamma+A}-\overline{B}=8{\cdot}3°$F. Even had the discontinuity of temperature occurred somewhat before 9h., the progressive fall of temperature which followed would probably have still produced the result $\overline{\gamma+A+B}=\overline{B}$, though there might have been a slight check in the fall during the middle part of the day owing to insolation, since in a cold current of the kind under consideration the cloud is often detached. Such a check is noticeable on the thermogram of March 2nd (Fig. 8). The Hourly Readings[1] show that the only bright sunshine recorded at Kew on March 1st and 2nd occurred between 10h.30m. and 11h.30m. on March 2nd.

Falmouth did not feel the full effect of the invasion of cold air, but the temperature began to fall slowly about 15h. on

[1] *Loc. cit. ante.*

Professional Notes No. 22.



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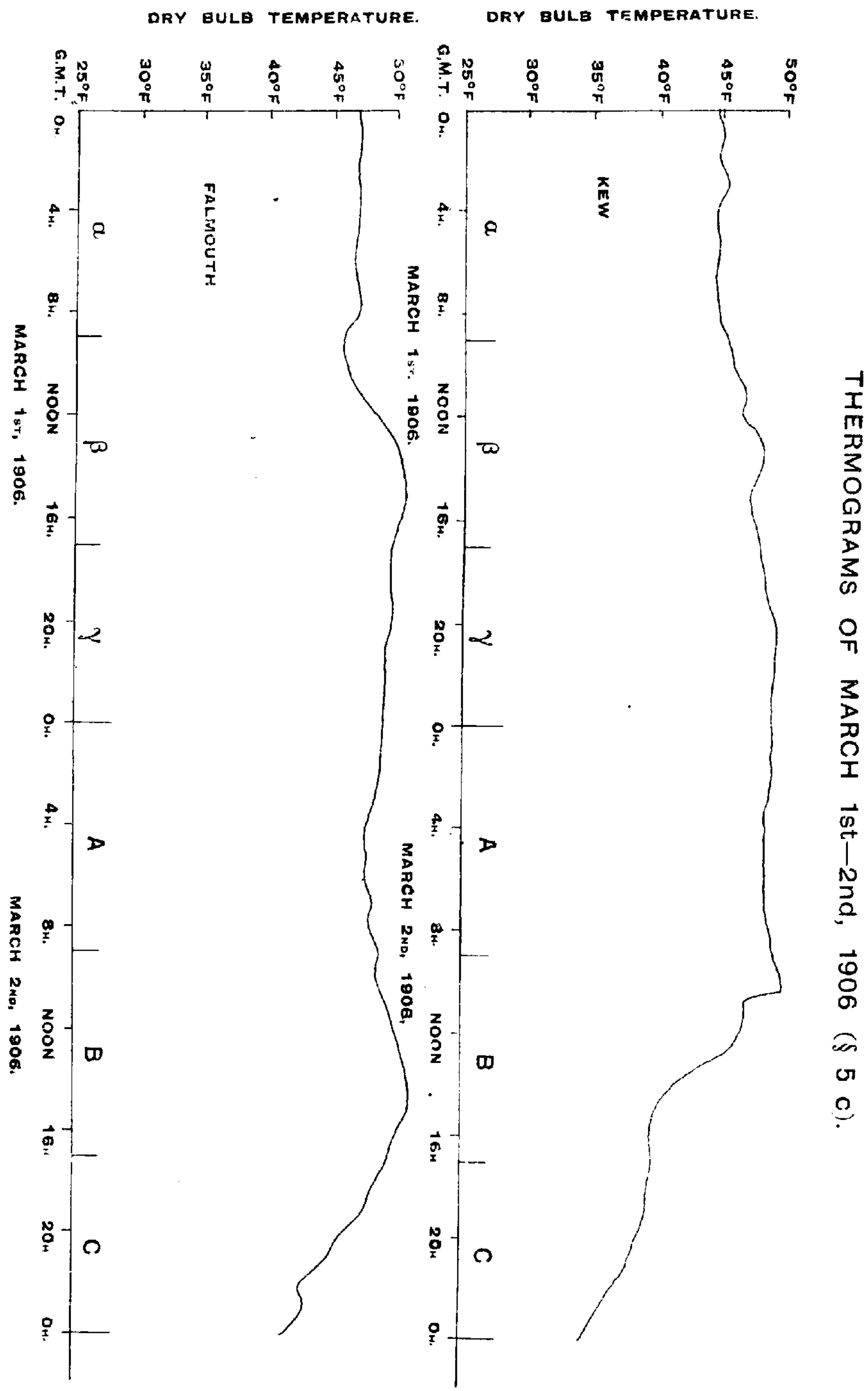

THERMOGRAMS OF MARCH 1st—2nd, 1906 (§ 5 c).

H.M.S.O. Press, Kingsway, W.C.2. Ps. 4967/351 D 633/940 Wt. 881 625 5/21

March 2nd, and the night was colder than the previous one. Under these conditions the day was " normal," and of Class 3.21 (Fig. 8).

(3) On this occasion the conditions were very much like those of March 2nd just discussed, but the " squall line " of the depression passed both Falmouth and Kew. At both places, after an almost uniformly warm night and morning the temperature began to fall about noon on November 30th and continued to do so during the rest of the day which was of Class 3.22 at both stations, the minimum of the previous day having occurred in the early morning and that of the current day, as just seen, in the evening.

(4) This case was again very similar to that of March 2nd, described above, the " squall line " affecting both stations. At Kew, after a warm night, the temperature began to fall between 5h. and 6h. on December 5th, marking the setting in of the cold current. Although this was before 9h. the tendency continued to be downwards during the remainder of the day making $\overline{B}$ considerably less than $\overline{\gamma + A}$. At Falmouth the general effect was the same, but the thermograph curve showed many fluctuations of temperature of short duration The day was of class 3.22 at Kew, but at Falmouth owing to a minor fluctuation of temperature, the civil day minimum occurred at 15h. 20m. and the day was of class 2.22.

The same characteristics appear in the remaining four cases, the effect depending upon a properly timed influx of colder air causing in some cases an actual discontinuity of the thermograph trace, in others merely a progressive decrease of temperature following on a warmer period. However, while the control rests mainly with the source of the air which passes the station during the period concerned, another essential factor is cloudiness which prevents $\overline{\gamma + A}$ from falling too low by radiation at night.

The causes found for the specially selected occasions above are the same in many, if not all, of the cases in which $\overline{\gamma + A + B} = \overline{B}$.

There is no general relation between the class of a day at Falmouth and that of the same day at Kew, but sometimes the conditions are sufficiently general to cause $\overline{\gamma + A + B} = \overline{B}$ at both stations while at other times while the conditions are general enough, the time at which the colder type sets in produces different results at the two places. Further, neither station may be affected by conditions which might at first seem suitable, *e.g.*, on the occasion of the well-known Line Squall of February 8th, 1906, the day was " normal " from the present point of view at Kew and at Falmouth.

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(3) On this occasion the conditions were very much like those of March 2nd just discussed, but the " squall line " of the depression passed both Falmouth and Kew. At both places, after an almost uniformly warm night and morning the temperature began to fall about noon on November 30th and continued to do so during the rest of the day which was of Class 3.22 at both stations, the minimum of the previous day having occurred in the early morning and that of the current day, as just seen, in the evening.

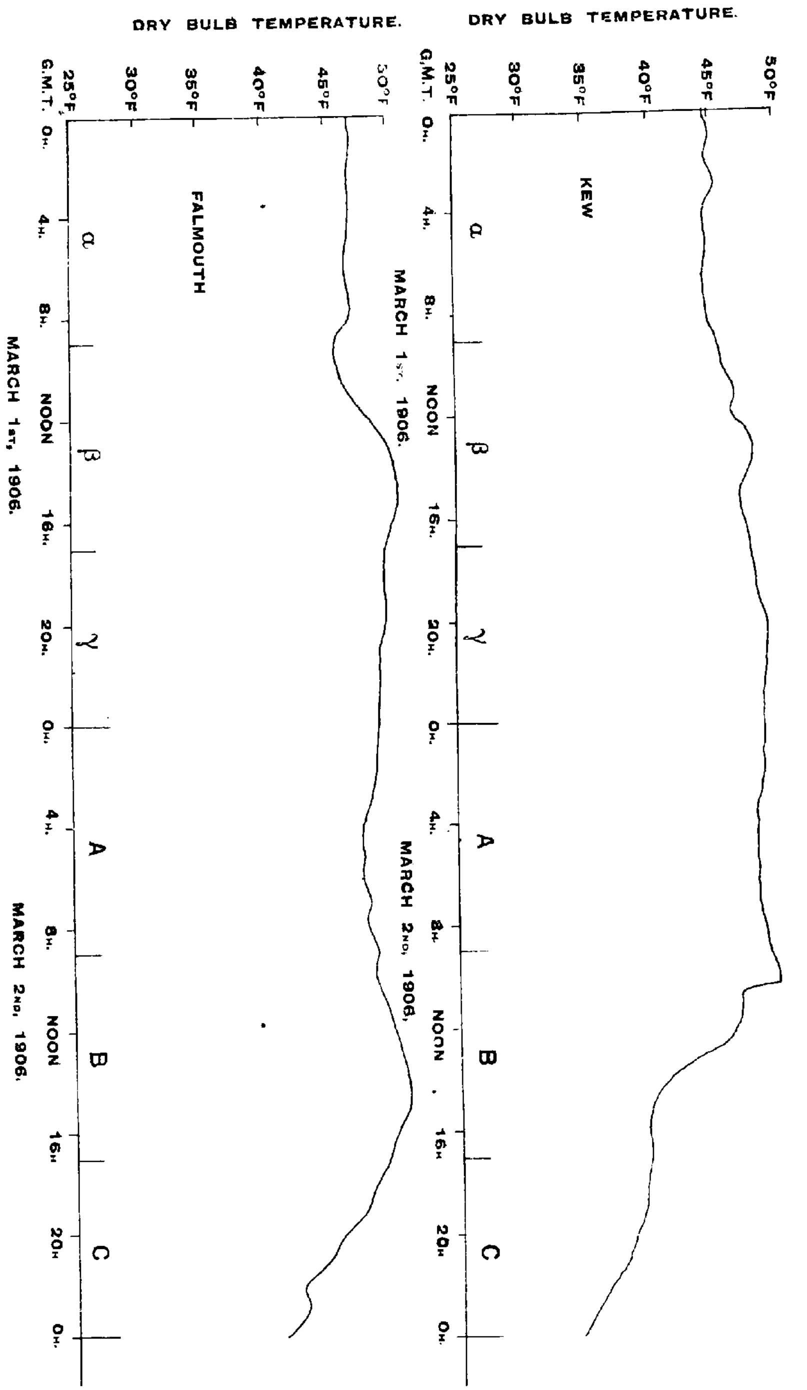
(4) This case was again very similar to that of March 2nd, described above, the " squall line " affecting both stations. At Kew, after a warm night, the temperature began to fall between 5h. and 6h. on December 5th, marking the setting in of the cold current. Although this was before 9h. the tendency continued to be downwards during the remainder of the day making $\overline{B}$ considerably less than $\overline{\gamma + A}$. At Falmouth the general effect was the same, but the thermograph curve showed many fluctuations of temperature of short duration The day was of class 3.22 at Kew, but at Falmouth owing to a minor fluctuation of temperature, the civil day minimum occurred at 15h. 20m. and the day was of class 2.22.

The same characteristics appear in the remaining four cases, the effect depending upon a properly timed influx of colder air causing in some cases an actual discontinuity of the thermograph trace, in others merely a progressive decrease of temperature following on a warmer period. However, while the control rests mainly with the source of the air which passes the station during the period concerned, another essential factor is cloudiness which prevents $\overline{\gamma + A}$ from falling too low by radiation at night.

The causes found for the specially selected occasions above are the same in many, if not all, of the cases in which $\overline{\gamma + A + B} = \overline{B}$.

There is no general relation between the class of a day at Falmouth and that of the same day at Kew, but sometimes the conditions are sufficiently general to cause $\overline{\gamma + A + B} = \overline{B}$ at both stations while at other times while the conditions are general enough, the time at which the colder type sets in produces different results at the two places. Further, neither station may be affected by conditions which might at first seem suitable, *e.g.*, on the occasion of the well-known Line Squall of February 8th, 1906, the day was " normal " from the present point of view at Kew and at Falmouth.

Professional Notes No. 22.



THERMOGRAMS OF MARCH 1st–2nd, 1906 (§ 5 c).

(*d*) **The time of occurrence of $\overline{B}$ on days when $\overline{\gamma + A + B} = \overline{B}$.**—Perhaps a note should be added on the time of occurrence of $\overline{B}$ on the "abnormal" days. Now the minimum temperature occurring during any specified period may be a turning point in the thermograph curve, *i.e.*, a temperature with higher temperature on either side, or it may only be the minimum by virtue of its occurrence at the beginning or end of the period, in which case it would cease to be so were the limits altered. On all days in class 2, $\overline{B}$, being equal to $\overline{A + B + C}$, must necessarily be of the former kind, but on many days of class 3 it is of the latter kind, though not necessarily so. Days of class 1 are not under consideration as they are "normal." Table VII. shows the number of cases for days when $\overline{\gamma + A + B} = \overline{B}$, in which $\overline{B}$ occurred before 13h.30m., after 13h.30m., and at 17h., the time 13h.30m. being

TABLE VII.—NUMBER OF CASES, FOR DAYS WHEN $\overline{\gamma + A + B} = \overline{B}$, IN WHICH $\overline{B}$ OCCURRED AT 17H., COMPARED WITH TOTAL NUMBER BEFORE AND AFTER 13H. 30M., 5 YEARS—1906–10.

KEW.

—	$\overline{B}$ before 13h. 30m.	$\overline{B}$ after 13h. 30m.	$\overline{B}$ at 17h.
Class 3.22	13·5	56·5	41
„ 3.122	6	21·5	17
„ 2.22	10	4	0
„ 2.12	5	2·5	0
Total	34·5	84·5	58

FALMOUTH.

—	$\overline{B}$ before 13h. 30m.	$\overline{B}$ after 13h. 30m.	$\overline{B}$ at 17h.
Class 3.22	11	55	47
„ 3.122	5·5	28·5	21·5
„ 2.22	17·5	3·5	0
„ 2.12	13	4	0
Total	47	91	68·5

chosen more or less arbitrarily. It will be noticed that in classes 3.22 and 3.122 the majority of cases gave $\overline{B}$ after 13h. 30m., a large percentage occurring as expected, actually at 17h. For classes 2.22, 2.12 the majority of cases gave $\overline{B}$ before 13h. 30m., and none at 17h.

The frequency with which $\overline{B}$ and $\overline{\gamma + A}$ occurred during each hour of the periods B and $\gamma + A$ was worked out, but the results (*d*) **The time of occurrence of $\overline{B}$ on days when $\overline{\gamma + A + B} = \overline{B}$.**—Perhaps a note should be added on the time of occurrence of $\overline{B}$ on the "abnormal" days. Now the minimum temperature occurring during any specified period may be a turning point in the thermograph curve, *i.e.*, a temperature with higher temperature on either side, or it may only be the minimum by virtue of its occurrence at the beginning or end of the period, in which case it would cease to be so were the limits altered. On all days in class 2, $\overline{B}$, being equal to $\overline{A + B + C}$, must necessarily be of the former kind, but on many days of class 3 it is of the latter kind, though not necessarily so. Days of class 1 are not under consideration as they are "normal." Table VII. shows the number of cases for days when $\overline{\gamma + A + B} = \overline{B}$, in which $\overline{B}$ occurred before 13h.30m., after 13h.30m., and at 17h., the time 13h.30m. being chosen more or less arbitrarily. It will be noticed that in classes 3.22 and 3.122 the majority of cases gave $\overline{B}$ after 13h. 30m., a large percentage occurring as expected, actually at 17h. For classes 2.22, 2.12 the majority of cases gave $\overline{B}$ before 13h. 30m., and none at 17h.

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Total	47	91	68·5

The frequency with which $\overline{B}$ and $\overline{\gamma + A}$ occurred during each hour of the periods B and $\gamma + A$ was worked out, but the results are not included here as, beyond showing that there were cases during each hour, there was nothing significant indicated.

The above remarks may appear fragmentary and to lack continuity, but they make no claim to be more than notes, and as mentioned at the outset, the investigation was framed to provide an answer to a special question which had arisen, and not to produce results in the most convenient form for future use. However, these figures having been obtained, it seems desirable to put them on record with the hope that at some time or other they may find an application other than the one for which they were originally intended.