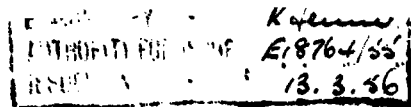


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DISTRIBUTION OF WET-BULB  
TEMPERATURE AT ABERDEEN  
AND ESKDALEMUIR

By A. B. THOMSON, M.A.



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# DISTRIBUTION OF WET-BULB TEMPERATURE AT ABERDEEN AND ESKDALEMUIR

By A. B. THOMSON, M.A.

**Summary.**—This paper outlines the results of an analysis of hourly wet-bulb temperature at Aberdeen and Eskdalemuir. Monthly, seasonal and annual distributions are shown, on a percentage basis, in tables and diagrams. Consideration is given to the determination of the approximate distribution of wet-bulb temperature at other places in Great Britain.

**Introduction.**—From time to time engineers and others have asked for information about the distribution of wet-bulb temperature in various localities. Some require the information in connexion with the design and efficient performance of cooling towers while others have humidifying or air-conditioning problems which call for reliable data. As exact information on the subject was not available this investigation was undertaken. Though it was made primarily to meet these requirements, the results may be useful in other ways; for instance, the wet-bulb temperature has probably a bearing on the growth of plants and the consumption of fuel.

In order to obtain reliable averages of the monthly, seasonal and annual distributions, it was felt necessary to analyse data covering a period of 10 yr. The periods used were 1938–47 at Aberdeen and 1940–49 at Eskdalemuir. These two stations were chosen partly on account of their large difference in altitude, and partly because readings made at each exact hour throughout the 24-hr. day were readily available.

The observations at Aberdeen were made at King's College in a north-wall screen 41 ft. above the ground. King's College lies between the valleys of the Don and Dee about one mile from the sea. Although the main area of the City of Aberdeen lies to the south-west, the site is largely surrounded by an inhabited area. Eskdalemuir Observatory, on the other hand, is an inland station in Dumfriesshire, 794 ft. above M.S.L. It is situated in open moorland on a ridge facing the south-east. The observations there were made in a louvered hut 3½ ft. above ground level. Fuller details about the two stations and the conditions under which the observations were made are given in the *Observatories' Year Book*<sup>1\*</sup>.

To reduce the work of analysis—over 175,000 readings were used—it was decided to group the data in ranges from which tables could be compiled showing the percentage frequency of occurrence of readings in each range. As the readings for both Aberdeen and Eskdalemuir were in degrees Absolute, the size of range chosen was 5°A. (9°F.). This is the smallest grouping which will give an exact conversion to degrees Fahrenheit. With the large numbers involved, little accuracy is lost throughout the greater part of the frequency range. The “tails” of the frequency distributions will obviously be less accurate, but, irrespective of the size of range, the “tails” in any 10-yr. sample are unlikely to reflect the true population to a fine degree of accuracy.

**Monthly and annual means of dry-bulb temperature, wet-bulb temperature and percentage relative humidity.**—As the 10-yr. means of dry-bulb temperature and relative humidity (Table I) are in good agreement with the corresponding means for the longer periods for each station, it is reasonable to assume that the 10-yr. periods constitute a representative sample of wet-bulb temperature.

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\* The index numbers refer to the bibliography on p. 26.

**Diurnal percentage frequency of wet-bulb temperature.**—In Table II\* all the observations below and equal to the freezing point were totalled for each tabular hour, and those above the freezing point in groups of 9°F. The number in each group is expressed as a percentage of the total observations for each hour. The distributions for each hour of the day in spring (March–May), summer (June–August), autumn (September–November), winter (December–February), and the year as a whole are also embodied in Table II\*. The percentages for all the hours (0100–2400) combined are graphed as cumulative-frequency curves in Fig. 1.

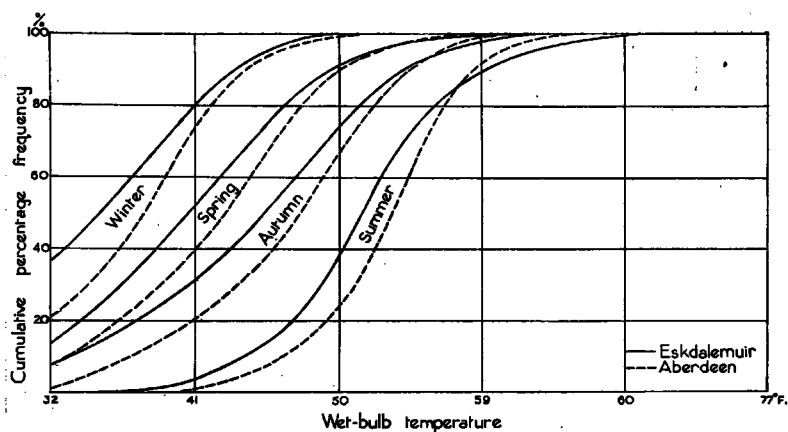


FIG. 1—SEASONAL OGIVES OF WET-BULB TEMPERATURE, 0100–2400

It is evident from the curves that the frequency of wet-bulb temperature below any particular point is, in general, greater at Eskdalemuir in winter, spring and autumn. It is also true (Tables II and III) that in summer the frequency of both low and high wet-bulb temperature is greater at Eskdalemuir than at Aberdeen. In summer the wet-bulb thermometer never freezes at Aberdeen, and only occasionally (after midnight) at Eskdalemuir. At the latter station spring has twice the number of wet-bulb frosts as autumn, while winter has three times as many as spring. For the year as a whole the percentage of wet-bulb frosts at Eskdalemuir is double that at Aberdeen.

The annual frequency of frost at Aberdeen—as shown by the wet-bulb thermometer—is 7.0 per cent. at 0900 G.M.T. and 4.2 per cent. at 1300. The corresponding dry-bulb frequency (4.3 per cent. at 0900 and 1.6 per cent. at 1300) was evaluated for comparison. Thus, frost can be expected to persist until at least 1300 on roughly one half (wet-bulb reckoning) and on one third (dry-bulb reckoning) the number of days on which morning frost occurs.

\* It should be noted that the range 32.1–40.9°F. extends over 8.9°F. and subsequent ranges over 9°F.

TABLE I—MEAN MONTHLY AND ANNUAL TEMPERATURE AND RELATIVE HUMIDITY

Aberdeen	Height of station above M.S.L. 79 ft.													Year
	Height of thermometer bulbs above ground 41 ft.													
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.		
1938														
Dry bulb (°F.)	41.3	41.0	48.5	45.9	47.8	54.3	56.7	56.5	54.5	49.2	45.4	40.2	48.4	
Wet bulb (°F.)	39.0	38.7	45.0	42.0	44.7	50.2	53.7	53.9	52.2	46.4	43.3	38.5	45.6	
Rel. hum. (%)	80	80	75	71	78	75	81	84	86	80	83	84	80	
1939														
Dry bulb (°F.)	38.0	42.6	41.6	43.9	49.7	55.5	56.7	58.1	54.5	46.3	44.5	39.7	47.5	
Wet bulb (°F.)	36.3	40.1	39.1	40.7	46.9	50.7	53.9	55.7	51.8	43.4	42.1	37.6	44.9	
Rel. hum. (%)	85	79	79	75	80	72	83	86	83	79	80	81	80	
1940														
Dry bulb (°F.)	34.2	37.3	40.5	43.1	50.8	57.1	55.8	56.6	52.0	48.9	43.1	40.0	46.6	
Wet bulb (°F.)	32.4	35.3	38.1	40.6	47.6	52.8	53.1	52.5	48.0	46.5	41.0	37.9	43.8	
Rel. hum. (%)	80	81	79	80	79	75	83	75	73	82	83	81	79	
1941														
Dry bulb (°F.)	33.9	36.6	38.0	41.4	45.8	53.9	58.2	55.3	55.4	48.0	44.2	42.1	46.1	
Wet bulb (°F.)	31.8	34.7	35.7	38.9	43.0	49.9	54.9	52.2	52.5	45.4	42.3	39.4	43.4	
Rel. hum. (%)	79	82	79	79	79	75	81	81	82	81	85	78	80	
1942														
Dry bulb (°F.)	35.6	34.7	38.8	44.0	48.3	53.2	57.0	57.6	53.3	48.4	42.3	43.0	46.4	
Wet bulb (°F.)	33.9	32.7	36.4	41.1	44.7	49.7	53.4	55.0	50.2	45.8	40.1	41.3	43.7	
Rel. hum. (%)	84	81	79	77	75	77	79	85	80	81	82	85	80	
1943														
Dry bulb (°F.)	39.1	43.3	44.3	48.3	49.2	54.7	56.2	55.0	53.3	50.6	42.7	40.7	48.1	
Wet bulb (°F.)	37.6	40.3	41.3	44.6	45.9	51.2	52.3	51.7	50.0	48.1	40.5	38.3	45.1	
Rel. hum. (%)	86	76	75	74	78	77	77	79	79	82	81	79	79	
1944														
Dry bulb (°F.)	41.4	38.9	40.5	47.1	48.9	52.7	56.2	57.6	51.5	47.6	40.3	39.3	46.8	
Wet bulb (°F.)	38.5	36.4	37.9	43.8	45.3	49.5	53.9	54.1	48.6	45.4	37.9	37.2	44.0	
Rel. hum. (%)	75	77	78	77	75	79	86	80	80	84	80	81	79	
1945														
Dry bulb (°F.)	33.6	42.6	46.3	46.1	48.9	54.7	58.8	56.5	55.0	51.7	46.7	42.3	48.6	
Wet bulb (°F.)	31.7	39.7	42.9	42.7	45.9	50.7	55.5	53.7	52.1	49.4	44.3	40.2	45.7	
Rel. hum. (%)	81	77	74	75	79	76	81	83	82	84	82	82	80	
1946														
Dry bulb (°F.)	38.7	40.0	41.4	47.9	47.2	54.1	58.3	55.6	54.4	48.5	45.1	39.5	47.6	
Wet bulb (°F.)	36.2	37.2	38.7	43.3	44.6	50.0	54.6	52.4	51.4	45.5	43.2	37.3	44.5	
Rel. hum. (%)	79	76	77	68	80	75	79	81	81	78	85	81	78	
1947														
Dry bulb (°F.)	38.6	32.8	34.3	44.8	48.9	54.6	59.1	60.5	54.4	50.9	42.5	41.4	46.9	
Wet bulb (°F.)	36.4	29.6	32.5	41.0	46.7	51.4	55.5	57.4	50.8	48.0	40.2	39.2	44.1	
Rel. hum. (%)	79	67	82	72	84	80	79	83	77	80	81	81	79	
Mean, 1938-47														
Dry bulb (°F.)	37.4	39.0	41.4	45.3	48.5	54.5	57.3	56.9	53.8	49.0	43.7	40.8	47.3	
Wet bulb (°F.)	35.4	36.5	38.8	41.9	45.5	50.6	54.1	53.9	50.8	46.4	41.5	38.7	44.5	
Rel. hum. (%)	81	78	78	75	79	76	81	82	80	81	82	81	79	
Mean 1921-47														
Dry bulb (°F.)	38.7	39.3	41.2	44.0	48.1	53.8	57.6	56.7	53.2	48.0	42.7	40.2	47.0	
Mean 1886-1910														
Rel. hum. (%)	80	79	79	78	79	78	78	79	81	82	82	82	80	

**Eskdalemuir**

Height of station above M.S.L. 794 ft.

Height of thermometer bulbs above ground 3½ ft.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
<b>1940</b>													
Dry bulb (°F.)	27.5	33.6	37.8	41.7	50.9	57.0	54.0	54.5	49.1	45.5	41.0	36.9	44.1
Wet bulb (°F.)	26.8	32.5	36.1	39.4	46.8	52.0	51.3	51.4	46.2	43.7	39.4	35.6	41.8
Rel. hum. (%)	90	88	85	81	74	73	83	82	81	86	86	87	83
<b>1941</b>													
Dry bulb (°F.)	29.1	32.9	35.8	39.4	45.5	53.8	56.5	53.4	54.5	46.8	40.3	38.5	43.9
Wet bulb (°F.)	27.9	31.8	33.8	37.0	42.1	50.4	53.8	51.1	52.2	44.6	38.8	37.2	41.7
Rel. hum. (%)	86	87	82	80	76	80	84	85	86	83	87	88	84
<b>1942</b>													
Dry bulb (°F.)	31.6	29.7	36.1	43.5	47.1	52.4	54.7	55.9	50.6	46.4	38.8	40.4	43.9
Wet bulb (°F.)	30.7	28.4	34.9	39.9	43.3	49.1	51.6	54.0	48.4	44.8	37.0	39.2	41.8
Rel. hum. (%)	88	83	88	74	74	80	81	88	85	87	84	89	83
<b>1943</b>													
Dry bulb (°F.)	36.4	40.5	40.6	45.5	47.9	52.9	55.2	53.9	50.4	47.3	39.7	36.8	45.6
Wet bulb (°F.)	35.4	38.8	38.7	43.0	44.2	50.2	52.3	51.6	48.0	45.7	37.8	35.2	43.4
Rel. hum. (%)	90	85	84	80	75	84	82	86	84	89	82	89	84
<b>1944</b>													
Dry bulb (°F.)	39.6	35.6	38.4	45.4	46.8	52.1	56.5	56.7	49.0	44.0	38.2	36.8	44.9
Wet bulb (°F.)	37.9	33.8	36.1	43.0	43.5	48.9	53.8	54.0	46.9	42.6	37.0	35.8	42.8
Rel. hum. (%)	87	82	80	82	78	80	86	84	86	89	89	89	84
<b>1945</b>													
Dry bulb (°F.)	30.7	40.3	42.6	43.8	47.9	52.9	57.0	55.9	52.8	48.3	42.9	37.9	46.1
Wet bulb (°F.)	29.3	39.0	40.5	41.0	45.1	49.8	54.0	52.7	50.5	46.9	41.7	36.7	43.9
Rel. hum. (%)	84	89	83	79	81	81	82	81	87	91	90	88	85
<b>1946</b>													
Dry bulb (°F.)	33.3	38.2	37.5	44.2	47.5	50.6	54.9	52.3	51.6	44.6	42.9	35.1	44.4
Wet bulb (°F.)	32.4	36.3	35.8	41.4	43.5	47.8	52.5	50.4	50.0	42.6	41.5	34.0	42.3
Rel. hum. (%)	90	82	84	78	73	82	85	88	89	84	89	89	84
<b>1947</b>													
Dry bulb (°F.)	34.0	27.0	32.2	41.1	50.2	54.1	56.7	60.5	52.3	47.8	39.9	38.5	44.5
Wet bulb (°F.)	32.9	25.5	30.7	38.5	47.8	51.8	54.1	56.4	50.0	46.2	38.3	37.0	42.4
Rel. hum. (%)	88	81	84	83	83	85	86	80	85	89	86	88	85
<b>1948</b>													
Dry bulb (°F.)	36.0	36.7	42.7	43.3	48.0	51.8	56.0	53.4	51.5	45.4	41.5	38.3	45.4
Wet bulb (°F.)	34.7	35.0	40.1	40.8	44.2	49.1	52.7	51.7	49.6	43.8	40.6	37.2	43.3
Rel. hum. (%)	88	83	81	81	75	83	81	89	87	87	91	89	85
<b>1949</b>													
Dry bulb (°F.)	38.3	38.5	38.4	44.8	47.7	54.8	56.9	56.7	55.6	48.3	40.9	38.4	46.6
Wet bulb (°F.)	37.0	37.1	36.1	42.5	44.2	51.1	53.3	54.1	53.5	46.8	39.6	36.9	44.3
Rel. hum. (%)	87	87	80	83	77	78	80	85	87	88	88	86	84
<b>Mean, 1940-49</b>													
Dry bulb (°F.)	33.7	35.3	38.2	43.3	47.9	53.2	55.8	55.3	51.7	46.4	40.6	37.8	44.9
Wet bulb (°F.)	32.5	33.8	36.3	40.7	44.5	50.0	52.9	52.7	49.5	44.8	39.2	36.5	42.8
Rel. hum. (%)	88	85	83	80	77	81	83	85	86	87	87	88	84
<b>Mean 1921-50</b>													
Dry bulb (°F.)	35.5	35.8	38.4	42.0	47.4	52.6	55.9	55.0	50.9	45.4	39.5	36.8	44.6
<b>Mean 1911-12, 1914-26</b>													
Rel. hum. (%)	88	86	83	80	80	78	82	84	84	86	86	88	84

TABLE II—DIURNAL PERCENTAGE FREQUENCY OF WET-BULB TEMPERATURE

Aberdeen	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200
°F.	JANUARY											
≤ 32.0	28.1	28.7	29.0	28.1	28.7	29.7	31.0	30.6	27.7	25.5	22.9	21.0
32.1-40.9	53.9	54.8	54.5	56.1	56.1	55.5	53.5	55.2	57.7	58.4	57.1	58.7
41.0-49.9	18.0	16.5	16.5	15.8	15.2	14.8	15.5	14.2	14.6	16.1	20.0	20.3
50.0-58.9	..	..	..	..	..	..	..	..	..	..	..	..
°F.	FEBRUARY											
≤ 32.0	27.0	27.0	28.4	29.8	29.5	29.1	29.1	28.7	26.2	23.0	20.6	18.8
32.1-40.9	53.9	53.6	52.8	52.5	52.8	52.8	53.9	55.7	56.4	58.5	56.7	54.2
41.0-49.9	18.8	19.1	18.5	17.4	17.4	17.8	16.7	14.9	16.7	18.2	20.9	25.2
50.0-58.9	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.7	0.7	0.3	1.8	1.8
°F.	MARCH											
≤ 32.0	16.1	18.1	18.4	19.7	19.1	18.7	18.4	16.4	12.6	10.0	9.4	7.4
32.1-40.9	53.9	51.9	51.6	51.3	52.6	52.6	52.9	51.6	49.3	46.5	43.9	44.2
41.0-49.9	29.4	29.4	29.4	28.4	27.7	28.4	28.4	31.0	36.8	41.6	43.2	43.2
50.0-58.9	0.6	0.6	0.6	0.6	0.6	0.3	0.3	1.0	1.3	1.9	3.5	5.2
°F.	APRIL											
≤ 32.0	2.3	3.0	3.7	3.7	4.7	3.0	1.3	0.3	0.7	..	..	..
32.1-40.9	52.7	51.3	54.0	56.0	57.3	53.4	50.0	42.0	34.7	31.0	27.7	25.7
41.0-49.9	43.3	44.0	41.0	39.0	37.0	42.3	46.7	54.4	59.3	60.7	62.7	63.3
50.0-58.9	1.7	1.7	1.3	1.3	1.0	1.3	2.0	3.3	5.3	8.3	9.6	11.0
°F.	MAY											
≤ 32.0	1.0	1.0	2.3	1.6	1.0	0.3	..	..	..	..	..	..
32.1-40.9	24.8	26.1	26.5	29.7	27.4	23.9	17.8	14.5	12.9	10.7	10.4	9.7
41.0-49.9	68.1	67.1	64.8	63.2	65.8	65.8	69.0	68.7	67.1	69.0	63.5	60.3
50.0-58.9	6.1	5.8	6.4	5.5	5.8	11.0	13.2	16.8	19.7	20.0	25.5	29.7
59.0-67.9	..	..	..	..	..	..	..	..	0.3	0.3	0.6	0.3
°F.	JUNE											
32.1-40.9	2.7	3.0	3.0	3.3	1.3	1.0	0.3	0.3	..	..	0.3	..
41.0-49.9	56.3	59.3	61.4	61.1	61.1	53.0	45.7	41.3	39.3	34.3	33.0	30.0
50.0-58.9	40.7	37.7	35.3	35.3	37.3	45.7	50.3	54.4	56.4	61.0	60.7	62.7
59.0-67.9	0.3	..	0.3	0.3	0.3	0.3	3.7	4.0	4.3	4.7	6.0	7.3
°F.	JULY											
32.1-40.9	..	..	0.3	0.3	..	..	..	..	..	..	..	..
41.0-49.9	21.6	26.4	27.8	28.7	25.5	18.7	13.5	7.1	4.9	2.6	1.9	1.9
50.0-58.9	76.8	72.3	70.6	70.3	72.9	79.4	83.9	85.5	86.1	86.4	84.2	81.3
59.0-67.9	1.6	1.3	1.3	0.7	1.6	1.9	2.6	7.4	9.0	11.0	13.9	16.8
°F.	AUGUST											
32.1-40.9	1.0	0.6	0.6	1.0	1.0	1.0	..	..	..	..	..	..
41.0-49.9	26.5	30.6	33.2	35.5	35.8	28.7	20.0	15.8	12.3	10.0	8.4	8.7
50.0-58.9	69.0	64.6	63.9	61.0	60.7	68.0	75.5	76.5	77.7	74.2	73.2	70.3
59.0-67.9	3.5	4.2	2.3	2.5	2.5	2.3	4.5	7.7	10.0	15.8	18.4	21.0

\* It should be noted that the range 32.1-40.9°F. extends over 8.9°F. and subsequent ranges over 9°F.

## FOR EACH MONTH AND SEASON AND FOR THE YEAR\*

1938-47

1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	
JANUARY												°F.
19.4	19.4	19.7	21.3	22.6	21.3	24.2	23.2	23.9	23.2	25.2	25.8	≤32.0
58.4	55.8	59.3	59.0	58.4	59.4	55.8	58.7	59.0	59.4	56.8	57.1	32.1-40.9
22.2	24.5	21.0	19.7	19.0	19.3	20.0	18.1	17.1	17.4	17.7	17.1	41.0-49.9
..	0.3	..	..	..	..	..	..	..	..	0.3	..	50.0-58.9
FEBRUARY												
16.7	14.9	15.6	17.7	20.2	22.3	24.8	25.2	25.5	25.2	26.2	27.0	≤32.0
55.3	57.1	59.2	57.8	56.0	55.7	51.8	52.5	54.6	55.7	53.6	52.8	32.1-40.9
25.5	25.5	22.4	22.0	22.7	21.3	23.1	22.0	19.5	18.8	19.9	19.9	41.0-49.9
2.5	2.5	2.8	2.5	1.1	0.7	0.3	0.3	0.4	0.3	0.3	0.3	50.0-58.9
MARCH												
7.1	6.1	6.5	7.4	8.0	9.7	11.3	11.6	13.5	14.2	14.2	16.1	≤32.0
44.2	44.8	44.8	44.2	45.5	46.4	46.8	49.7	50.0	49.7	51.9	50.6	32.1-40.9
43.2	43.6	42.6	42.6	42.6	41.3	39.7	37.1	35.5	35.8	33.6	32.3	41.0-49.9
5.5	5.5	6.1	5.8	3.9	2.6	2.2	1.6	1.0	0.3	0.3	1.0	50.0-58.9
APRIL												
..	..	..	..	0.3	0.3	0.3	0.3	0.3	1.7	2.0	2.0	≤32.0
23.3	24.0	24.3	27.3	29.0	30.0	34.0	41.7	43.4	48.3	49.6	51.3	32.1-40.9
63.7	64.7	64.0	61.4	59.4	60.7	58.4	53.0	52.0	46.7	46.7	45.0	41.0-49.9
13.0	11.3	11.7	11.3	11.3	9.0	7.3	5.0	4.3	3.3	1.7	1.7	50.0-58.9
MAY												
9.0	9.7	9.4	9.1	10.0	11.9	12.9	14.8	16.5	19.7	20.6	21.9	≤32.0
62.3	61.3	64.8	64.8	63.9	62.3	68.8	70.4	71.0	68.1	68.8	67.7	32.1-40.9
28.7	28.7	25.5	25.8	25.5	25.2	17.7	14.5	12.5	11.9	11.0	9.4	41.0-49.9
..	0.3	0.3	0.3	0.6	0.6	0.6	0.3	..	..	..	..	50.0-58.9
..	..	..	..	..	..	..	..	..	0.3	0.6	1.0	59.0-67.9
JUNE												
0.3	..	..	..	..	..	0.3	0.3	0.3	1.0	1.3	2.0	≤32.0
26.0	25.0	23.7	24.3	24.7	28.3	31.0	37.3	43.0	47.3	51.0	53.7	32.1-40.9
66.7	68.0	69.3	69.0	69.0	67.4	66.0	60.4	55.4	51.7	46.7	43.7	41.0-49.9
7.0	7.0	7.0	6.7	6.3	4.3	2.7	2.0	1.3	..	1.0	0.6	50.0-58.9
..	..	..	..	..	..	..	..	..	..	..	..	59.0-67.9
JULY												
1.9	1.0	1.6	1.6	1.3	1.9	3.2	4.5	8.7	11.3	13.9	16.1	≤32.0
80.3	83.2	81.6	82.9	84.5	88.1	89.0	88.4	86.8	85.5	83.5	82.3	32.1-40.9
17.8	15.8	16.8	15.5	14.2	10.0	7.8	7.1	4.5	3.2	2.6	1.6	41.0-49.9
..	..	..	..	..	..	..	..	..	..	..	..	50.0-58.9
..	..	..	..	..	..	..	..	..	..	..	..	59.0-67.9
AUGUST												
7.1	7.5	7.8	8.0	8.1	8.0	9.7	13.9	14.8	17.8	21.6	24.5	≤32.0
70.0	69.0	70.6	72.3	73.5	76.8	78.7	75.8	76.8	76.1	74.2	71.6	32.1-40.9
22.9	23.5	21.6	19.7	18.4	15.2	11.6	10.3	8.4	6.1	4.2	3.9	41.0-49.9
..	..	..	..	..	..	..	..	..	..	..	..	50.0-58.9
..	..	..	..	..	..	..	..	..	..	..	..	59.0-67.9

TABLE II—DIURNAL PERCENTAGE FREQUENCY OF WET-BULB TEMPERATURE

Aberdeen

	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200
°F.	SEPTEMBER											
32.1-40.9	5.7	6.0	7.3	8.3	9.3	8.3	7.3	3.0	1.0	0.3	0.7	0.7
41.0-49.9	45.0	44.3	44.0	44.7	45.0	47.7	44.7	43.7	34.0	30.7	27.3	24.0
50.0-58.9	47.3	48.4	48.0	45.7	45.0	43.3	47.0	51.3	61.3	63.0	66.3	69.6
59.0-67.9	2.0	1.3	0.7	1.3	0.7	0.7	1.0	2.0	3.7	6.0	5.7	5.7
	OCTOBER											
≤32.0	..	..	..	..	0.3	..	0.3	..	..	..	..	..
32.1-40.9	20.6	22.3	22.3	22.3	22.9	22.9	21.6	18.1	11.9	6.8	4.5	2.9
41.0-49.9	58.1	59.0	60.3	59.7	60.0	60.6	61.0	63.5	65.5	65.5	65.5	63.6
50.0-58.9	21.3	18.7	17.1	17.7	16.8	16.5	17.1	18.4	22.6	27.7	30.0	33.5
59.0-67.9	..	..	0.3	0.3	..	..	..	..	..	..	..	..
	NOVEMBER											
≤32.0	5.7	6.3	7.3	6.7	7.3	6.7	7.0	8.0	5.3	4.0	3.0	1.7
32.1-40.9	41.0	41.7	39.3	42.3	41.7	42.3	43.7	45.7	43.3	41.0	38.3	37.7
41.0-49.9	44.3	43.7	46.4	42.7	42.7	43.3	42.0	39.3	42.7	45.3	48.4	50.3
50.0-58.9	9.0	8.3	7.0	8.3	8.3	7.7	7.3	7.0	8.7	9.7	10.3	10.3
	DECEMBER											
≤32.0	12.3	13.5	14.5	15.8	16.1	14.2	12.9	13.2	12.9	11.3	10.3	8.7
32.1-40.9	54.5	53.5	52.9	52.2	51.9	55.8	56.5	56.5	56.1	56.8	53.6	52.6
41.0-49.9	33.2	32.4	31.6	31.0	31.0	28.7	29.0	29.7	30.7	31.6	35.5	37.7
50.0-58.9	..	0.6	1.0	1.0	1.0	1.3	1.6	0.6	0.3	0.3	0.6	1.0
	SPRING (March-May)											
≤32.0	6.5	7.4	8.1	8.4	8.3	7.4	6.6	5.7	4.5	3.4	3.1	2.5
32.1-40.9	43.7	43.0	43.9	45.5	45.7	43.1	40.1	36.0	32.3	29.3	27.3	26.5
41.0-49.9	47.0	46.9	45.1	43.6	43.6	45.5	48.0	51.3	54.3	57.1	56.4	55.5
50.0-58.9	2.8	2.7	2.8	2.5	2.5	3.9	5.2	7.1	8.8	10.1	12.9	15.3
59.0-67.9	..	..	..	..	..	..	..	..	0.1	0.1	0.2	0.1
	SUMMER (June-August)											
32.1-40.9	1.2	1.2	1.3	1.5	0.8	0.7	0.1	0.1	..	..	0.1	..
41.0-49.9	34.6	38.6	40.5	41.5	40.5	33.3	26.2	21.2	18.6	15.4	14.2	13.4
50.0-58.9	62.4	58.4	56.9	55.8	57.2	64.6	70.1	72.3	73.6	74.0	72.8	71.5
59.0-67.9	1.9	1.9	1.3	1.2	1.5	1.5	3.6	6.4	7.8	10.5	12.8	15.1
	AUTUMN (September-November)											
≤32.0	1.9	2.1	2.4	2.2	2.5	2.2	2.4	2.6	1.8	1.3	1.0	0.5
32.1-40.9	22.4	23.3	23.0	24.3	24.6	24.5	24.2	22.2	18.7	15.9	14.4	13.6
41.0-49.9	49.2	49.1	50.3	49.1	49.3	50.7	49.3	49.0	47.6	47.4	47.3	46.1
50.0-58.9	25.8	25.1	24.0	23.9	23.3	22.4	23.7	25.5	30.8	33.4	35.5	37.8
59.0-67.9	0.7	0.4	0.3	0.5	0.2	0.2	0.3	0.7	1.2	2.0	1.9	1.9
	WINTER (December-February)											
≤32.0	22.3	22.9	23.8	24.4	24.6	24.2	24.2	24.1	22.2	19.8	17.9	16.1
32.1-40.9	54.1	54.0	53.4	53.7	53.7	54.7	54.6	55.8	56.8	57.9	55.8	55.2
41.0-49.9	23.5	22.7	22.3	21.5	21.3	20.5	20.5	19.7	20.7	22.1	25.6	27.8
50.0-58.9	0.1	0.3	0.4	0.4	0.4	0.5	0.7	0.4	0.3	0.3	0.8	0.9
	YEAR											
≤32.0	7.6	8.0	8.5	8.7	8.8	8.4	8.3	8.0	7.0	6.0	5.4	4.7
32.1-40.9	30.3	30.3	30.3	31.2	31.0	30.7	29.7	28.4	26.8	25.7	24.3	23.7
41.0-49.9	38.6	39.4	39.6	39.0	38.8	37.5	36.0	35.4	35.4	35.5	35.9	35.8
50.0-58.9	22.9	21.7	21.2	20.7	21.0	23.0	25.0	26.4	28.5	29.6	30.7	31.5
59.0-67.9	0.6	0.6	0.4	0.4	0.4	0.4	1.0	1.8	2.3	3.2	3.7	4.3



FOR EACH MONTH AND SEASON AND FOR THE YEAR\*—continued

1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	
SEPTEMBER												°F.
0.3	0.3	0.7	0.7	0.7	0.7	1.3	2.3	2.7	4.7	4.7	5.3	32.1-40.9
24.3	23.7	24.0	26.3	28.7	31.3	34.3	36.3	38.0	39.7	42.0	44.4	41.0-49.9
68.4	68.3	67.6	65.7	64.6	63.3	60.1	58.1	56.3	53.3	51.0	48.0	50.0-58.9
7.0	7.7	7.7	7.3	6.0	4.7	4.3	3.3	3.0	2.3	2.3	2.3	59.0-67.9
OCTOBER												≤32.0
3.2	3.6	3.2	4.9	5.5	7.1	10.0	13.2	14.8	15.5	17.1	18.7	32.1-40.9
62.3	61.9	62.3	63.0	64.2	64.8	63.8	61.9	61.9	63.2	61.3	59.7	41.0-49.9
34.5	34.5	34.2	31.8	30.0	28.1	26.2	24.9	23.3	21.3	21.6	21.6	50.0-58.9
..	..	0.3	0.3	0.3	..	..	..	..	..	..	..	59.0-67.9
NOVEMBER												≤32.0
1.3	1.0	1.0	1.7	2.3	2.3	3.0	3.7	4.0	3.3	5.3	5.3	32.1-40.9
36.7	35.3	35.7	39.0	40.3	41.3	40.7	41.7	43.0	44.0	43.0	42.3	41.0-49.9
51.0	52.7	51.3	48.0	47.1	47.1	47.6	45.6	44.0	43.7	43.4	43.1	50.0-58.9
11.0	11.0	12.0	11.3	10.3	9.3	8.7	9.0	9.0	9.0	8.3	9.3	59.0-67.9
DECEMBER												≤32.0
7.4	6.8	7.7	8.1	8.7	9.4	10.3	10.6	11.0	11.3	11.9	12.3	32.1-40.9
51.7	51.9	52.0	52.9	52.3	54.5	52.9	54.6	54.5	55.5	54.9	54.5	41.0-49.9
40.3	40.3	40.0	38.4	38.4	35.8	36.5	34.5	33.9	33.2	33.2	33.2	50.0-58.9
0.6	1.0	0.3	0.6	0.6	0.3	0.3	0.3	0.6	..	..	..	59.0-67.9
SPRING (March-May)												≤32.0
2.4	2.1	2.2	2.5	2.8	3.4	3.9	4.0	4.7	5.4	5.7	6.4	32.1-40.9
25.5	26.2	26.2	26.9	28.1	29.5	31.2	35.3	36.5	39.1	40.7	41.2	41.0-49.9
56.3	56.4	57.1	56.2	55.2	54.7	55.5	53.5	52.8	50.2	49.7	48.4	50.0-58.9
15.8	15.2	14.5	14.3	13.6	12.3	9.1	7.1	6.0	5.2	4.0	4.0	59.0-67.9
..	0.1	0.1	0.1	0.2	0.2	0.2	0.1	..	..	..	..	59.0-67.9
SUMMER (June-August)												≤32.0
0.1	..	..	..	..	..	0.1	0.1	0.1	0.3	0.4	0.7	32.1-40.9
11.5	11.0	10.9	11.2	11.2	12.6	14.5	18.4	22.0	25.2	28.6	31.2	41.0-49.9
72.4	73.5	73.9	74.8	75.8	77.5	78.0	75.0	73.1	71.3	68.4	66.1	50.0-58.9
16.0	15.5	15.2	14.0	13.0	9.9	7.4	6.5	4.8	3.1	2.6	2.1	59.0-67.9
AUTUMN (September-November)												≤32.0
0.4	0.3	0.3	0.5	0.8	0.8	1.0	1.2	1.3	1.1	1.8	1.8	32.1-40.9
3.3	13.0	13.1	14.7	15.4	16.3	17.3	19.0	20.1	21.3	21.5	22.1	41.0-49.9
46.0	46.3	46.0	45.9	46.8	47.9	48.8	48.1	48.1	49.0	49.0	49.1	50.0-58.9
37.9	37.9	37.9	36.3	35.0	33.5	31.5	30.5	29.5	27.8	26.9	26.3	59.0-67.9
2.3	2.5	2.6	2.5	2.1	1.5	1.4	1.1	1.0	0.8	0.8	0.8	59.0-67.9
WINTER (December-February)												≤32.0
14.4	13.6	14.3	15.6	17.1	17.5	19.6	19.5	20.0	19.7	20.9	21.5	32.1-40.9
55.1	54.9	56.8	56.5	55.5	56.5	53.5	55.3	56.1	56.9	55.1	54.9	41.0-49.9
29.5	30.3	27.9	26.8	26.8	25.6	26.6	24.9	23.6	23.3	23.7	23.5	50.0-58.9
1.0	1.2	1.0	1.0	0.5	0.3	0.2	0.2	0.3	0.1	0.2	0.1	59.0-67.9
YEAR												≤32.0
4.2	4.0	4.1	4.6	5.0	5.4	6.1	6.1	6.4	6.5	7.0	7.4	32.1-40.9
23.4	23.4	23.9	24.4	24.7	25.4	25.4	27.3	28.1	29.2	29.3	29.6	41.0-49.9
35.9	36.0	35.5	35.0	35.0	35.2	36.4	36.3	36.7	37.0	37.8	38.1	50.0-58.9
31.9	32.0	32.0	31.8	31.4	31.1	29.9	28.4	27.4	26.3	25.0	24.2	59.0-67.9
4.6	4.6	4.5	4.2	3.9	2.9	2.2	1.9	1.4	1.0	0.9	0.7	59.0-67.9



												1940-49
1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	
JANUARY												°F.
38.0	36.5	38.0	41.0	41.9	41.6	44.9	47.4	47.1	46.5	45.8	47.1	≤32.0
42.0	43.8	44.6	42.3	42.6	43.3	40.3	38.4	38.4	38.7	37.7	36.8	32.1-40.9
20.0	19.7	17.4	16.7	15.5	15.1	14.8	14.2	14.5	14.8	16.5	16.1	41.0-49.9
FEBRUARY												
32.1	31.8	32.9	35.7	37.8	41.0	41.3	42.0	42.0	43.5	44.9	44.9	≤32.0
42.8	44.2	41.7	40.3	41.7	38.2	38.9	38.9	40.3	39.9	38.5	38.2	32.1-40.9
25.1	24.0	25.4	24.0	20.5	20.8	19.8	19.1	17.7	16.6	16.6	16.9	41.0-49.9
MARCH												
11.3	11.3	11.6	13.2	15.8	20.6	22.6	25.2	28.4	31.6	32.9	37.4	≤32.0
38.7	37.4	38.1	37.1	39.3	42.0	49.0	50.6	48.7	46.8	46.5	43.6	32.1-40.9
47.1	48.4	46.4	46.8	42.3	36.4	28.4	24.2	22.9	21.6	20.6	19.0	41.0-49.9
2.9	2.9	3.9	2.9	2.6	1.0	..	..	..	..	..	..	50.0-58.9
APRIL												
20.7	20.7	22.7	25.3	27.7	1.3	2.3	8.0	10.0	10.0	11.7	15.0	≤32.0
67.6	65.6	64.0	61.7	61.3	60.7	54.4	46.4	40.3	36.3	34.3	32.3	32.1-40.9
11.7	13.7	13.3	13.0	11.0	5.7	1.0	0.3	..	..	0.3	0.3	41.0-49.9
..	..	..	..	..	..	..	..	..	..	..	..	50.0-58.9
MAY												
8.7	7.7	0.3	9.7	10.6	12.9	17.4	20.9	1.3	4.2	6.1	7.1	≤32.0
47.5	49.1	48.7	48.4	51.3	54.6	55.5	64.6	60.3	55.5	52.9	49.7	32.1-40.9
40.6	38.7	40.0	39.7	36.5	31.9	26.1	13.9	9.4	7.1	5.8	4.2	41.0-49.9
3.2	4.5	2.9	2.2	1.6	0.6	1.0	0.6	0.3	..	..	..	50.0-58.9
..	..	..	..	..	..	..	..	..	..	..	..	59.0-67.9
JUNE												
27.7	25.7	27.3	25.3	25.3	31.0	36.7	45.3	55.3	59.3	59.4	62.3	≤32.0
56.6	58.3	56.7	58.3	58.3	54.0	51.0	47.4	40.7	35.0	32.3	27.0	32.1-40.9
15.7	15.7	16.0	15.7	15.7	14.7	12.0	7.3	3.0	1.0	1.0	0.7	41.0-49.9
..	0.3	..	0.7	0.7	0.3	0.3	..	..	..	..	..	50.0-58.9
..	..	..	..	..	..	..	..	1.0	4.7	7.3	10.0	59.0-67.9
..	..	..	..	..	..	..	..	..	..	..	..	68.0-76.9
JULY												
3.5	2.9	3.2	3.2	3.5	5.5	11.6	19.7	29.0	37.7	40.3	45.8	≤32.0
72.3	69.4	70.0	69.4	70.4	71.6	72.6	71.6	66.5	57.8	56.2	49.3	32.1-40.9
23.2	26.4	25.5	25.5	24.8	21.9	15.2	8.7	4.5	4.5	2.9	2.6	41.0-49.9
1.0	1.3	1.3	1.9	1.3	1.0	0.6	..	..	..	..	..	50.0-58.9
..	..	..	..	..	..	..	..	..	..	..	..	59.0-67.9
..	..	..	..	..	..	..	..	..	..	..	..	68.0-76.9
AUGUST												
5.2	4.8	4.5	4.5	7.7	11.0	16.4	24.8	30.7	35.5	38.1	41.0	≤32.0
66.8	67.1	67.2	67.8	64.6	64.8	67.5	66.5	64.8	61.2	57.7	54.5	32.1-40.9
27.4	27.1	27.7	27.1	27.7	24.2	16.1	8.4	4.2	2.3	1.3	1.0	41.0-49.9
0.6	1.0	0.6	0.6	..	..	..	..	..	..	..	..	50.0-58.9
..	..	..	..	..	..	..	..	..	..	..	..	59.0-67.9
..	..	..	..	..	..	..	..	..	..	..	..	68.0-76.9

TABLE II—DIURNAL PERCENTAGE FREQUENCY OF WET-BULB TEMPERATURE

Eskdalemuir	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200
°F.	SEPTEMBER											
≤32.0	1.3	1.7	2.0	3.0	2.7	3.0	2.0	0.7	..	..	..	..
32.1-40.9	13.7	14.3	15.7	15.0	15.7	14.7	13.0	6.3	3.0	2.3	0.7	1.3
41.0-49.9	46.0	48.3	49.3	48.3	50.0	50.3	52.0	47.4	38.3	32.3	28.7	26.3
50.0-58.9	38.0	35.0	32.3	32.7	30.6	31.3	32.3	44.3	55.7	59.7	64.5	65.4
59.0-67.9	1.0	0.7	0.7	1.0	1.0	0.7	0.7	1.3	3.0	5.7	6.0	7.0
°F.	OCTOBER											
≤32.0	5.8	6.8	6.8	7.7	7.7	7.1	7.1	5.8	2.9	1.0	..	0.3
32.1-40.9	31.9	30.0	30.3	30.6	31.0	31.9	31.6	25.8	20.0	12.2	9.4	8.1
41.0-49.9	42.9	43.8	44.2	44.3	44.8	45.2	44.5	50.3	56.1	60.7	61.3	60.0
50.0-58.9	19.4	19.4	18.7	17.4	16.5	15.8	16.8	18.1	21.0	26.1	29.0	31.6
59.0-67.9	..	..	..	..	..	..	..	..	..	..	0.3	..
°F.	NOVEMBER											
≤32.0	19.7	18.7	18.7	19.3	18.7	19.0	19.7	19.7	18.0	12.0	6.7	5.0
32.1-40.9	41.0	45.6	45.0	44.3	44.3	44.7	46.3	44.3	43.6	43.3	42.7	38.7
41.0-49.9	33.3	30.0	32.3	32.7	33.0	31.0	28.0	30.7	33.7	38.0	43.3	48.0
50.0-58.9	6.0	5.7	4.0	3.7	4.0	5.3	6.0	5.3	4.7	6.7	7.3	8.3
°F.	DECEMBER											
≤32.0	26.4	27.1	26.4	28.7	26.1	28.0	26.8	26.8	26.4	22.6	18.4	15.2
32.1-40.9	47.4	47.4	47.1	44.8	48.4	46.1	49.4	47.4	47.5	48.7	51.6	54.2
41.0-49.9	25.5	24.5	25.5	25.5	24.8	25.2	23.5	25.5	26.1	28.4	30.0	30.6
50.0-58.9	0.7	1.0	1.0	1.0	0.7	0.7	0.3	0.3	..	0.3	..	..
°F.	SPRING (March-May)											
≤32.0	21.5	22.5	24.5	25.0	24.6	22.0	16.6	12.7	8.9	6.9	5.1	4.7
32.1-40.9	45.8	44.9	43.4	43.1	42.9	42.6	40.8	36.4	33.8	28.1	26.9	23.6
41.0-49.9	31.3	31.3	30.5	30.5	31.1	33.6	39.2	45.1	49.3	52.7	52.2	54.6
50.0-58.9	1.4	1.3	1.6	1.3	1.4	1.9	3.3	5.7	7.8	12.1	15.2	16.0
59.0-67.9	..	..	..	..	..	..	0.1	0.1	0.1	0.2	0.5	1.2
°F.	SUMMER (June-August)											
≤32.0	0.1	0.1	0.4	0.4	0.1	..	..	..	..	..	..	..
32.1-40.9	7.7	8.9	10.0	10.9	9.2	4.0	1.0	0.1	..	..	..	..
41.0-49.9	49.3	49.3	51.0	50.8	52.0	51.6	42.1	31.7	24.9	19.9	15.3	13.1
50.0-58.9	41.5	40.8	37.5	37.0	37.6	42.6	54.1	61.0	63.3	63.8	66.9	66.6
59.0-67.9	1.3	0.9	1.1	1.0	1.1	1.7	2.8	7.2	11.6	16.2	17.6	19.9
68.0-76.9	..	..	..	..	..	..	..	..	0.2	0.1	0.2	0.3
°F.	AUTUMN (September-November)											
≤32.0	8.9	9.0	9.1	10.0	9.7	9.7	9.6	8.7	6.9	4.3	2.2	1.8
32.1-40.9	28.9	30.0	30.3	30.0	30.3	30.4	30.3	25.5	22.2	19.2	17.5	15.9
41.0-49.9	40.8	40.8	42.0	41.8	42.6	42.2	41.5	42.9	42.9	43.9	44.6	44.9
50.0-58.9	21.1	20.0	18.3	17.9	17.0	17.5	18.3	22.5	27.0	30.8	33.6	35.1
59.0-67.9	0.3	0.2	0.2	0.3	0.3	0.2	0.2	0.4	1.0	1.9	2.1	2.3
°F.	WINTER (December-February)											
≤32.0	39.2	40.3	39.5	41.4	40.0	40.5	39.8	40.4	39.0	35.5	32.2	28.8
32.1-40.9	41.4	40.6	41.4	39.9	41.6	41.4	43.6	42.1	43.2	44.1	45.7	46.6
41.0-49.9	19.2	18.7	18.7	18.4	18.2	17.8	16.5	17.4	17.8	20.3	22.0	24.6
50.0-58.9	0.2	0.3	0.3	0.3	0.2	0.2	0.1	0.1	..	0.1	..	..
°F.	YEAR											
≤32.0	17.4	17.9	18.3	19.1	18.5	17.9	16.4	15.4	13.7	11.6	9.8	8.7
32.1-40.9	30.9	31.1	31.2	31.0	31.0	29.6	28.9	26.0	24.7	22.8	22.4	21.4
41.0-49.9	35.2	35.1	35.7	35.4	36.0	36.4	34.9	34.3	33.7	34.2	33.5	34.3
50.0-58.9	16.1	15.6	14.5	14.2	14.1	15.6	19.0	22.4	24.6	26.8	28.9	29.6
59.0-67.9	0.4	0.3	0.3	0.3	0.4	0.5	0.8	1.9	3.2	4.6	5.3	5.9
68.0-76.9	..	..	..	..	..	..	..	..	0.1	< 0.1	0.1	0.1

## FOR EACH MONTH AND SEASON AND FOR THE YEAR\*—continued

1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	
SEPTEMBER												°F.
1.0	1.0	0.3	0.3	0.7	3.0	4.7	6.7	8.7	9.3	11.7	13.0	≤32.0
25.3	25.0	26.7	26.4	29.3	33.7	42.0	46.0	47.3	48.0	46.6	47.0	32.1-40.9
65.0	65.7	64.3	65.0	63.3	59.6	51.0	45.6	42.0	41.4	39.7	37.7	41.0-49.9
8.7	8.3	8.7	8.3	6.7	3.7	2.3	1.7	2.0	1.3	1.0	1.0	50.0-58.9
OCTOBER												°F.
..	..	..	0.7	0.7	1.6	2.6	2.6	2.9	4.2	5.8	6.1	≤32.0
7.7	8.1	9.4	10.3	16.8	22.2	27.1	28.4	30.0	30.6	29.0	32.9	32.1-40.9
59.4	60.3	61.0	59.7	55.1	52.0	47.1	45.5	45.5	44.5	45.8	42.0	41.0-49.9
32.2	31.3	29.3	29.0	27.4	24.2	23.2	23.5	21.6	20.7	19.4	19.0	50.0-58.9
0.7	0.3	0.3	0.3	..	..	..	..	..	..	..	..	59.0-67.9
NOVEMBER												°F.
3.7	4.3	5.7	9.3	11.7	13.0	14.7	15.3	16.0	18.3	17.3	19.7	≤32.0
40.0	38.0	42.0	41.7	41.0	42.3	42.7	43.7	43.0	43.0	43.0	42.3	32.1-40.9
48.3	49.0	44.3	41.7	40.6	39.7	37.3	35.7	35.7	33.7	35.4	33.0	41.0-49.9
8.0	8.7	8.0	7.3	6.7	5.0	5.3	5.3	5.3	5.0	4.3	5.0	50.0-58.9
DECEMBER												°F.
11.9	12.3	12.6	16.8	18.4	21.6	25.2	24.2	24.2	24.2	26.8	25.5	≤32.0
57.1	56.5	57.4	55.2	54.9	52.3	49.0	51.0	52.0	50.3	48.4	49.6	32.1-40.9
30.7	30.9	29.7	27.7	26.4	25.8	25.5	24.5	23.5	25.2	24.5	24.2	41.0-49.9
0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.7	50.0-58.9
SPRING (March-May)												°F.
3.8	3.8	4.0	4.5	5.3	7.4	8.4	11.1	13.3	15.3	17.0	19.9	≤32.0
22.7	22.0	22.9	24.0	25.9	29.0	36.2	38.9	42.3	44.5	45.0	44.9	32.1-40.9
53.9	54.2	52.9	52.2	51.5	50.4	46.0	45.0	41.2	37.8	36.0	33.7	41.0-49.9
18.5	18.5	19.1	18.6	16.7	12.9	9.1	4.8	3.1	2.4	2.1	1.5	50.0-58.9
1.1	1.5	1.0	0.8	0.5	0.2	0.3	0.2	0.1	..	..	..	59.0-67.9
SUMMER (June-August)												°F.
..	..	..	..	..	..	..	0.1	0.4	1.9	3.6	5.2	≤32.0
12.0	11.0	11.5	10.9	12.1	15.7	21.4	29.8	38.1	44.0	45.8	49.6	32.1-40.9
65.3	65.0	64.7	65.2	64.5	63.6	63.8	62.0	57.5	51.5	48.9	43.8	41.0-49.9
22.2	23.1	23.1	22.8	22.8	20.3	14.5	8.1	3.9	2.6	1.7	1.4	50.0-58.9
0.5	0.9	0.7	1.1	0.7	0.4	0.3	..	..	..	..	..	59.0-67.9
AUTUMN (September-November)												°F.
1.2	1.4	1.9	3.3	4.1	4.8	5.7	5.9	6.3	7.5	8.0	9.0	≤32.0
16.1	15.6	17.1	17.4	19.5	22.5	24.8	26.3	27.3	27.7	27.9	29.5	32.1-40.9
44.5	44.9	44.2	42.7	41.9	41.9	42.2	42.4	42.9	42.1	42.6	40.7	41.0-49.9
35.1	35.2	33.9	33.7	32.4	29.6	26.5	24.8	23.0	22.3	21.1	20.5	50.0-58.9
3.1	2.9	3.0	2.9	2.1	1.2	0.8	0.5	0.7	0.4	0.3	0.3	59.0-67.9
WINTER (December-February)												°F.
27.2	26.7	27.7	31.0	32.6	34.5	37.0	37.8	37.7	37.9	39.0	39.0	≤32.0
47.4	48.3	48.1	46.1	46.5	44.7	42.9	42.9	43.6	43.1	41.6	41.6	32.1-40.9
25.3	24.9	24.1	22.8	20.8	20.6	20.0	19.3	18.6	18.9	19.3	19.2	41.0-49.9
0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	50.0-58.9
YEAR												°F.
8.0	7.9	8.3	9.7	10.4	11.6	12.7	13.6	14.2	15.1	15.9	16.9	≤32.0
21.5	21.4	21.9	21.7	22.8	24.0	25.9	27.0	28.3	29.2	29.5	30.2	32.1-40.9
33.9	33.8	33.2	32.1	31.6	32.2	32.4	34.2	35.3	35.8	35.9	35.9	41.0-49.9
29.9	29.8	29.6	29.5	28.6	26.6	25.0	23.0	21.0	19.1	18.2	16.6	50.0-58.9
6.6	6.9	6.8	6.7	6.4	5.5	3.9	2.2	1.2	0.8	0.5	0.4	59.0-67.9
0.1	0.2	0.2	0.3	0.2	0.1	0.1	..	..	..	..	..	68.0-76.9

TABLE III—MONTHLY, SEASONAL, AND ANNUAL PERCENTAGE FREQUENCY

## Aberdeen

1938-47

	0100- 0600	0700- 1200	1300- 1800	1900- 2400	0100- 2400	0100- 0600	0700- 1200	1300- 1800	1900- 2400	0100- 2400
°F.	JANUARY					FEBRUARY				
≤32.0 ..	28.7	26.5	20.6	24.2	25.0	28.5	24.4	17.8	25.7	24.1
32.1-40.9 ..	55.2	56.7	58.4	57.8	57.0	53.1	55.9	56.9	53.4	54.8
41.0-49.9 ..	16.1	16.8	20.9	17.9	18.0	18.2	18.8	23.3	20.5	20.2
50.0-58.9 ..	..	..	0.1	0.1	<0.1	0.4	0.9	2.0	0.4	0.9
°F.	MARCH					APRIL				
≤32.0 ..	18.3	12.4	7.5	13.5	12.9	3.4	0.4	0.1	1.1	1.2
32.1-40.9 ..	52.3	48.0	45.0	49.8	48.8	54.1	35.2	26.3	44.7	40.1
41.0-49.9 ..	28.8	37.4	42.6	35.6	36.1	41.1	57.8	62.3	50.3	52.9
50.0-58.9 ..	0.6	2.2	4.9	1.1	2.2	1.4	6.6	11.3	3.9	5.8
°F.	MAY					JUNE				
≤32.0 ..	1.2	..	..	0.3	0.4	..	..	..	..	..
32.1-40.9 ..	26.4	12.6	9.8	17.7	16.6	2.4	0.2	0.1	0.9	0.9
41.0-49.9 ..	65.8	66.3	63.2	69.1	66.1	58.6	37.3	25.3	43.9	41.3
50.0-58.9 ..	6.6	20.8	26.6	12.7	16.7	38.7	57.5	68.2	53.9	54.6
59.0-67.9 ..	..	0.3	0.4	0.2	0.2	0.3	5.0	6.4	1.3	3.2
°F.	JULY					AUGUST				
32.1-40.9 ..	0.1	..	..	..	<0.1	0.9	..	..	..	0.2
41.0-49.9 ..	24.8	5.3	1.6	9.6	10.3	31.7	12.5	7.8	17.0	17.3
50.0-58.9 ..	73.7	84.6	83.4	85.9	81.9	64.5	74.6	72.0	75.5	71.7
59.0-67.9 ..	1.4	10.1	15.0	4.5	7.8	2.9	12.9	20.2	7.5	10.8
°F.	SEPTEMBER					OCTOBER				
≤32.0 ..	..	..	..	..	..	0.1	0.1	..	..	<0.1
32.1-40.9 ..	7.5	2.2	0.6	3.6	3.4	22.2	11.0	4.6	14.9	13.1
41.0-49.9 ..	45.1	34.0	26.4	39.1	36.2	59.6	64.0	63.0	62.0	62.2
50.0-58.9 ..	46.3	59.8	66.3	54.4	56.7	18.0	24.9	32.2	23.1	24.6
59.0-67.9 ..	1.1	4.0	6.7	2.9	3.7	0.1	..	0.2	..	0.1
°F.	NOVEMBER					DECEMBER				
≤32.0 ..	6.7	4.8	1.6	4.1	4.3	14.4	11.6	8.0	11.2	11.3
32.1-40.9 ..	41.4	41.6	38.1	42.4	40.9	53.5	55.3	52.5	54.5	53.9
41.0-49.9 ..	43.8	44.7	49.5	44.6	45.6	31.3	32.4	38.9	34.1	34.2
50.0-58.9 ..	8.1	8.9	10.8	8.9	9.2	0.8	0.7	0.6	0.2	0.6

	SPRING 0100-2400	SUMMER 0100-2400	AUTUMN 0100-2400	WINTER 0100-2400
°F.				
≤32.0 ..	4.9	..	1.4	20.0
32.1-40.9 ..	35.1	0.4	19.1	55.3
41.0-49.9 ..	51.7	22.8	48.1	24.2
50.0-58.9 ..	8.2	69.5	30.1	0.5
59.0-67.9 ..	0.1	7.3	1.2	..

8/

	YEAR						
	0100- 0600	0600- 1200	1300- 1800	1900- 2400	0700- 1800	1900- 0600	0100- 2400
°F.							
≤32.0 ..	8.4	6.6	4.6	6.6	5.6	7.5	6.5
32.1-40.9 ..	30.6	26.4	24.2	28.2	25.3	29.4	27.4
41.0-49.9 ..	38.8	35.7	35.4	37.0	35.6	37.9	36.7
50.0-58.9 ..	21.7	28.6	31.7	26.8	30.1	24.3	27.2
59.0-67.9 ..	0.5	2.7	4.1	1.4	3.4	0.9	2.2

OF WET-BULB TEMPERATURE IN 6-HR., 12-HR., AND 24-HR. PERIODS\*

**Eskdalemuir**

1940-49

	0100-0600	0700-1200	1300-1800	1900-2400	0100-0600	0700-1200	1300-1800	1900-2400	0100-0600
	JANUARY				FEBRUARY				
°F.									
≤32.0 ..	48.0	45.9	39.6	46.5	44.9	45.9	39.6	35.2	43.1
32.1-40.9 ..	37.2	39.6	43.0	38.4	39.6	38.8	43.2	41.5	39.1
41.0-49.9 ..	14.8	14.5	17.4	15.1	15.5	15.3	17.2	23.3	17.8
	MARCH				APRIL				
≤32.0 ..	39.7	24.5	14.0	29.7	27.0	18.3	2.3	0.2	9.5
32.1-40.9 ..	43.5	42.5	38.8	47.5	43.1	50.1	36.6	24.9	49.5
41.0-49.9 ..	16.8	32.3	44.5	22.8	29.1	31.3	56.2	63.5	40.7
50.0-58.9 ..	..	0.7	2.7	..	0.8	0.3	4.9	11.4	0.3
	MAY				JUNE				
≤32.0 ..	11.8	0.5	<0.1	3.1	3.9	0.6	..	..	0.1
32.1-40.9 ..	38.0	16.0	9.6	29.1	23.2	13.4	0.2	..	3.8
41.0-49.9 ..	46.1	58.2	50.0	56.4	52.6	63.2	42.9	27.1	53.1
50.0-58.9 ..	4.1	24.2	37.8	11.1	19.3	22.5	48.2	57.0	38.8
59.0-67.9 ..	..	1.1	2.6	0.3	1.0	0.3	8.7	15.6	4.2
68.0-76.9 ..	..	..	..	..	..	..	..	0.3	0.1
	JULY				AUGUST				
32.1-40.9 ..	5.6	..	..	0.5	1.5	6.4	0.3	..	1.3
41.0-49.9 ..	44.8	14.1	3.7	30.7	23.3	44.5	17.1	6.3	31.1
50.0-58.9 ..	48.3	73.2	70.5	62.3	63.6	47.2	56.0	66.3	62.1
59.0-67.9 ..	1.3	12.3	24.5	6.4	11.1	1.9	16.6	26.9	5.5
68.0-76.9 ..	..	0.4	1.3	0.1	0.5	..	..	0.5	..
	SEPTEMBER				OCTOBER				
≤32.0 ..	2.3	0.4	..	0.4	0.8	7.0	2.8	0.5	4.0
32.1-40.9 ..	14.8	4.5	1.1	9.0	7.3	31.0	17.8	12.4	29.7
41.0-49.9 ..	48.8	37.5	27.7	46.2	40.0	44.2	55.5	57.9	45.1
50.0-58.9 ..	33.3	53.7	63.8	42.9	48.5	17.8	23.8	28.9	21.2
59.0-67.9 ..	0.8	3.9	7.4	1.5	3.4	..	0.1	0.3	..
	NOVEMBER				DECEMBER				
≤32.0 ..	19.0	13.5	7.9	16.9	14.3	27.1	22.7	15.6	25.0
32.1-40.9 ..	44.2	43.2	40.9	42.9	42.8	46.9	49.7	55.5	50.0
41.0-49.9 ..	32.0	36.9	43.9	35.1	37.0	25.2	27.4	28.6	24.6
50.0-58.9 ..	4.8	6.4	7.3	5.1	5.9	0.8	0.2	0.3	0.4

	SPRING 0100-2400	SUMMER 0100-2400	AUTUMN 0100-2400	WINTER 0100-2400
°F.				
≤32.0 ..	12.9	0.1	6.2	36.0
32.1-40.9 ..	35.4	2.6	24.3	43.7
41.0-49.9 ..	43.2	31.4	42.7	20.1
50.0-58.9 ..	8.2	55.3	25.7	0.1
59.0-67.9 ..	0.3	10.4	1.1	..
68.0-76.9 ..	..	0.2	..	..

	YEAR						
	0100-0600	0700-1200	1300-1800	1900-2400	0700-1800	1900-0600	0100-2400
°F.							
≤32.0 ..	18.2	12.6	9.3	14.7	10.9	16.4	13.7
32.1-40.9 ..	30.8	24.3	22.2	28.5	23.3	29.6	26.4
41.0-49.9 ..	35.6	34.1	32.8	34.8	33.6	35.3	34.4
50.0-58.9 ..	15.0	25.4	29.0	20.5	27.1	17.8	22.4
59.0-67.9 ..	0.4	3.6	6.5	1.5	5.0	0.9	3.0
68.0-76.9 ..	..	<0.1	0.2	<0.1	0.1	<0.1	0.1

\*It should be noted that the range 32.1-40.9°F. extends over 8.9°F. and subsequent ranges over 9°F.

68

Monthly and annual percentage frequency of wet-bulb temperature in 6-hr., 12-hr. and 24-hr. periods.—The figures for the months in Table III show, as expected, that the greatest number of wet-bulb frosts occurs in the period 0100–0600, and that there are more in the interval 0700–1200 than during 1300–1800. It follows that wet-bulb frosts are more frequent during the 12 hr., 0100–1200 than during 1300–2400.

The annual frequencies were summed to give the total frequencies below 32.1°, 41°, 50° and 59°F. in each of the 6-hourly periods, and plotted in Fig. 2. The cumulative frequencies in the day hours (0700–1800), the night hours (1900–0600) and for the whole period (0100–2400) are also shown. Clearly, in each of the temperature ranges the period 0700–1200 provides the best

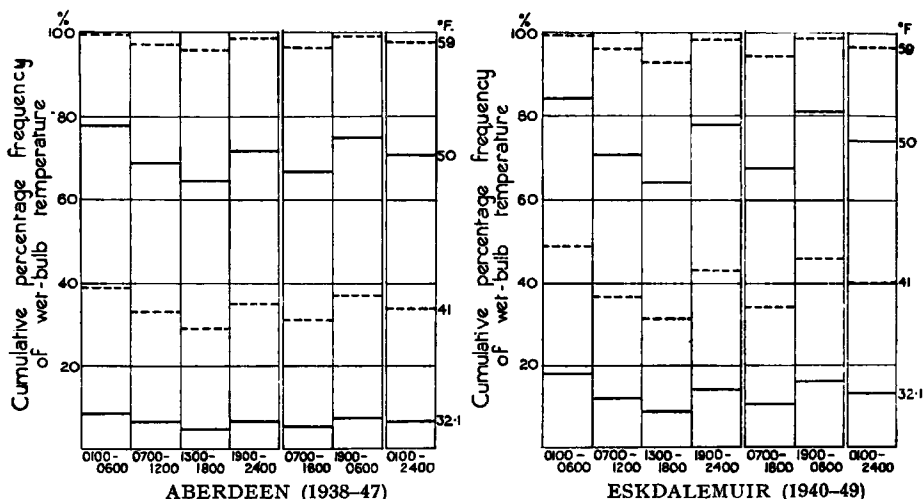


FIG. 2—ANNUAL CUMULATIVE PERCENTAGE FREQUENCY OF WET-BULB TEMPERATURE

approximation and the period 1900–2400 the next best approximation to the percentage occurrence of wet-bulb temperature for the whole day (0100–2400). It is also evident that the wet-bulb temperature is below 41°F. for about 35–40 per cent. of the time. The corresponding dry-bulb temperature would be about 43°F., i.e. 1°F. higher than the critical temperature above which it is reckoned that plant growth begins and is maintained.

Monthly and annual percentage frequency of wet-bulb temperature for each year.—Table IV is included to show the variation from year to year over the 10-yr. periods.

The year 1947 provided both the coldest month and the mildest one. In February, 1947, 86.0 per cent. of the hourly readings at Aberdeen and 98.8 at Eskdalemuir were below the freezing point. In August 1947, the mildest month in the 10-yr. periods, 33.5 per cent. of the readings at Aberdeen and 38.3 at Eskdalemuir reached or exceeded 59°F. The group frequencies for the 12 months as a whole do not vary widely from year to year at Aberdeen nor at Eskdalemuir, while the mean values for the whole 10-yr. periods show fair agreement at the two stations.

A Pearsonian frequency curve<sup>2</sup> was fitted to the mean annual distribution of all the hourly readings (0100–2400) at Eskdalemuir (Fig. 3). The equation found to a Type I curve was

$$Y = 37.006 \left(1 + \frac{x}{6.692}\right)^{11.328} \left(1 - \frac{x}{3.131}\right)^{5.300},$$



where  $Y$  is the percentage frequency and  $x$  the wet-bulb temperature in units of  $9^\circ\text{F.}$  from the mode as origin. The constants together with the actual and calculated values expressed as a percentage of the total number of hourly readings were as follows :—

Mode (origin)	.. ..	44.81°F.	Total number of hourly		
Mean	.. ..	43.10°F.	readings	.. ..	87,672
			Unit	.. ..	9°F.
Standard deviation	=	1.050 (9.45°F.)	Skewness	=	-0.183
$\mu_2$	=	1.103	$\beta_1$	=	0.086
$\mu_3$	=	-0.340	$\beta_2$	=	2.846
$\mu_4$	=	3.462	$\kappa$	=	-0.117

where  $\mu_2$ ,  $\mu_3$  and  $\mu_4$  are the 2nd, 3rd and 4th moments about the mean, the skewness (Karl Pearson) is (mean — mode)  $\div$  standard deviation,  $\beta_1$  ( $=\mu_3^2/\mu_2^3$ ) and  $\beta_2$  ( $=\mu_4/\mu_2^2$ ) are skewness coefficients, and  $\kappa$  is Pearson's criterion defined by

$$\kappa = \frac{\beta_1 (\beta_2 + 3)^2}{4(2\beta_2 - 3\beta_1 - 6) (4\beta_2 - 3\beta_1)}$$

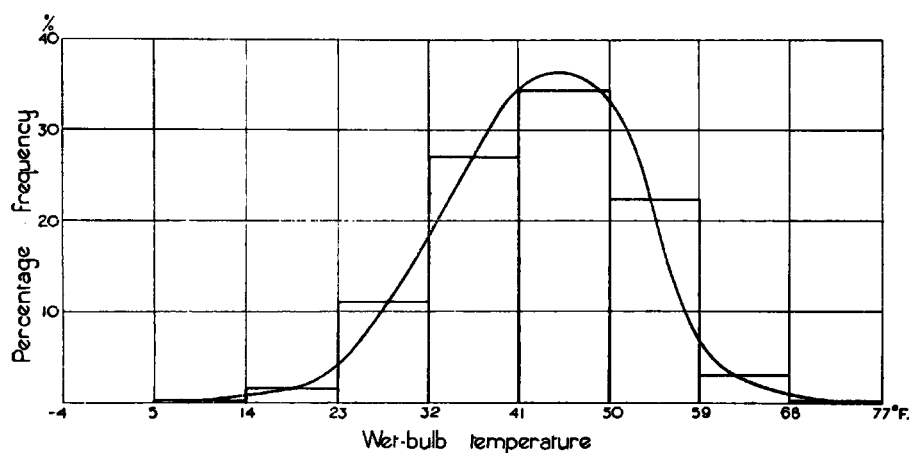


FIG. 3—ANNUAL PERCENTAGE FREQUENCY OF WET-BULB TEMPERATURE, 0100-2400  
ESKDALEMUIR, 1940-49  
(Pearson Type I curve)

Range °F.	Percentage frequency		
	Observed	Theoretical $Y$	Area
— 4-4.9	< 0.1	< 0.1	< 0.1
5-13.9	0.2	0.1	0.2
14-22.9	1.7	1.8	2.1
23-31.9	11.1	10.1	10.4
32-40.9	27.1	27.2	26.9
41-49.9	34.4	36.8	35.8
50-58.9	22.4	21.5	21.3
59-67.9	3.0	2.5	3.2
68-76.9	0.1	< 0.1	0.1

TABLE IV—MONTHLY AND ANNUAL PERCENTAGE FREQUENCY OF

Aberdeen	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1938-47
°F.	JANUARY, 0100-2400										
14.0-22.9 ..	..	0.5	5.1	5.8	..	1.2	0.1	10.7	1.3	..	..
23.0-31.9 ..	4.6	17.9	38.0	39.0	30.6	13.0	9.3	34.3	15.2	10.4	..
32.0-40.9 ..	66.8	58.3	46.7	52.1	62.8	53.7	52.3	48.0	68.3	74.4	..
41.0-49.9 ..	28.5	23.3	10.2	3.1	6.6	32.1	38.2	7.0	15.2	15.2	..
50.0-58.9 ..	0.1	..	..	..	..	..	0.1	..	..	..	..
	FEBRUARY, 0100-2400										
14.0-22.9 ..	..	..	..	..	0.4	..	..	..	..	1.8	..
23.0-31.9 ..	1.0	5.3	25.5	25.3	38.4	2.5	16.6	3.4	21.2	84.2	..
32.0-40.9 ..	74.2	53.0	58.6	68.3	61.2	52.0	67.2	60.9	51.0	14.0	..
41.0-49.9 ..	23.9	37.4	15.9	6.4	..	43.9	13.1	33.5	27.8	..	..
50.0-58.9 ..	0.9	4.3	..	..	..	1.6	0.1	2.2	..	..	..
	MARCH, 0100-2400										
5.0-13.9 ..	..	..	..	..	..	..	..	..	..	0.1	..
14.0-22.9 ..	..	..	..	..	..	..	..	..	0.9	8.3	..
23.0-31.9 ..	1.9	0.4	12.4	12.6	20.0	1.3	16.6	..	11.7	37.0	..
32.0-40.9 ..	15.7	69.4	53.2	82.3	57.4	41.0	50.3	22.0	52.2	50.3	..
41.0-49.9 ..	68.1	30.2	34.4	5.1	22.6	55.8	31.5	76.1	32.9	4.3	..
50.0-58.9 ..	14.3	..	..	..	..	1.9	1.6	1.9	2.3	..	..
	APRIL, 0100-2400										
23.0-31.9 ..	0.1	0.6	0.7	1.9	0.3	..	1.0	2.9	1.2	1.8	..
32.0-40.9 ..	37.5	53.7	48.9	69.8	45.0	20.8	21.0	32.1	31.7	42.3	..
41.0-49.9 ..	58.9	42.2	49.2	25.7	53.3	64.9	71.5	53.6	55.7	53.8	..
50.0-58.9 ..	3.5	3.5	1.2	2.6	1.4	14.3	6.5	11.4	11.4	2.1	..
	MAY, 0100-2400										
23.0-31.9 ..	0.9	..	..	0.5	0.9	0.3	..	..	..	..	..
32.0-40.9 ..	19.5	6.4	3.6	33.0	19.0	14.2	25.7	14.0	20.6	11.7	..
41.0-49.9 ..	62.9	69.5	68.3	64.5	71.2	68.7	51.5	67.5	69.6	67.3	..
50.0-58.9 ..	16.7	22.6	28.1	2.0	8.9	16.8	22.3	18.5	9.8	21.0	..
59.0-67.9 ..	..	1.5	..	..	..	..	0.5	..	..	..	..
	JUNE, 0100-2400										
32.0-40.9 ..	..	3.2	..	2.2	1.9	..	..	0.1	0.5	0.7	..
41.0-49.9 ..	44.0	37.5	21.2	45.8	51.3	30.8	55.3	40.3	50.3	36.4	..
50.0-58.9 ..	54.9	53.9	72.4	47.3	41.8	68.8	44.7	58.6	44.9	58.9	..
59.0-67.9 ..	1.1	5.4	6.4	4.7	5.0	0.4	..	1.0	4.3	4.0	..
	JULY, 0100-2400										
32.0-40.9 ..	..	..	..	..	..	0.3	..	..	..	..	..
41.0-49.9 ..	12.2	14.2	9.9	7.8	9.4	21.6	5.5	7.8	5.8	8.9	..
50.0-58.9 ..	80.8	81.5	88.2	79.7	85.6	72.6	92.2	78.2	84.4	75.9	..
59.0-67.9 ..	7.0	4.3	1.9	12.5	5.0	5.5	2.3	14.0	9.8	15.2	..
	AUGUST, 0100-2400										
32.0-40.9 ..	1.5	..	..	0.3	..	..	0.4	..	..	..	..
41.0-49.9 ..	21.6	4.3	31.6	18.4	9.7	33.0	16.0	16.2	20.6	1.1	..
50.0-58.9 ..	61.3	81.7	59.5	79.7	79.7	64.0	72.3	76.1	76.9	65.4	..
59.0-67.9 ..	15.6	14.0	8.9	1.6	10.6	3.0	11.3	7.7	2.5	33.5	..

HOURLY AND 0900 WET-BULB TEMPERATURE FOR EACH YEAR

Aberdeen	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1938-47
°F.	SEPTEMBER, 0100-2400										
32.0-40.9 ..	0.7	3.2	6.2	..	5.0	10.3	4.3	0.4	0.4	3.8	..
41.0-49.9 ..	27.2	32.9	59.2	22.1	36.7	30.7	56.0	29.9	34.4	32.6	..
50.0-58.9 ..	67.2	49.3	33.6	73.2	55.7	58.5	39.7	65.0	63.9	61.0	..
59.0-67.9 ..	4.9	14.6	1.0	4.7	2.6	0.5	..	4.7	1.3	2.6	..
	OCTOBER, 0100-2400										
23.0-31.9 ..	..	0.3	..	..	..	..	..	..	..	..	..
32.0-40.9 ..	12.4	27.7	11.7	24.7	12.6	5.9	15.4	2.3	11.3	7.5	..
41.0-49.9 ..	61.3	64.6	67.3	46.6	70.6	58.2	69.8	49.0	73.3	61.2	..
50.0-58.9 ..	26.3	7.4	21.0	28.3	16.8	35.9	14.8	48.7	15.4	31.0	..
59.0-67.9 ..	..	..	..	0.4	..	..	..	..	..	0.3	..
	NOVEMBER, 0100-2400										
14.0-22.9 ..	..	..	..	..	..	..	..	..	..	1.1	..
23.0-31.9 ..	2.9	0.6	1.8	1.7	5.4	2.5	7.9	0.6	1.1	13.1	..
32.0-40.9 ..	40.2	38.3	45.9	31.7	46.3	60.1	65.2	21.1	28.8	35.8	..
41.0-49.9 ..	33.2	58.6	52.2	64.8	47.5	20.2	26.5	59.3	58.6	35.4	..
50.0-58.9 ..	23.7	2.5	0.1	1.8	0.8	17.2	0.4	19.0	11.5	14.6	..
	DECEMBER, 0100-2400										
14.0-22.9 ..	..	..	..	0.5	..	..	..	..	..	3.1	..
23.0-31.9 ..	15.7	18.9	0.4	4.8	12.6	5.2	14.6	3.6	6.9	14.5	..
32.0-40.9 ..	46.4	52.1	82.6	60.7	29.8	64.5	62.8	50.4	77.3	25.3	..
41.0-49.9 ..	37.9	28.9	16.9	33.6	54.4	30.2	22.6	45.7	15.8	55.5	..
50.0-58.9 ..	..	0.1	0.1	0.4	3.2	0.1	..	0.3	..	1.6	..
	YEAR, 0100-2400										
5.0-13.9 ..	..	..	..	..	..	..	..	..	..	<0.1	<0.1
14.0-22.9 ..	..	<0.1	0.4	0.5	<0.1	0.1	<0.1	0.9	0.2	1.2	0.4
23.0-31.9 ..	2.3	3.7	6.5	7.1	8.9	2.1	5.5	3.8	4.7	13.0	5.7
32.0-40.9 ..	25.9	30.4	29.7	35.2	28.2	26.7	30.6	20.7	28.4	22.2	27.8
41.0-49.9 ..	40.1	36.9	36.4	28.8	36.3	40.9	38.0	40.5	38.3	31.1	36.7
50.0-58.9 ..	29.3	25.7	25.5	26.4	24.7	29.4	24.7	31.8	26.9	27.8	27.2
59.0-67.9 ..	2.4	3.3	1.5	2.0	1.9	0.8	1.2	2.3	1.5	4.7	2.2
	YEAR 0900										
14.0-22.9 ..	..	0.3	0.8	0.8	..	0.3	..	1.1	0.3	1.9	0.5
23.0-31.9 ..	2.5	3.6	6.8	6.8	9.6	2.2	5.5	3.8	6.0	13.4	6.0
32.0-40.9 ..	25.5	28.5	29.0	35.9	26.6	26.7	31.7	21.1	26.9	20.8	27.3
41.0-49.9 ..	39.4	35.6	35.8	26.0	35.9	39.5	36.9	38.6	35.6	30.2	35.4
50.0-58.9 ..	30.7	27.1	26.5	28.3	25.7	30.7	25.1	32.9	29.6	28.5	28.5
59.0-67.9 ..	1.9	4.9	1.1	2.2	2.2	0.6	0.8	2.5	1.6	5.2	2.3

TABLE IV—MONTHLY AND ANNUAL PERCENTAGE FREQUENCY OF

Eskdalemuir	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1940-49
°F.	JANUARY, 0100-2400										
4.0-4.9 ..	1.3	1.9	..	..	..	2.3	1.1	0.5	..	..	..
5.0-13.9 ..	2.3	7.7	..	..	..	..	..	..	..	..	..
14.0-22.9 ..	23.8	9.1	6.0	5.1	3.4	15.2	12.7	3.6	0.7	3.9	..
23.0-31.9 ..	48.8	43.5	54.6	20.2	11.3	46.2	30.1	39.7	21.9	15.0	..
32.0-40.9 ..	22.3	37.8	30.5	50.1	40.3	29.4	40.5	46.2	67.6	48.7	..
41.0-49.9 ..	1.5	..	8.9	24.6	45.0	6.9	15.6	10.0	9.8	32.4	..
	FEBRUARY, 0100-2400										
4.0-4.9 ..	..	..	0.3	..	..	..	..	0.1	..	..	..
5.0-13.9 ..	..	0.7	0.3	..	0.7	..	1.5	3.4	..	..	..
14.0-22.9 ..	3.2	7.2	11.7	..	3.2	0.3	7.3	15.2	0.9	4.5	..
23.0-31.9 ..	43.7	43.9	67.3	7.1	29.6	6.5	16.4	80.1	32.3	8.5	..
32.0-40.9 ..	43.1	42.6	20.7	57.9	53.4	53.3	40.9	1.2	49.7	57.3	..
41.0-49.9 ..	10.0	5.6	..	35.0	13.1	39.9	33.9	..	17.1	29.7	..
	MARCH, 0100-2400										
5.0-13.9 ..	..	..	..	..	0.5	..	0.9	3.8	..	..	..
14.0-22.9 ..	5.1	1.9	2.0	1.2	4.0	1.1	4.2	10.0	..	1.5	..
23.0-31.9 ..	21.5	29.7	33.0	9.7	20.4	7.9	30.0	37.5	7.0	24.2	..
32.0-40.9 ..	35.9	61.6	40.7	53.5	45.4	35.8	34.1	40.5	43.7	52.1	..
41.0-49.9 ..	37.0	6.8	24.3	35.5	28.5	54.6	26.6	8.2	48.9	20.9	..
50.0-58.9 ..	0.5	..	..	0.1	1.2	0.6	4.2	..	0.4	1.3	..
	APRIL, 0100-2400										
14.0-22.9 ..	..	0.5	..	..	0.8	..	..	0.7	..	..	..
23.0-31.9 ..	10.0	14.6	8.2	2.1	1.4	8.3	3.3	7.1	7.0	4.0	..
32.0-40.9 ..	52.1	60.7	47.1	25.7	23.5	36.7	40.0	51.5	42.2	30.9	..
41.0-49.9 ..	33.7	24.2	40.0	67.8	70.5	48.0	50.2	40.7	45.8	58.3	..
50.0-58.9 ..	4.2	..	4.7	4.4	3.8	7.0	6.5	..	5.0	6.8	..
	MAY, 0100-2400										
14.0-22.9 ..	..	0.1	..	..	..	..	..	..	..	..	..
23.0-31.9 ..	0.4	4.5	4.8	4.1	3.3	5.1	3.5	0.8	5.9	2.4	..
32.0-40.9 ..	15.0	32.2	25.1	25.3	29.0	16.3	30.3	17.3	23.1	21.5	..
41.0-49.9 ..	52.4	56.5	57.3	48.3	52.9	53.6	49.4	46.1	51.2	58.9	..
50.0-58.9 ..	31.9	6.2	12.8	21.9	14.0	24.3	16.7	30.7	17.8	17.2	..
59.0-67.9 ..	0.3	0.5	..	0.4	0.8	0.7	0.1	5.1	2.0	..	..
	JUNE, 0100-2400										
23.0-31.9 ..	..	..	0.8	0.1	..	..	0.1	..	..	0.1	..
32.0-40.9 ..	3.6	8.1	6.8	2.6	2.8	2.9	10.0	0.6	1.8	4.9	..
41.0-49.9 ..	36.2	37.6	45.2	45.4	57.3	47.2	56.6	34.8	62.7	42.4	..
50.0-58.9 ..	41.8	43.5	41.2	46.5	39.6	46.3	30.4	55.0	33.3	39.0	..
59.0-67.9 ..	18.4	10.4	6.0	5.4	0.3	3.6	2.9	9.0	2.2	13.6	..
68.0-76.9 ..	..	0.4	..	..	..	..	..	0.6	..	..	..
	JULY, 0100-2400										
32.0-40.9 ..	2.8	1.2	3.2	0.9	0.5	1.3	0.4	1.1	3.0	0.8	..
41.0-49.9 ..	23.2	19.1	25.2	32.1	13.1	15.3	24.5	20.2	30.8	30.0	..
50.0-58.9 ..	71.6	65.3	68.0	57.1	75.1	71.0	70.0	57.7	49.6	49.8	..
59.0-67.9 ..	2.4	13.6	3.6	9.9	11.3	12.4	5.1	21.0	12.8	19.4	..
68.0-76.9 ..	..	0.8	..	..	..	..	..	..	3.8	..	..
	AUGUST, 0100-2400										
32.0-40.9 ..	4.2	1.5	..	1.7	1.3	1.6	4.6	0.7	3.9	0.9	..
41.0-49.9 ..	31.0	32.4	13.0	31.4	24.6	30.7	31.0	10.8	23.9	18.4	..
50.0-58.9 ..	57.7	63.1	74.5	63.0	49.8	52.0	63.3	49.7	68.4	62.4	..
59.0-67.9 ..	7.1	3.0	12.0	3.9	24.3	15.7	1.1	38.3	3.8	18.2	..
68.0-76.9 ..	..	..	0.5	..	..	..	..	0.5	..	0.1	..

## HOURLY AND 0900 WET-BULB TEMPERATURE FOR EACH YEAR—continued

Eskdalemuir	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1940-49
°F.	SEPTEMBER, 0100-2400										
23.0-31.9 ..	1.3	..	0.8	2.2	1.2	..	..	1.1	0.1	..	..
32.0-40.9 ..	13.5	1.7	9.6	13.9	12.4	4.7	0.5	7.4	8.9	1.8	..
41.0-49.9 ..	60.8	30.4	44.5	35.3	53.8	38.0	48.2	36.5	33.2	19.6	..
50.0-58.9 ..	24.4	60.6	45.0	46.5	31.6	49.9	50.6	48.8	57.8	69.2	..
59.0-67.9 ..	..	7.3	0.1	2.1	1.0	7.4	0.7	6.2	..	9.4	..
	OCTOBER, 0100-2400										
14.0-22.9 ..	..	..	..	..	0.1	..	..	..	..	0.1	..
23.0-31.9 ..	0.9	3.9	..	2.3	3.4	2.3	5.5	0.7	7.7	4.6	..
32.0-40.9 ..	26.0	25.9	30.4	12.9	27.7	10.9	29.0	13.9	30.8	24.3	..
41.0-49.9 ..	67.1	40.8	46.6	63.0	63.4	51.2	50.6	58.4	38.7	26.6	..
50.0-58.9 ..	6.0	28.8	23.0	21.8	5.4	35.6	14.9	27.0	22.8	44.1	..
59.0-67.9 ..	..	0.6	..	..	..	..	..	..	..	0.3	..
	NOVEMBER, 0100-2400										
14.0-22.9 ..	0.1	0.1	2.5	0.1	1.0	..	..	7.4	1.4	..	..
23.0-31.9 ..	7.8	12.6	15.4	20.6	12.2	6.7	3.1	19.8	15.8	7.8	..
32.0-40.9 ..	50.0	46.8	54.4	47.3	60.7	31.5	46.7	27.1	26.9	45.3	..
41.0-49.9 ..	41.7	39.2	27.7	25.8	25.0	56.5	38.3	27.8	41.3	46.9	..
50.0-58.9 ..	0.4	1.3	..	6.2	1.1	5.3	11.9	17.9	14.6	..	..
	DECEMBER, 0100-2400										
5.0-13.9 ..	..	..	0.3	..	..	..	..	..	..	..	..
14.0-22.9 ..	..	1.9	3.9	2.4	2.8	1.6	3.2	4.3	3.0	0.9	..
23.0-31.9 ..	21.4	23.1	12.1	17.5	21.8	21.7	23.2	13.6	20.6	13.2	..
32.0-40.9 ..	59.9	36.4	32.0	61.3	49.9	54.4	68.2	54.0	41.1	62.0	..
41.0-49.9 ..	18.7	38.6	50.0	18.8	25.5	22.3	5.4	28.1	32.9	23.9	..
50.0-58.9 ..	..	..	1.7	..	..	..	..	..	2.4	..	..
	YEAR, 0100-2400										
-4.0-4.9 ..	0.1	0.2	..	..	..	..	..	<0.1	..	..	<0.1
5.0-13.9 ..	0.2	0.7	<0.1	..	0.1	0.2	0.3	0.6	..	..	0.2
14.0-22.9 ..	2.7	1.7	2.1	0.8	1.3	1.6	2.3	3.4	0.5	0.9	1.7
23.0-31.9 ..	12.9	14.5	16.2	7.2	8.6	8.8	9.6	16.4	9.8	6.7	11.1
32.0-40.9 ..	27.3	29.6	25.1	29.2	28.7	23.0	28.7	22.0	28.6	29.0	27.1
41.0-49.9 ..	34.5	27.7	32.0	38.6	39.5	38.6	35.8	26.8	36.5	34.0	34.4
50.0-58.9 ..	20.0	22.5	22.8	22.4	18.6	24.5	22.5	24.0	22.8	24.3	22.4
59.0-67.9 ..	2.3	3.0	1.8	1.8	3.2	3.3	0.8	6.7	1.5	5.1	3.0
68.0-76.9 ..	..	0.1	<0.1	..	..	..	..	0.1	0.3	<0.1	0.1
	YEAR, 0900										
-4.0-4.9 ..	0.3	..	..	..	..	..	..	..	..	..	<0.1
5.0-13.9 ..	0.5	0.5	..	..	..	0.3	0.3	0.5	..	..	0.5
14.0-22.9 ..	2.5	2.5	2.0	1.1	1.9	2.5	3.3	3.3	0.5	1.1	2.0
23.0-31.9 ..	13.1	13.4	17.8	6.1	7.6	8.2	9.6	15.3	8.5	7.1	10.6
32.0-40.9 ..	24.3	29.1	20.8	28.2	29.0	20.5	24.4	22.2	27.9	27.1	25.3
41.0-49.9 ..	34.2	25.2	34.8	39.4	37.7	40.0	35.9	24.1	35.8	30.7	33.7
50.0-58.9 ..	21.8	26.6	23.0	24.1	21.1	25.8	25.7	25.5	25.4	27.4	24.6
59.0-67.9 ..	3.3	2.7	1.6	1.1	2.7	2.7	0.8	9.1	1.4	6.6	3.2
68.0-76.9 ..	..	..	..	..	..	..	..	..	0.5	..	0.1

Mean monthly and annual percentage frequency of wet-bulb temperature.—Cumulative percentage-frequency curves (Fig. 4) were constructed from the mean monthly data in Table V. The months group conveniently in six pairs, namely January and February, March and December, April and November, May and October, June and September, and July and August. As the months in each pair have about equal mean wet-bulb temperature (Table I), it was expected that the curves for January and February, for example, would approximately coincide at the point "50 per cent." because, in this country, roughly half the observations lie above and below the mean. It was not, however, obvious that there would be a fairly close frequency relationship in each pair nor indeed that there would be six distinct pairs.

TABLE V—MEAN MONTHLY AND ANNUAL PERCENTAGE FREQUENCY OF HOURLY AND 0900 WET-BULB TEMPERATURE

## Aberdeen

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1938-47 Year
°F.	HOURLY												
5.0-13.9	..	..	<0.1	..	..	..	..	..	..	..	..	..	<0.1
14.0-22.9	2.5	0.2	0.9	..	..	..	..	..	..	..	0.1	0.4	0.4
23.0-31.9	21.2	22.3	11.4	1.0	0.3	..	..	..	..	<0.1	3.8	9.7	5.7
32.0-40.9	58.4	56.4	49.4	40.3	16.7	0.9	<0.1	0.2	3.4	13.1	41.3	55.1	27.8
41.0-49.9	18.0	20.2	36.1	52.9	66.1	41.3	10.3	17.3	36.2	62.2	45.6	34.2	36.7
50.0-58.9	<0.1	0.9	2.2	5.8	16.7	54.6	81.9	71.7	56.7	24.6	9.2	0.6	27.2
59.0-67.9	..	..	..	..	0.2	3.2	7.8	10.8	3.7	0.1	..	..	2.2
	0900												
14.0-22.9	4.2	..	1.3	..	..	..	..	..	..	..	0.3	0.6	0.5
23.0-31.9	22.6	24.1	10.6	0.4	..	..	..	..	..	..	4.3	11.3	6.0
32.0-40.9	58.6	58.5	50.0	35.0	12.9	..	..	..	1.0	11.9	44.0	57.1	27.3
41.0-49.9	14.6	16.7	36.8	59.3	67.1	39.3	4.9	12.3	34.0	65.5	42.7	30.7	35.4
50.0-58.9	..	0.7	1.3	5.3	19.7	56.4	86.1	77.7	61.3	22.6	8.7	0.3	28.5
59.0-67.9	..	..	..	..	0.3	4.3	9.0	10.0	3.7	..	..	..	2.3

## Eskdalemuir

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1940-49 Year
°F.	HOURLY												
-4.0-4.9	0.3	<0.1	..	..	..	..	..	..	..	..	..	..	<0.1
5.0-13.9	1.4	0.7	0.5	..	..	..	..	..	..	..	..	..	0.2
14.0-22.9	8.4	5.3	3.1	0.2	<0.1	..	..	..	..	<0.1	1.3	2.4	1.7
23.0-31.9	33.1	33.5	22.1	6.6	3.5	0.1	..	..	0.7	3.1	12.1	18.8	11.1
32.0-40.9	41.3	42.1	44.4	41.0	23.6	4.4	1.5	2.0	7.4	23.2	43.7	51.9	27.1
41.0-49.9	15.5	18.4	29.1	48.0	52.6	46.6	23.3	24.7	40.0	50.7	37.0	28.5	34.4
50.0-58.9	..	..	0.8	4.2	19.3	41.6	63.6	60.5	48.5	23.0	5.9	0.4	22.4
59.0-67.9	..	..	..	..	1.0	7.2	11.1	12.7	3.4	<0.1	..	..	3.0
68.0-76.9	..	..	..	..	..	0.1	0.5	0.1	..	..	..	..	0.1
	0900												
-4.0-4.9	0.3	..	..	..	..	..	..	..	..	..	..	..	<0.1
5.0-13.9	1.9	0.7	..	..	..	..	..	..	..	..	..	..	0.5
14.0-22.9	10.7	4.9	3.2	..	..	..	..	..	..	..	1.3	4.5	2.0
23.0-31.9	34.8	35.0	20.4	0.7	..	..	..	..	..	2.3	15.6	20.7	10.6
32.0-40.9	39.7	44.9	47.7	40.0	16.1	..	..	..	3.0	20.6	44.7	48.7	25.3
41.0-49.9	12.6	14.5	28.7	56.3	63.3	45.3	15.2	14.8	38.3	56.1	33.7	26.1	33.7
50.0-58.9	..	..	..	3.0	20.3	46.0	73.6	69.7	55.7	21.0	4.7	..	24.6
59.0-67.9	..	..	..	..	0.3	8.7	10.6	15.5	3.0	..	..	..	3.2
68.0-76.9	..	..	..	..	..	..	0.6	..	..	..	..	..	0.1

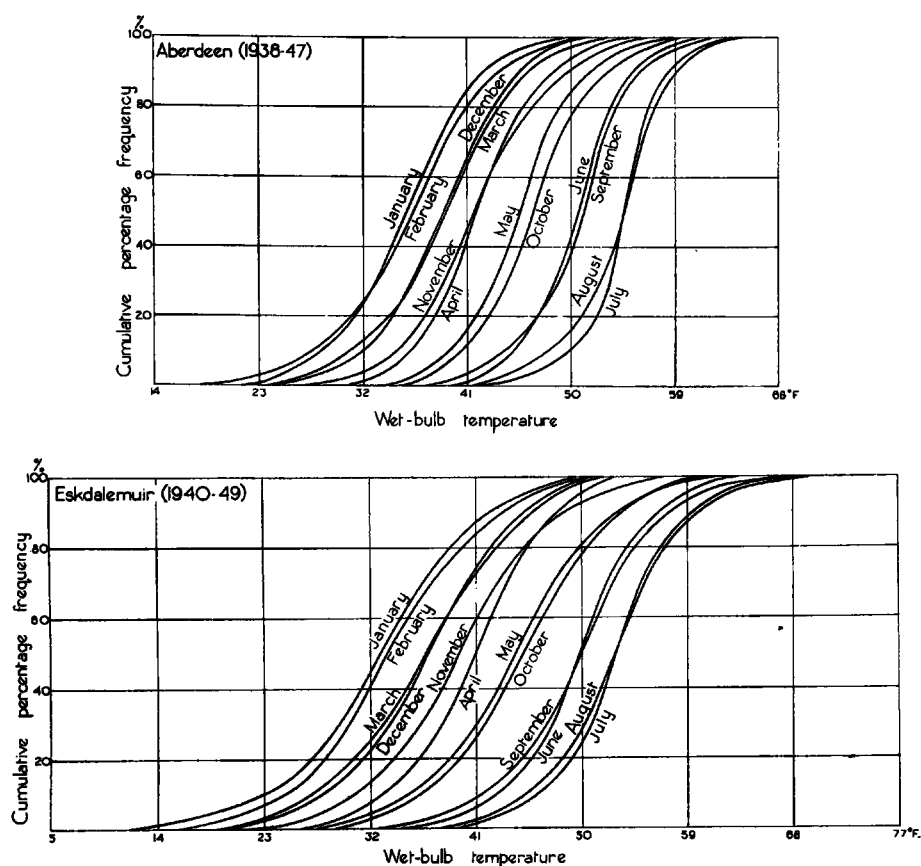


FIG. 4—MEAN MONTHLY OGIVES OF WET-BULB TEMPERATURE, 0100-2400

It seems probable that, for other places in Great Britain, the months with roughly equal mean wet-bulb temperature will group in a similar manner, and that the cumulative percentage-frequency curves for each member of the group will be similar. Reasonable accuracy could therefore be obtained by confining the analysis to one month in each group.

Standard deviations of monthly and annual wet-bulb temperature at Aberdeen and Eskdalemuir for 0100-2400 and 0900.—The standard deviations for the 0100-2400 and 0900 observations were calculated from the second moment of the monthly and annual percentage frequencies and Sheppard's correction applied for grouping<sup>2</sup>.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	<i>degrees Fahrenheit</i>												
0100-2400 G.M.T.													
Aberdeen ..	5.7	5.6	6.0	4.8	4.7	4.4	2.8	4.0	4.9	4.8	5.9	5.2	8.1
Eskdalemuir	7.8	7.2	7.1	5.7	6.5	5.8	5.1	5.3	5.9	6.4	6.9	6.2	9.4
0900 G.M.T.													
Aberdeen ..	5.9	5.3	5.8	4.4	4.5	4.3	2.3	3.4	4.3	4.5	6.0	5.2	8.3
Eskdalemuir	8.0	6.8	6.6	4.3	4.9	5.1	4.0	4.2	4.8	5.9	6.9	6.8	9.8

The monthly values of the standard deviations indicate a well marked seasonal variation, being greatest in the winter months and least in July and August both for the 0100-2400 and 0900 observations. They point also to a rather larger variability at Eskdalemuir than at Aberdeen. Moreover the diurnal effect is negligible in winter and not large in summer. The apparent increase in standard deviation at 0900 in some winter months is probably a result of the large grouping ( $9^{\circ}\text{F.}$ ) used in the frequency distributions.

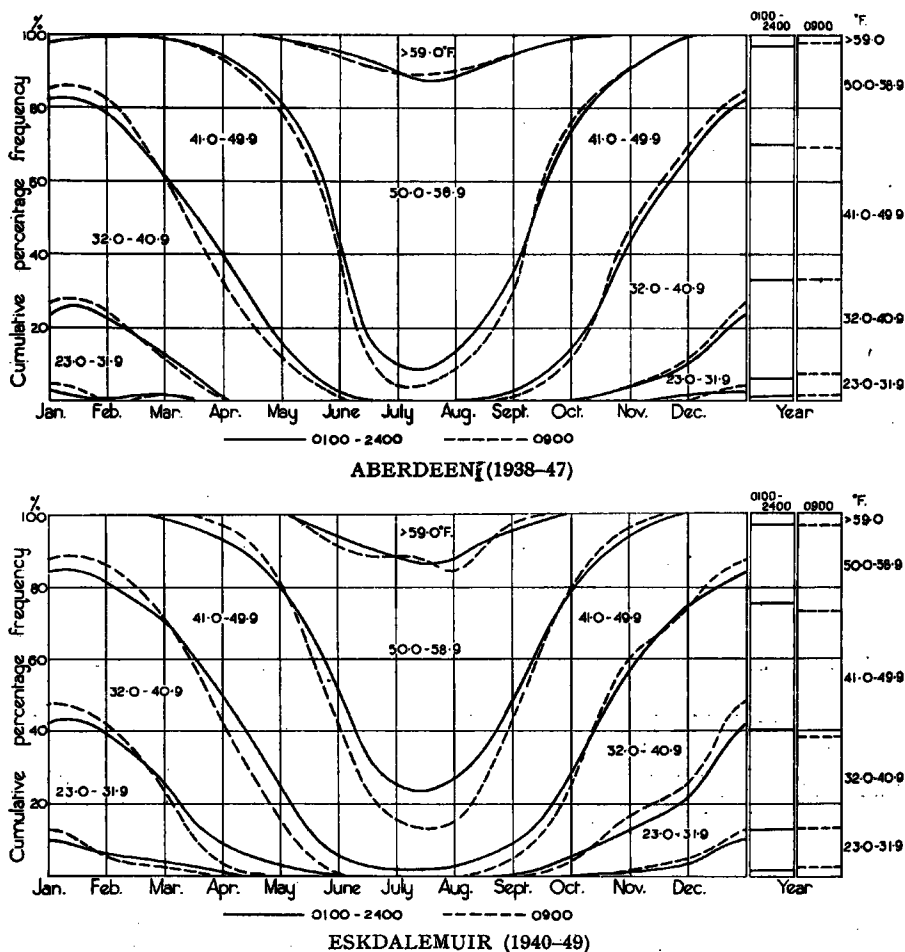


FIG. 5—MEAN MONTHLY CUMULATIVE PERCENTAGE FREQUENCY OF WET-BULB TEMPERATURE  
0100-2400 and 0900

As the standard deviations for 0100-2400 and 0900 show fair agreement the 0900 distributions should be similar to those for 0100-2400. The percentage frequencies at 0900 for each year and the mean monthly and annual values are set out in Tables IV and V. The 0900 data are plotted alongside the 0100-2400 data in Fig. 5. Thus, curves constructed from the 0900 observations at any station will, for most purposes, be reasonably representative of all the hourly readings.



Comparison of wet-bulb temperature at Aberdeen, Eskdalemuir, Glasgow and Kew.—The only data known to the writer for comparison with those at Aberdeen and Eskdalemuir are for Glasgow<sup>3</sup> (frequency of hourly wet-bulb temperature above 50°F. for the years 1874–79, 1881–83) and for Kew<sup>4</sup> (frequency above 60°F. for the period 1937–51). The percentage frequencies and the mean wet-bulb temperatures for each month are given below :

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Frequency of hourly wet-bulb temperature per cent.													
≥50°F. (0100–2400)													
Aberdeen ..	<0.1	0.9	2.2	5.8	16.9	57.8	89.7	82.5	60.4	24.7	9.2	0.6	29.4
Eskdalemuir ..	..	..	0.8	4.2	20.3	48.9	75.2	73.3	51.9	23.0	5.9	0.4	25.5
Glasgow ..	..	0.1	0.2	5.3	17.9	57.0	81.5	78.2	53.0	22.0	4.6	0.1	26.6
≥59°F. (0100–2400)													
Aberdeen ..	..	..	..	..	0.2	3.2	7.8	10.8	3.7	0.1	..	..	2.2
Eskdalemuir ..	..	..	..	..	1.0	7.3	11.6	12.8	3.4	<0.1	..	..	3.1
Glasgow ..	..	..	..	0.1	0.5	3.4	8.1	8.1	1.5	0.1	..	..	1.8
Kew* ..	..	..	..	0.3	3.0	15.3	30.7	31.9	17.2	2.3	0.1	..	8.5
Mean wet-bulb temperature degrees Fahrenheit													
Aberdeen ..	35.4	36.5	38.8	41.9	45.5	50.6	54.1	53.9	50.8	46.4	41.5	38.7	44.5
Eskdalemuir ..	32.5	33.8	36.3	40.7	44.5	50.0	52.9	52.7	49.5	44.8	39.2	36.5	42.8
Glasgow ..	36.5	37.3	37.3	41.0	45.3	50.7	53.6	53.6	50.0	45.3	39.4	37.3	43.9
Kew ..	38	38	41	45	49	55	58	58	55	49	44	39	47

\* ≥ 60° F. at Kew.

It is evident that at Glasgow and Kew the months group in the same pairs as were found for Aberdeen and Eskdalemuir and that the mean wet-bulb temperatures for the months determine the pairs.

Fig. 6 shows the Aberdeen and Eskdalemuir cumulative-frequency curves for July, temperatures being reckoned as departures from the respective July

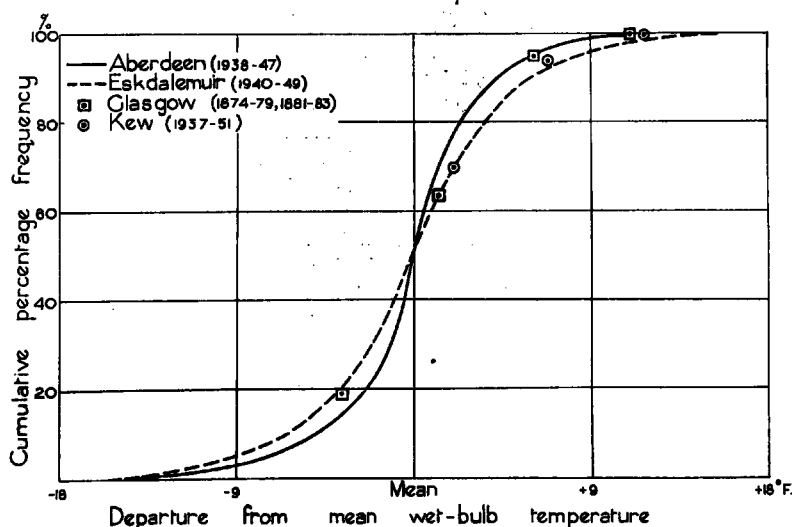


FIG. 6—OGIVES OF DEPARTURE FROM JULY MEAN WET-BULB TEMPERATURE

wet-bulb means. On the same basis are shown the percentage frequencies below 50°, 55°, 60° and 65°F. at Glasgow and below 60°, 65° and 70°F. at Kew. There is a good measure of agreement.

It would appear therefore that, given a set of monthly cumulative-percentage-frequency curves for one station, these can be used to find approximately the percentage frequencies at any other station provided the monthly mean wet-bulb temperatures are known.

#### BIBLIOGRAPHY

1. London, Meteorological Office. *Observatories' Year Book*. London.
2. ELDERTON, W. P. ; Frequency curves and correlation. 3rd edn., Cambridge, 1938.
3. London, Meteorological Office. MS. data.
4. HOWARD, A. G. W. ; Climate of Kew Observatory, 1871-1950. Appendix, Monthly averages, 1937-1951. Typescript, Meteorological Office, London.

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