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THE CLIMATE OF WEST LOTHIAN

(2ND EDITION)

by J.A.Plant

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## THE CLIMATE OF WEST LOTHIAN

by J. A. PLANT

### Introduction

West Lothian is a small but, in parts, highly populated county situated in the industrial belt of Scotland on the southern shores of the Firth of Forth.

The county is bounded on the east by the River Almond and the Breich Water, on the west by the River Avon, and on the north by the Firth of Forth. The southwest boundary practically coincides with the watershed between the Forth and Clyde.

The topography of the county is extremely varied and rises from the flat land between Grangemouth and Bo'ness in the north, up to the Knock (1023 feet) and Cairnpapple Hills some seven miles inland. These summits form part of a broken ridge known as the Bathgate Hills which extend north and south for five miles between Bathgate and Linlithgow. The northern end of the ridge is cut across by a valley in which the county town, Linlithgow, is situated 150 feet above sea level. A mile or so north of Linlithgow the land rises again to the 550 feet Airngath Hill near Grange. To the east of the county, several small isolated hills are found between Queensferry and the Midlothian county boundary. To the south of the county are the high bleak uplands of the West Calder (Midlothian) and Whitburn (West Lothian) districts.

It can be seen from the relief and drainage map at Figure 1 that more than half the area of the county lies at an elevation of between about 400 and 600 feet and also that nearly a quarter lies at an elevation of about 600 to 800 feet. The best agricultural land is found in the lower areas near the Forth and also to the east of the Bathgate Hills. South-west of Bathgate, the land rises again and above the 400 feet contour, the sub-soil is largely composed of boulder clay often covered with gravel and peat. On the windswept heights the arable limit is about 700 feet.

The rivers and streams in the area flow in a general west to east direction and the main highways in the county follow the same direction. The undulating nature of the country is perhaps the most striking feature of the topography and communications in the north-south direction are hampered by the terrain;

the north to south roads are consequently less convenient for traffic.

The county is disfigured by numerous coal mining waste "bings" in the Bo'ness, Bathgate and Fauldhouse areas. Similarly, great heaps of spent shale from the oil shale workings in the Broxburn and Winchburgh areas mar the appearance of otherwise attractive, cultivated countryside. There is no doubt that in both the upper and lower lying parts of the county the extensive coal and oil shale mining operations have completely upset the natural drainage of what once must have been large tracts of good agricultural land. For example, drainage dislocations due to mining activity are mainly responsible for the degeneration and confused disposition of arable, permanent grass and rough grazing in the marginal land of south-west West Lothian.

#### General Climate

In broad terms the climate of West Lothian is typical of that of the eastern side of Scotland. The hours of sunshine are high in relation to the latitude and the average rainfall is well below the average for the United Kingdom as a whole. However, it should be borne in mind that the populated parts of West Lothian stretch from sea level to almost 1,000 feet and a study of the vegetation during even a brief journey from north to south across the county will illustrate the effects of the considerable range of climates within the county borders, ranging from the genial climate of the agricultural areas near the Forth coastline to the harsh, windswept climate of the Armadale-Harthill-Fauldhouse district where the dismal moors are rendered the more melancholy by the debris of coal mining.

There is a marked absence of cultivated land in the southern part of West Lothian and in the adjoining district of western Midlothian. Here, an annual rainfall which frequently exceeds 35 inches is associated with soils consisting mainly of cold intractable clays, conditions which taken together are no encouragement to the arable farmer. North and eastwards, this region gradually merges with the zone of more or less continuous arable cultivation which, interrupted by the Pentlands and Edinburgh, stretches from the Avon to the North Sea coast of East Lothian.

The topography of the county exposes much of it to the full effect of the wind and local increases in the general wind speed are experienced throughout the county on ridges or where features of the landscape form a wind funnel. Although the lee of local high ground affords shelter from the wind in some places, there is, in general, a distinct lack of sheltering trees throughout the county particularly in the higher central and southern areas, although some of the estates surrounding the great country houses are extremely well-wooded. The absence of shelter from the wind, coupled with high humidities and low temperatures, contributes to the "rawness" of the climate during the winter and spring months.

The separate aspects of the climate of West Lothian are discussed in the following paragraphs under the headings of Rainfall, Temperature, Relative Humidity, Sunshine, Winds, Fog, Snow and Thunderstorms. However, it should be mentioned at this point that there is a paucity of basic weather records of all kinds from the county of West Lothian. Indeed, the only records which are available are from a rather scant network of stations making measurements of amounts of rainfall. Estimating temperatures, winds, snow cover etc. in the complete absence of records is not an easy matter, particularly in a county which has so varied a topography. Such estimates are made by applying approximate rules or surmises which are based on general meteorological experience rather than on directly applicable observational evidence and in the case of temperature for example, it has been necessary to decide which of the records from stations in adjoining counties are likely to be most typical of the various regions of West Lothian.

#### 1. RAINFALL

The annual average rainfall over the county of West Lothian (see Annual Average Rainfall Map at Figure 2) gradually increases from the flat coastal stretch along the Forth south-westwards to the high ground in the south-west corner of the county. It ranges from a value of less than  $27\frac{1}{2}$  inches along the stretch of coast in the Dalmeny/Forth Road Bridge area to over 40 inches in the Whitburn/Fauldhouse area.

Broadly speaking, the average rainfall over the drier parts of the county

is about the same as that of Edinburgh, and not much more than that in the London area, while the wetter parts of the county have an annual rainfall similar to that in the Glasgow area.

Monthly and Annual Averages of Rainfall for a number of rainfall measuring stations within or near the fringe of the county are given in Tables 1 and 1A. The rainfall averages quoted in Table 1 are actual averages over the 35 years from 1916 to 1950 (the standard period for rainfall averages in current use in this country), while the averages quoted in Table 1A have been estimated from short term records.

Cumulative Frequencies of Daily Rainfall for Grange, Linlithgow, which give the total number of days in 35 years having specified amounts of rainfall, are given in Table 1B. Grange, which is situated about one mile north of Linlithgow, has the longest and most complete record of daily rainfall measurements within the county. The daily rainfalls at Grange should give a reasonably close guide to the daily rainfalls likely to be experienced in other parts of the county.

Maximum Daily Rainfalls at Grange, Linlithgow, recorded during the 54 years from 1912 to 1965 are given in Table 1C.

#### Intense Falls of Rain in Short Periods of Time

In general, the more intense the rainfall, the less likely it is to last for a given period of minutes or hours. The probability that rainfall of a certain intensity will last for a certain time is less in West Lothian than in the upland parts of Scotland and the more thundery areas in central and southwest Scotland. It is appreciably less for the shorter durations than in the south of England and the Midlands which have a much higher incidence of thunderstorms and thundery downpours than West Lothian.

Table 1D gives the number of days in each year from 1949 to 1967 with specified amounts of rain falling in specified times at the Meteorological Office at Turnhouse (Edinburgh) Airport. The total numbers of days over the whole period of 19 years are shown at the foot of the Table. Turnhouse Airport which lies near the eastern boundary of West Lothian is the only location in the Lothians for which statistics of this type are available but unfortunately, a period of 19 years of recorded rainfall intensities is too short a term from

which to obtain a reliable assessment of the long term relationship between intensity and frequency at any individual recording station.

There are very few long period records of rainfall intensities for places in Scotland and therefore drainage engineers make fairly wide use of the Bilham formula (1) for obtaining probabilities of intense falls of rain in short periods of time. Following a recent investigation by D. J. Holland (2) it has become necessary to modify the frequencies obtained from Bilham's formula in respect of intensities greater than 1.25 inches per hour and the figures given in the upper table of Table 1E, which refer to falls with durations of 2 hours or less, are based on Bilham's formula modified where necessary by Holland. However, it can be seen from Table 1F, which compares the estimated frequencies obtained from the Bilham formula with observed frequencies obtained from the Turnhouse Airport records, that for durations up to about 2 hours, the frequencies obtained from the Bilham formula appear to be too high. Experience suggests that for durations up to about 2 hours, the frequencies obtained from the Bilham formula could be halved when applied to West Lothian i.e. a return period of "1 day per 5 years" obtained from the upper table of Table 1E would become "1 day per 10 years". Alternatively, for durations up to 2 hours, a 20 per cent reduction could be made to the amounts quoted in the upper table of Table 1E to relate the Bilham intensities to West Lothian.

When studying the comparison of the observed and estimated frequencies given in Table 1F, it should also be noted that for durations of about 4 to 8 hours or more, the estimated frequencies obtained from the Bilham formula are lower in most cases than the actual frequencies observed at Turnhouse Airport.

So far, the data discussed refer to rainfall at a point, but areal rainfall is required for most design purposes. Because of the variability of intense rain in space and time, the areal rainfall for a given duration and return period is always smaller than the corresponding point rainfall. To obtain areal rainfall, the point rainfall should be multiplied by the appropriate factor in the lower table of Table 1E. These factors were derived from a formula by D. J. Holland, assuming a roughly circular area and a roughly equal contribution to the drainage system from all parts of the area. Advice on how to apply these factors to the more difficult cases can usually be given by

the Meteorological Office or the Road Research Laboratory of the Ministry of Transport. The formula is based on results from an experimental raingauge network at Cardington near Bedford (3). A similar experiment in rather more hilly country near Winchcombe in the Cotswolds is still being analysed.

### Driving Rain

Measurements from raingauges set into the walls of buildings have been made in Glasgow by the Building Research Station, Ministry of Public Building and Works. These measurements show that the amount of rain driven on to a wall is directly proportional to the product of the rainfall on the ground and the wind speed during the rain. Thus, a convenient and satisfactory index of driving rain can be obtained by taking the product of the annual rainfall in millimetres and the average wind speed in metres per second divided by 1,000 giving an index in  $m^2/sec.$

By preparing indices in this way for a wide selection of places in the British Isles, it is possible to divide the country into three zones in which the exposure to driving rain may be considered, respectively, as "sheltered", "moderate", and "severe". Sheltered areas are those with an index of  $3m^2/sec.$  or less, moderately exposed ones those with an index of between 3 and  $7m^2/sec.$  and severely exposed ones those with an index of  $7m^2/sec.$  or above.

With an index of  $6.3m^2/sec.$  (calculated from data for Renfrew Airport) it can be seen that Glasgow lies almost in the "severe" zone and the city has in fact a higher index of driving rain than any other city of comparable size in the British Isles.

The worst wind direction for driving rain in Glasgow is from southwest as can be seen from the following wind directions expressed as percentages of the total driving rain index:

<u>N.E.</u>	<u>East</u>	<u>S.E.</u>	<u>South</u>	<u>S.W.</u>	<u>West</u>	<u>N.W.</u>	<u>North</u>	<u>Total</u>
9	10	5	15	34	22	4	1	100%

Unfortunately, no instrumental records of driving rain are available from within the county of West Lothian but driving rain is a factor which should be borne very much in mind at the building-design and siting stage because large areas of the county are exposed to the full effect of the wind. There is little doubt that many parts of West Lothian would fall into or near the

"severe" category, particularly exposed locations in the higher wetter regions of the county or on or near the crests of the numerous ridges which traverse the lower lying areas. The worst wind directions for driving rain are probably similar to the worst directions in Glasgow. Thus, it would seem desirable to pay special attention to making west-facing walls weather-tight, particularly west-facing walls of buildings which are more exposed to the wind than their general surroundings.

#### Evapotranspiration

Estimates for West Lothian of the water loss due to evaporation and transpiration can only be approximate and, as in the case of the other meteorological parameters, the actual values for a particular place will depend to some extent on the local topography.

Estimated average monthly and annual totals of evapotranspiration are given below for an average county height of 420 feet. These values have been taken from "Potential Transpiration" - Technical Bulletin No. 16 of the Ministry of Agriculture, Fisheries and Food (HMSO).

#### Average Values of Evapotranspiration (PT) in inches

<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year</u>
0.00	0.35	1.10	2.00	3.05	3.40	3.20	2.55	1.60	0.85	0.15	-0.05	18.20

Comparing the values quoted above with the averages of rainfall given in Tables 1 and 1A, it can be seen that there is a risk of a soil moisture deficit in the spring and early summer over the lower lying drier parts of West Lothian. The risk would be greatest after a dry winter and the balance might not be restored until the rains of the late summer and autumn.

#### Rainfall during the Working Part of the Day

Table 1G gives the total number of days per month during the 10 years from 1958 to 1967 on which 0.1 millimetres (.004 inches) or more of rain fell at Turnhouse (Edinburgh) Airport during the working part of the day i.e. between 0700 and 1700 hours Greenwich Mean Time (0800 and 1800 hours British Standard Time). Similarly, Table 1G also gives for the same 10 year period, the total number of hours per month between 0700 and 1700 hours GMT with a total of 0.1 millimetres or more of rain falling within the hour. Days and hours with

only a few spots of rain amounting to less than .05 millimetres have not been included in Table 1G but otherwise this Table includes all occasions of "measurable" rain i.e. all occasions of "slight", "moderate" and "heavy" rain.

Table 1H gives the total number of days on which rain fell at a rate of 0.5 millimetres or more per hour for some time during the working part of the day and also the total number of hours between 0700 and 1700 hours GMT in which rain fell at a rate of 0.5 millimetres or more per hour for some time during the hour. Rain falling at a rate of 0.5 millimetres or more per hour corresponds to the lower limit of the Meteorological Office classification of "moderate" rainfall which is rain falling fast enough to form puddles rapidly. Thus, days and hours with rain falling at a rate of 0.5 millimetres or more per hour can be thought of more simply as days and hours with "moderate" or "heavy" rainfall.

There is practically no experimental evidence on the subject of rainfall as a factor affecting outdoor work but experience suggests that the number of working days and working hours with rain falling at a rate of 0.5 millimetres or more per hour (i.e. the figures provided in Table 1H) are likely to give the most realistic guide to the problem of estimating the time lost because of rainfall on most types of outdoor work. On the other hand it is thought that the figures quoted in Table 1G will be of particular interest to painting and roofing contractors or building contractors who are concerned with unusual types of outdoor work which are especially prone to interruption by rainfall.

Turnhouse Airport is the only location in the Lothians for which it is possible to provide the information contained in Tables 1G and 1H but it is considered that these Tables should provide a reasonably fair guide to rainfall during the working part of the day at most towns in West Lothian. It should be noted that the figures in Tables 1G and 1H refer to a 7-day working week and not to a 5-day working week.

TABLE 1 MONTHLY AND ANNUAL AVERAGES OF RAINFALL (INCHES) 1916 TO 1950 FOR PLACES IN THE WEST LOTHIAN AREA

Station	Ht. (feet)	N.G.R.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Little Denny	243	NS(26) 805820	5.23	3.69	2.86	2.51	3.01	2.75	3.70	4.28	4.34	5.25	4.71	4.42	46.75
Falkirk	105	NS(26) 879803	4.10	2.92	2.42	2.05	2.60	2.25	3.22	3.44	3.22	3.93	3.59	3.45	37.19
Falkirk, Kerse	18	NS(26) 912817	3.66	2.45	2.12	1.85	2.45	2.05	3.02	3.29	2.96	3.56	3.22	2.96	33.59
Leurleston, Inglewood	133	NS(26) 914794	4.03	2.66	2.39	2.06	2.66	2.32	3.40	3.42	3.31	3.97	3.54	3.37	37.13
Lechoote near Torphichen	550	NS(26) 974737	3.75	2.57	2.38	2.12	2.74	2.32	3.24	3.41	3.26	3.83	3.44	3.03	36.09
Grange near Linthgow	450	NT(36) 000787	3.22	2.23	2.05	1.79	2.60	2.15	3.16	3.36	2.82	3.41	2.91	2.73	32.43
Dalmeny House	20	NT(36) 163779	2.55	1.74	1.70	1.66	2.20	1.99	2.97	3.24	2.67	2.89	2.48	2.10	28.19
Uphall No. 8	577	NT(36) 024708	3.52	2.38	2.21	2.09	2.52	2.29	3.17	3.45	3.18	3.67	3.29	2.98	34.75
Middleton Hall	350	NT(36) 061716	3.43	2.38	2.10	2.06	2.46	2.20	3.13	3.49	3.13	3.56	3.11	2.79	33.84
Harperrig	900	NT(36) 102612	4.17	2.90	2.70	2.63	2.90	2.58	3.42	4.03	3.60	4.18	3.80	3.72	40.63
Addiewell	620	NT(36) 001626	4.00	2.61	2.28	2.29	2.58	2.36	3.34	3.60	3.63	3.98	3.52	3.50	37.69

Blackford Hill, Edinburgh	441	NT(36)259706	2.45	1.68	1.60	1.62	2.21	1.88	3.03	3.15	2.55	2.83	2.42	2.11	27.53
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TABLE 1A ESTIMATED MONTHLY AND ANNUAL AVERAGES OF RAINFALL 1916 TO 1950 FOR PLACES IN THE WEST LOTHIAN AREA

Station	N.G.R.	Ht. (ft)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year (inches)
Grangemouth Park	NS(26) 930816	15	3.69	2.41	2.14	1.87	2.48	2.10	3.09	3.36	2.99	3.59	3.26	2.95	33.93
Bathgate, North- bank Filters	NS(26) 981692	640	4.12	2.72	2.41	2.33	2.79	2.48	3.57	3.76	3.69	4.07	3.57	3.30	38.81
Stonerigg Filters	NS(26) 933676	620	3.87	2.59	2.23	2.15	2.59	2.34	3.29	3.58	3.40	3.98	3.40	3.11	36.53
Carribber Reservoir	NS(26) 972749	350	3.58	2.49	2.18	2.04	2.67	2.28	3.27	3.41	3.19	3.69	3.23	3.09	35.12
Cockleroy Reservoir	NS(26) 994749	521	3.62	2.48	2.23	2.09	2.73	2.30	3.33	3.50	3.23	3.66	3.26	3.01	35.44
Preston House	NS(26) 995758	350	3.65	2.47	2.25	2.11	2.79	2.33	3.36	3.54	3.25	3.70	3.29	3.04	35.78
Beecraigs	NT(36) 013743	477	4.00	2.71	2.47	2.35	3.06	2.59	3.69	3.81	3.57	4.05	3.61	3.34	39.25
Craigentroan	NT(36) 001766	290	3.32	2.30	2.11	1.84	2.68	2.21	3.26	3.46	2.91	3.51	3.00	2.81	33.41
West Calder, Westwood	NT(36) 014643	480	3.65	2.39	2.12	2.12	2.43	2.19	3.09	3.33	3.30	3.72	3.26	3.12	34.72
Pateshill Reservoir	NS(26) 984595	939	4.48	2.92	2.54	2.58	2.87	2.66	3.76	4.06	4.06	4.48	3.93	3.93	42.27
Uphall No. 7	NT(36) 018712	640	3.57	2.41	2.23	2.12	2.58	2.34	3.22	3.50	3.26	3.76	3.36	3.04	35.39
Midcalder	NT(36) 053676	400	3.37	2.25	2.09	2.02	2.42	2.12	3.15	3.21	3.08	3.40	3.05	2.95	33.11
Crosswood	NT(36) 056575	950	4.18	2.84	2.44	2.52	2.80	2.56	3.61	3.90	3.86	4.35	3.82	3.74	40.62
Morton	NT(36) 074632	749	3.89	2.65	2.38	2.38	2.77	2.46	3.54	3.73	3.66	3.97	3.46	3.45	38.45
Turnhouse Airport	NT(36) 159739	114	2.43	1.65	1.56	1.59	2.16	1.86	2.91	3.10	2.54	2.78	2.37	2.02	26.97
Balerno	NT(36) 147651	700	3.67	2.49	2.30	2.30	2.74	2.37	3.63	3.71	3.45	3.83	3.37	3.23	37.09

TABLE 1B

CUMULATIVE FREQUENCIES OF DAILY RAINFALL, IN INCHES, 35 YEARS FROM 1931 TO 1965

GRANGE, LINLITHGOW, WEST LOTHIAN

Daily totals (inches)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	All Months
3.78					1								1
2.96							1						1
2.00 or more					1		1	1		1			4
1.90 " "					1		1	1		1			4
1.80 " "					1		2	1		1			5
1.70 " "					2		3	1		1	1	1	9
1.60 " "					2		4	2		1	1	1	11
1.50 " "					2		5	3	3	2	1	1	17
1.40 " "					3	1	7	4	5	3	1	1	25
1.30 " "			1		3	1	7	5	5	3	2	2	29
1.20 " "			1		4	1	7	7	10	7	3	2	42
1.10 " "			1	1	4	1	12	11	12	9	5	2	58
1.00 " "			1	1	6	2	15	16	13	11	7	6	78
0.90 " "	2	3	2	2	8	4	18	19	14	15	10	7	104
0.80 " "	11	4	3	4	12	8	24	25	16	16	17	13	153
0.70 " "	20	7	5	6	16	13	32	36	29	24	23	17	228
0.60 " "	28	13	11	8	22	18	40	46	35	35	31	24	311
0.50 " "	35	20	18	16	34	25	60	64	52	56	44	31	455
0.40 " "	69	36	32	36	55	40	92	86	67	75	65	56	709
0.30 " "	107	66	73	62	79	74	131	122	107	115	109	99	1144
0.20 " "	190	121	122	105	140	130	191	188	171	187	172	177	1894
0.10 " "	299	236	227	208	236	238	310	294	290	301	303	323	3265
0.04 " "	427	370	359	352	363	360	437	429	410	453	452	480	4892
0.005 " "	595	548	538	533	521	538	580	602	582	626	640	686	6989
less than .005 inches*	490	441	547	517	564	512	505	483	468	459	410	399	5795
Total No. of Days	1085	989	1085	1050	1085	1050	1085	1085	1050	1085	1050	1085	12784

\* Including rainless days.

Example:- The entry at 0.20 inch or more under January (viz. 190) is the total number of days in January in the 35 years from 1931 to 1965 with falls of 0.20 inch or more.

TABLE 1C

MAXIMUM DAILY RAINFALL IN INCHES - GRANGE, LINLITHGOW - 1912 TO 1965

	<u>Jan.</u>	<u>Feb.</u>	<u>Mar.</u>	<u>Apr.</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sep.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>
Maximum Daily Fall	1.28	1.04	1.39	1.16	3.78	1.48	2.96	3.70	1.58	2.00	1.94	1.76
Year of Occurrence	1918	1919	1950	1961	1941	1931	1951	1920	1956	1949	1917	1953

Example:

The daily fall of 1.28 inches which occurred in January 1918 is the highest daily fall recorded at Grange, Linlithgow in any January during the period from 1912 to 1965.

TABLE 1D  
INTENSITIES OF RAINFALL RECORDED AT TURNHOUSE (EDINBURGH) AIRPORT  
 Number of Days with Specified Amounts of Rain falling in specified times (19 years from 1949 to 1967)

Year	Amount of 5 mm (0.2 inch) falling within		Amount of 10 mm (0.4 inch) falling within		Amount of 15 mm (0.6 inch) falling within		Amount of 20 mm (0.8 inch) falling within		Amount of 25 mm (1.0 inch) falling within	
	5 mins.	10 15 mins. mins.	5 15 30 mins. mins. mins.	1 hr.	15 30 mins. mins.	1 2 4 hrs. hrs. hrs.	30 mins.	1 2 4 8 hrs. hrs. hrs. hrs.	1 2 4 8 16 hrs. hrs. hrs. hrs. hrs.	1 2 4 8 16 hrs. hrs. hrs. hrs. hrs.
1949	-	-	0	0	0	0	0	0	0	0
1950	-	-	0	0	0	0	0	0	0	0
1951	-	-	0	0	0	0	0	0	0	0
1952	-	-	0	0	0	0	0	0	0	0
1953	-	-	0	1	0	0	0	0	0	0
1954	-	-	0	0	0	0	0	0	0	0
1955	-	-	0	0	0	0	0	0	0	0
1956	0	2	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	0	0	0	0	0
1958	2	3	0	0	0	0	0	0	0	0
1959	0	1	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0	0
1966	2	3	0	1	0	1	0	0	0	0
1967	0	0	0	0	0	0	0	0	0	0
Total	4	9 15	0	2 7 14	0	1 3 10 37	0	0 3 11 35	0	0 4 20 33
Number of Years of record	12	12 12	19	19 19 19	19	19 19 19 19	19	19 19 19 19	19	19 19 19 19

Note: Records of amounts of 5 millimetres (0.2 inch) falling within 5 minutes, 10 minutes and 15 minutes are not available from Turnhouse Airport for the years before 1956.

TABLE 1E

MAXIMUM RAINFALL IN INCHES FROM MODIFIED BILHAM FORMULA

Duration (minutes)	<u>Return Period (years)</u>						
	1 day per Annum	1 day per 2 years	1 day per 5 years	1 day per 10 years	1 day per 20 years	1 day per 50 years	1 day per 100 years
2 minutes or less	0.09	0.11	0.14	0.16	0.19	0.22	0.24
4 minutes or less	0.15	0.18	0.23	0.27	0.31	0.36	0.40
6 minutes or less	0.18	0.23	0.30	0.35	0.40	0.48	0.54
8 minutes or less	0.21	0.27	0.35	0.41	0.48	0.58	0.65
10 minutes or less	0.24	0.30	0.39	0.47	0.55	0.66	0.75
15 minutes or less	0.28	0.36	0.48	0.58	0.68	0.83	0.96
20 minutes or less	0.31	0.40	0.54	0.66	0.79	0.97	1.12
25 minutes or less	0.34	0.43	0.58	0.72	0.87	1.09	1.27
30 minutes or less	0.36	0.46	0.62	0.77	0.94	1.18	1.39
40 minutes or less	0.40	0.50	0.68	0.85	1.05	1.34	1.59
50 minutes or less	0.43	0.54	0.73	0.91	1.13	1.46	1.75
60 minutes or less	0.46	0.58	0.78	0.96	1.19	1.56	1.88
90 minutes or less	0.52	0.66	0.88	1.09	1.35	1.78	2.18
120 minutes or less	0.58	0.72	0.96	1.19	1.47	1.94	2.38

Example: The maximum rainfall in 60 minutes or less on one day in 50 years = 1.56 inches.

FACTORS FOR CONVERTING POINT RAINFALLS INTO AREAL RAINFALLS

Area (acres)	<u>Duration (minutes)</u>						
	2	6	10	15	30	60	120
100	0.94	0.95	0.96	-	-	-	-
150	0.92	0.94	0.95	0.95	0.96	-	-
200	0.91	0.93	0.94	0.94	0.95	0.95	0.96
300	0.89	0.91	0.92	0.93	0.94	0.94	0.95
500	0.86	0.89	0.90	0.91	0.92	0.92	0.93
700	0.83	0.87	0.88	0.89	0.90	0.91	0.92
1000	0.80	0.85	0.86	0.87	0.88	0.89	0.90
1500	0.75	0.81	0.83	0.84	0.86	0.87	0.88
2000	-	-	0.80	0.82	0.83	0.85	0.86
3000	-	-	-	0.78	0.80	0.82	0.83
5000	-	-	-	-	0.74	0.76	0.77
7000	-	-	-	-	-	0.72	0.73

TABLE 1F  
COMPARISON OF OBSERVED AND ESTIMATED INTENSITIES OF RAINFALL  
FOR THE EDINBURGH AREA

Number of Days in 10 years with specified amounts of rain falling  
in specified times

	A. <u>Observed</u> <u>Frequency</u> (number of days in 10 years)	B. <u>Estimated</u> <u>Frequency</u> (number of days in 10 years)	C. <u>Observed Fre-</u> <u>quency as</u> <u>Percentage of</u> <u>Estimated</u> <u>Frequency</u>	D. <u>Period of</u> <u>Record used</u> <u>For Calcula-</u> <u>tion of A.</u> (years)
<u>Amount of 0.2 inches falling within:</u>				
5 minutes or less	3.3	5.5*	60%	12
10 " " "	7.5	14.9	50%	12
15 " " "	12.5	22.3	56%	12
<u>Amount of 0.4 inches falling within:</u>				
15 minutes or less	1.1	3.5*	31%	19
30 " " "	3.7	7.3	51%	19
60 " " "	7.4	14.6	51%	19
<u>Amount of 0.6 inches falling within:</u>				
30 minutes or less	0.5	2.2	23%	19
1 hour " "	1.6	4.4	36%	19
2 hours " "	5.3	8.8	60%	19
4 hours " "	19.5	17.6	111%	19
<u>Amount of 0.8 inches falling within:</u>				
2 hours or less	1.6	3.6	44%	19
4 " " "	5.8	7.2	81%	19
8 " " "	18.4	14.4	128%	19
<u>Amount of 1.0 inches falling within:</u>				
4 hours or less	2.1	3.6	58%	19
8 " " "	10.5	7.2	146%	19
16 " " "	17.4	14.4	121%	19

Notes

- The observed frequencies in column 'A' above have been calculated from intensities of rainfall recorded at Turnhouse (Edinburgh) Airport during the 19 years from 1949 to 1967 - see column 'D' and Table 1D.
- The estimated frequencies in column 'B' above were mainly obtained from Bilham's formula:-

$$n = \frac{1.25t}{(r + 0.1)^{3.55}}$$

where:

n = frequency (number of days in 10 years)  
t = duration in hours  
r = rainfall in inches

But the following modification due to D. J. Holland for intensities greater than 1.25 inches per hour was used to estimate the frequencies marked with an asterisk:-

$$n = \frac{r \exp. \left(1 - \frac{0.8r}{t}\right)}{(r + 0.1)^{3.55}}$$

TABLE 1G

NUMBER OF DAYS WITH 0.1 MILLIMETRES OR MORE OF RAIN FALLING AT SOME TIME DURING  
THE 10 HOUR PERIOD BETWEEN 0700 AND 1700 HOURS GREENWICH MEAN TIME (0800  
AND 1800 HOURS BRITISH STANDARD TIME) IN EACH MONTH AND YEAR  
DURING THE 10 YEARS FROM 1958 TO 1967 AT  
TURNHOUSE (EDINBURGH) AIRPORT

<u>Year</u>	<u>Jan.</u>	<u>Feb.</u>	<u>Mar.</u>	<u>Apr.</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sep.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>	<u>Year Total</u>
<u>Number of Days</u>													
1958	11	12	11	11	13	12	9	16	13	10	8	18	144
1959	6	7	11	11	9	11	8	3	2	9	15	17	109
1960	14	11	7	10	5	8	21	16	9	18	12	13	144
1961	10	15	9	10	8	9	7	14	12	16	11	13	134
1962	17	8	9	14	8	6	8	15	11	6	13	12	127
1963	12	8	14	15	13	13	9	16	10	11	17	4	142
1964	6	6	11	12	12	8	6	15	15	9	9	13	122
1965	14	5	11	15	14	12	15	9	17	11	14	17	154
1966	14	20	6	12	12	15	8	15	7	13	9	14	145
1967	13	13	15	9	24	6	9	11	12	16	10	7	145
10 year mean	11.7	10.5	10.4	11.9	11.8	10.0	10.0	13.0	10.8	11.9	11.8	12.8	136.6

NUMBER OF HOURS DURING THE 10 HOUR PERIOD BETWEEN 0700 AND 1700 HOURS  
GREENWICH MEAN TIME WITH 0.1 MILLIMETRES OR MORE OF RAIN FALLING AT SOME TIME  
DURING THE HOUR IN EACH MONTH AND YEAR DURING THE 10 YEARS  
FROM 1958 TO 1967 AT TURNHOUSE (EDINBURGH) AIRPORT

<u>Year</u>	<u>Jan.</u>	<u>Feb.</u>	<u>Mar.</u>	<u>Apr.</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sep.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>	<u>Year Total</u>
1958	25	41	35	32	38	39	58	51	31	21	22	77	470
1959	16	24	20	37	16	25	26	3	9	22	75	48	321
1960	51	39	25	19	15	18	63	39	31	70	30	37	437
1961	36	46	15	47	18	18	19	42	41	46	43	50	421
1962	52	23	18	45	34	12	20	58	33	23	54	38	410
1963	30	31	44	50	39	41	36	63	29	29	87	18	497
1964	16	8	35	38	29	15	14	57	41	29	27	41	350
1965	45	10	40	45	45	25	57	30	48	35	62	61	503
1966	44	68	14	47	48	41	24	55	22	39	32	53	487
1967	40	42	38	29	85	16	27	37	41	53	18	18	444
10 year mean	35.5	33.2	28.4	38.9	36.7	25.0	34.4	43.5	32.6	36.7	45.0	44.1	434.0

10 year mean  
expressed as  
percentage of  
total working  
time

11%	12%	9%	13%	12%	8%	11%	14%	11%	12%	15%	14%	12%
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TABLE 1H

NUMBER OF DAYS WITH RAIN FALLING AT A RATE OF 0.5 MILLIMETRES OR MORE PER HOUR BETWEEN THE HOURS OF 0700 AND 1700 HOURS GREENWICH MEAN TIME (0800 AND 1800 HOURS BRITISH STANDARD TIME) IN EACH MONTH AND YEAR DURING THE 10 YEARS PERIOD FROM 1958 TO 1967 AT TURNHOUSE (EDINBURGH) AIRPORT

<u>Year</u>	<u>Jan.</u>	<u>Feb.</u>	<u>Mar.</u>	<u>Apr.</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sep.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>	<u>Year Total</u>
<u>Number of Days</u>													
1958	6	9	9	9	12	11	9	12	10	10	6	17	120
1959	3	3	7	10	7	8	8	2	2	7	14	14	85
1960	12	10	5	7	3	8	21	15	9	17	8	12	127
1961	9	14	8	10	8	8	7	12	12	15	9	13	125
1962	16	8	7	13	6	6	7	14	11	4	12	11	115
1963	10	6	10	14	11	11	9	16	9	10	15	4	125
1964	3	4	8	9	11	8	6	15	13	9	8	11	105
1965	14	5	10	15	13	11	14	9	16	9	13	16	145
1966	11	13	4	11	12	13	8	14	7	12	9	13	127
1967	10	13	13	9	23	6	8	10	11	16	10	4	133
10 year mean	9.4	8.5	8.1	10.7	10.6	9.0	9.7	11.9	10.0	10.9	10.4	11.5	120.7

NUMBER OF HOURS WITH RAIN FALLING AT A RATE OF 0.5 MILLIMETRES OR MORE PER HOUR BETWEEN THE HOURS OF 0700 AND 1700 HOURS GREENWICH MEAN TIME (0800 AND 1800 HOURS BRITISH STANDARD TIME) IN EACH MONTH AND YEAR DURING THE 10 YEARS PERIOD FROM 1958 TO 1967 AT TURNHOUSE (EDINBURGH) AIRPORT

<u>Year</u>	<u>Jan.</u>	<u>Feb.</u>	<u>Mar.</u>	<u>Apr.</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sep.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>	<u>Year Total</u>
<u>Number of Hours</u>													
1958	13	26	23	24	29	29	49	33	25	18	13	53	335
1959	11	10	14	25	12	19	20	2	4	15	59	38	229
1960	34	32	15	15	12	17	56	32	25	59	23	33	353
1961	34	31	12	36	14	14	18	36	37	38	33	37	340
1962	49	20	11	37	22	11	17	51	29	17	29	28	321
1963	20	22	28	37	31	35	26	41	26	27	63	14	370
1964	11	5	25	29	25	14	14	44	38	26	19	34	284
1965	40	5	21	42	34	21	45	29	40	28	44	46	395
1966	28	53	12	29	38	34	21	45	17	29	26	42	374
1967	27	39	35	19	64	13	20	30	34	53	17	11	362
10 year mean	26.7	24.3	19.6	29.3	28.1	20.7	28.6	34.3	27.5	31.0	32.6	33.6	336.3
10 year mean expressed as percentage of total working time	9%	9%	6%	10%	9%	7%	9%	11%	9%	10%	11%	11%	9%

NOTE: The numbers of days and numbers of hours quoted in the above tables should not be taken to mean that rain has fallen continuously at a rate of 0.5 millimetres or more per hour throughout the day between 0700 and 1700 hours or continuously at the same rate throughout an hour during this period. For example, the above tables include days and hours when rain fell at a rate of 0.5 millimetres or more per hour for only a few minutes.

## 2. TEMPERATURE

In winter, temperatures over the lower lying more densely populated parts of West Lothian are comparable with those of London or other places near the east coast. However, the rise of temperature at the end of winter is much slower in West Lothian than it is in the south and consequently, although not much more severe than in the south, the winters last longer and spring is later and cooler than it is in the south. In summer and early autumn, temperatures in West Lothian are several degrees lower than they are in the south.

The temperature regime in West Lothian is complex and the complete absence of temperature records from places within the county does not help to define it. Generally speaking, day time temperatures are highest on the lower ground, particularly in the more sheltered areas, but this is offset to some extent by a tendency to lower night temperatures in these same areas, except in the immediate vicinity of the Forth coastline. This effect is most marked in still clear weather. It is the result of air which has been cooled by contact with the ground, and which has thus become relatively dense, draining downhill and stagnating in the valleys and hollows. The cold air is replaced at the higher levels by rather warmer air which has not been in contact with the ground. On a still clear frosty night, the minimum temperature in a valley or hollow in West Lothian could be considerably less than the minimum temperature on the crest of a nearby ridge. For example, it is worthy of note that a minimum temperature of 1°F was recorded at Turnhouse (Edinburgh) Airport on the night of 14/15 February 1966 while during the same night the minimum temperature recorded at the Royal Observatory, Blackford Hill, Edinburgh (altitude 450 feet) was 21°F. As mentioned previously, the undulating nature of the ground is perhaps the most striking feature of the topography of West Lothian and it follows that this "frost hollow" effect is widespread throughout the county. The areas most likely to suffer from it are the more sheltered and flatter parts of the basins and valleys of the numerous streams which flow through the county. In windy, cloudy weather, the surface of the ground cools less rapidly at night and the air near the surface is too well-mixed to show the effect.

It should perhaps be explained at this point that air ("shade") temperatures are read from thermometers exposed in ventilated wooden screens at a height of four feet above ground level and an 'air frost' occurs when the temperature at four feet falls below 32°F. However, at night time and particularly on clear, calm nights the air in close contact with the ground is nearly always cooled to below the temperature at four feet. Consequently, the incidence of 'ground frost' is much higher than the incidence of air frost. No records of 'ground frost' are available for West Lothian but in any case it would be difficult to provide representative statistics of ground frost as conditions will vary considerably over quite short distances from place to place depending on the composition of the surface (e.g. grass, bare soil, tarmacadam or concrete) and whether a particular site lies in a sheltered place or is exposed to the wind. Because of the excellent insulating characteristics of grass, a grass-covered surface will normally have a higher frequency of ground frosts than the other surfaces mentioned because the grass seals off the only source of heat during the night period i.e. the soil. At a low lying and sheltered grass-covered site in West Lothian away from the Forth coastline, the average number of days with ground frost per year is likely to be about twice the average number of air frosts.

In dealing with problems involving heat loss, whether it is related to human comfort, heating of buildings or frost penetration, it is necessary to consider the combined effect of temperature and wind. For example, the wind cooling effect is roughly proportional to the square root of the wind speed, and in cold air with a wind of 12 mph the loss of heat from a dry surface is about three times the loss at the same temperature in calm air. As a general rule, the heat loss will be greatest in the higher parts of the county, on the crests of ridges in the lower parts, and in the upper storeys of high buildings which are more exposed to the wind than their surroundings. The absence of shelter from the wind over large areas of West Lothian, particularly the tree-less moorland areas in the south and west, is a very important consideration because it is this factor which contributes to the rawness of the climate in winter and spring and even on warm, sunny days in

the summer the strength of the wind in these unsheltered areas leads to the feeling that temperatures are much lower than they actually are.

Averages and Extremes of Air Temperature for several places near to the county border of West Lothian are given in Tables 2, 2A and 2B. The standard period for temperature averages in current use in the Meteorological Office is the 30 years from 1931 to 1960 but all the averages quoted in Table 2 have been estimated from shorter periods or broken periods of records.

The temperature figures quoted for Turnhouse (Edinburgh) Airport and Falkirk should provide a reasonably close guide to the temperature regime in the milder parts of West Lothian near the Forth coastline although the extreme temperatures quoted for Turnhouse Airport are likely to be more typical of the extreme temperatures in low-lying sheltered places some distance from the Forth. The temperatures quoted for Midcalder should be broadly representative of places in West Lothian at an elevation of 400 to 500 feet while those for Carnwath should be fairly typical of places at an elevation of 600 to 700 feet although there are no doubt some favoured places in the county at an elevation of 600 to 700 feet where the temperatures are more similar to those at Balerno and Midcalder.

Hourly Averages and Extremes of Air Temperature at Turnhouse Airport are included in the tables of Relative Humidity given in the following Section (Section 3) of this Report.

#### The Growing Season

The growing season is sometimes defined as that period of the year during which on the average the mean daily temperature is 42°F (5.6°C) or above. The growing season in the most favoured districts of West Lothian near the Forth coastline will usually begin during the last week in March and will last until well after the middle of November giving a length of from 225 to 250 days. At the 400 to 700 feet level, the start is likely to be delayed until early April and the end will come early in November. The very slow rate of accumulation of warmth in the spring particularly at heights above 400 feet can be noted from the mean temperatures in Table 2. These temperatures also demonstrate the reluctance of autumn to give way to winter dormancy.

The Percentage Amount of Time with Air Temperatures below Certain Limits at Turnhouse Airport is given in Table 2C. These figures should provide a reasonably reliable guide for planning purposes to the durations of air temperatures in the lower-lying more densely populated parts of West Lothian.

The Numbers of Days with Maximum Air Temperatures exceeding 60°F, 65°F, 70°F, 75°F and 80°F at Turnhouse Airport are given in Table 2D. Again, these data should be fairly typical of the lower-lying, more densely populated parts of West Lothian.

The Number of Days with Air Frost, the longest periods of continuous frost, and the average and extreme dates of the first and last air frosts for certain representative stations near to West Lothian are given in Tables 2E and 2F.

Low Temperatures during the Working Part of the Day

Experience suggests that building contractors are interested in the number of working days and working hours with temperatures "below 32°F", "below 34°F" and "below 36°F" during the winter months.

Tables 2G to 2I have been prepared from records of hourly readings of air temperature made at Turnhouse Airport between 0700 and 1700 hours Greenwich Mean Time (0800 and 1800 hours British Standard Time) on each day during the 10 years from 1958 to 1967. Owing to the convention formerly in use in the Meteorological Office whereby tenths of a degree Fahrenheit were rounded off and recorded in the records to the nearest whole degree, "below 31.6°F", "below 33.6°F", and "below 35.6°F" are the nearest precise values of temperature available from the records to the temperature thresholds of "below 32°F", "below 34°F", and "below 36°F".

The number of days quoted in these Tables may slightly underestimate the true number of days on which the air temperature fell to below the stated levels because on several days the minimum air temperature could have fallen below these levels for a short time during the 60 minutes between the routine hourly readings.

It should be borne in mind when consulting Tables 2G to 2I that there will be occasions when the ground is frozen for several hours with an air temperature higher than 33.6°F or 35.6°F; perhaps the number of these occasions will be approximately counter-balanced by the number of occasions when outdoor building work is able to proceed even though the air temperature is below 33.6°F or 35.6°F.

The figures in Table 2G to 2I relate to a 7-day working week and not to a 5-day working week.

A Table for Converting Temperatures in degrees Fahrenheit to degrees Centigrade  
is given at Table 2J.

TABLE 2

ESTIMATED AVERAGES OF DAILY MAXIMUM, MINIMUM AND MEAN TEMPERATURE  
IN DEGREES FAHRENHEIT FOR TEMPERATURE RECORDING STATIONS ON THE FRINGE OF THE  
COUNTY OF WEST LOTHIAN - (30 YEARS PERIOD FROM 1931-1960)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
<u>FALKIRK</u> (altitude 100 feet)													
Maximum	42.4	44.1	48.4	53.9	60.0	65.5	67.7	66.8	62.5	55.4	48.3	44.6	55.0
Minimum	31.5	32.5	35.0	38.4	42.3	47.9	51.7	51.3	47.4	42.5	37.1	34.3	41.0
Mean	37.0	38.3	41.7	46.2	51.2	56.7	59.7	59.0	54.9	49.0	42.7	39.5	48.0
<u>CARNWATH</u> (altitude 706 feet)													
Maximum	39.6	40.9	45.8	50.7	57.1	62.1	64.3	63.3	58.9	52.2	45.8	42.1	51.9
Minimum	29.0	30.1	32.7	35.4	39.4	44.8	48.4	47.5	44.6	40.1	35.1	32.3	38.3
Mean	34.3	35.5	39.3	43.1	48.3	53.5	56.3	55.4	51.7	46.1	40.5	37.2	45.1
<u>BALERNO</u> (altitude 700 feet)													
Maximum	41.1	40.9	46.1	51.6	57.8	63.0	65.4	65.1	60.7	54.9	47.3	43.9	53.1
Minimum	30.1	30.0	33.1	36.0	40.3	45.6	48.6	48.9	47.5	43.0	37.1	34.0	39.5
Mean	35.6	35.5	39.6	43.8	49.1	54.3	57.0	57.0	54.1	48.9	42.2	38.9	46.3
<u>MIDCALDER</u> (altitude 400 feet)													
Maximum	41.0	42.4	46.6	51.7	57.4	62.9	65.6	65.0	60.7	53.6	47.4	43.3	53.1
Minimum	30.4	31.1	34.5	37.0	41.2	46.4	49.9	49.2	46.3	42.1	36.0	33.5	39.8
Mean	35.7	36.7	40.5	44.3	49.3	54.7	57.7	57.1	53.5	47.9	41.7	38.4	46.5
<u>TURNHOUSE AIRPORT</u> (altitude 114 feet)													
Maximum	41.8	43.7	47.7	52.8	57.7	63.0	66.1	65.2	61.3	54.7	48.4	43.9	53.9
Minimum	32.1	32.6	35.0	37.5	42.2	47.5	51.2	50.3	47.2	42.6	37.3	35.1	40.9
Mean	36.9	38.1	41.3	45.1	49.9	55.3	58.7	57.7	54.3	48.7	42.9	39.5	47.4

TABLE 2A

AVERAGES OF THE HIGHEST AND LOWEST TEMPERATURE IN EACH MONTH  
IN DEGREES FAHRENHEIT FOR TEMPERATURE RECORDING STATIONS ON THE FRINGE OF THE  
COUNTY OF WEST LOTHIAN

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
<u>FALKIRK</u> (altitude 100 feet) 21 years from 1947 to 1967													
Average of the Highest each Month	52	52	57	63	71	77	77	74	71	65	56	53	80 *
Average of the Lowest each Month	19	19	24	29	33	39	43	41	37	31	25	21	16 **
<u>CARNWATH</u> (altitude 706 feet) 16 years from 1952 to 1967													
Average of the Highest each Month	49	50	55	62	70	73	72	72	68	62	53	51	76 *
Average of the Lowest each Month	12	13	20	23	28	33	35	34	31	25	19	13	7 **
<u>BALERNO</u> (altitude 700 feet) 34 years from 1932 to 1965													
Average of the Highest each Month	50	48	55	61	68	74	73	73	68	61	55	51	77 *
Average of the Lowest each Month	19	20	23	27	32	38	41	41	36	29	25	22	16 **
<u>MIDCALDER</u> (altitude 400 feet) 13½ years from June 1948 to December 1961													
Average of the Highest each Month	52	52	57	63	69	74	74	74	69	64	55	52	78 *
Average of the Lowest each Month	18	18	24	27	31	36	40	38	35	29	25	20	14 **
<u>TURNHOUSE AIRPORT</u> (altitude 114 feet) 19 years from 1949 to 1967													
Average of the Highest each Month	53	53	57	64	69	75	74	73	70	65	56	54	78 *
Average of the Lowest each Month	17	16	22	26	32	37	40	39	36	29	24	18	12 **

\* = Average of the Highest EACH YEAR

\*\* = Average of the Lowest EACH YEAR

TABLE 2B

ABSOLUTE HIGHEST AND LOWEST TEMPERATURES IN DEGREES FAHRENHEIT  
RECORDED IN EACH MONTH AT TEMPERATURE RECORDING STATIONS ON THE  
FRINGE OF THE COUNTY OF WEST LOTHIAN

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
<u>FALKIRK</u> (altitude 100 feet) 21 years from 1947 to 1967													
Absolute Highest in each Month	57	59	65	68	80	85	86	83	79	77	60	57	86 *
Absolute Lowest in each Month	12	6	8	25	27	34	40	36	30	25	15	14	6 **
<u>CARNWATH</u> (altitude 706 feet) 16 years from 1952 to 1967													
Absolute Highest in each Month	54	56	66	66	76	79	81	83	78	72	56	55	83 *
Absolute Lowest in each Month	0	4	6	19	23	30	31	29	23	19	11	0	0 **
<u>BALERNO</u> (altitude 700 feet) 34 years from 1932 to 1965													
Absolute Highest in each Month	56	59	67	70	76	82	82	80	76	74	61	56	82 *
Absolute Lowest in each Month	7	9	7	21	25	31	35	35	30	17	15	8	7 **
<u>MIDCALDER</u> (altitude 400 feet)													
Absolute Highest in each Month	56	56	65	68	76	81	82	82	77	75	59	56	82 *
Absolute Lowest in each Month	6	6	17	23	29	30	36	33	29	24	12	10	6 **
<u>TURNHOUSE AIRPORT</u> (altitude 114 feet) 19 years from 1949 to 1967													
Absolute Highest in each Month	58	59	69	68	75	82	81	83	77	76	59	58	83 *
Absolute Lowest in each Month	5	1	13	22	29	32	37	35	27	23	16	8	1 **

\* = Absolute Highest during Whole Period

\*\* = Absolute Lowest during Whole Period

TABLE 2C

PERCENTAGE AMOUNT OF TIME WITH AIR ("SHADE") TEMPERATURES BELOW CERTAIN  
LIMITS IN DEGREES FAHRENHEIT AT TURNHOUSE (EDINBURGH) AIRPORT

(computed from hourly readings of air temperature made at each hour on the hour during the 9 years from 1952-1960)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
	%	%	%	%	%	%	%	%	%	%	%	%	%
32°F or below	24.8	21.9	7.3	3.3	0.2	0.0	0.0	0.0	0.1	1.6	7.1	12.9	6.5
34°F or below	34.3	33.1	12.4	5.6	1.1	0.0	0.0	0.0	0.3	2.8	9.4	19.0	9.7
36°F or below	44.9	46.2	19.4	9.1	2.1	0.1	0.0	0.1	0.5	4.4	13.5	26.3	13.7
38°F or below	57.6	57.9	29.0	14.1	4.0	0.3	0.1	0.1	0.9	6.4	19.9	36.4	18.7
40°F or below	67.8	67.4	42.2	20.7	6.9	0.9	0.1	0.3	2.0	9.9	28.1	49.1	24.5
42°F or below	76.3	74.8	55.6	29.7	10.3	2.1	0.4	0.7	4.1	14.3	37.8	62.0	30.5
44°F or below	82.3	81.2	67.5	39.9	15.4	3.7	0.9	1.4	6.7	20.2	50.2	72.5	36.5
46°F or below	88.3	87.1	77.9	51.8	24.1	7.3	1.8	2.9	10.4	27.6	64.1	81.1	43.5
48°F or below	92.9	91.8	86.4	63.4	35.7	13.7	3.5	5.4	15.4	39.2	77.5	87.5	50.7
50°F or below	97.0	96.1	92.0	73.1	49.8	23.5	7.0	9.9	23.4	51.8	86.9	93.0	58.3
52°F or below	99.2	98.9	96.1	82.6	61.5	34.7	12.9	17.4	34.4	65.7	94.7	97.1	66.1
54°F or below	99.8	99.8	98.6	89.2	71.6	47.5	23.6	27.8	47.5	77.8	97.8	98.9	73.1
56°F or below	99.9	99.9	99.3	94.5	80.3	60.7	38.2	41.7	61.3	87.5	99.2	99.7	80.1
58°F or below	100.0	99.9	99.7	97.5	86.3	72.3	53.2	57.1	74.0	93.2	99.7	100.0	86.0
60°F or below		100.0	99.9	98.8	91.5	82.1	66.6	69.4	83.3	96.1	100.0		90.5
62°F or below			99.9	99.4	95.0	88.3	78.0	80.1	89.8	98.4			93.9
64°F or below			99.9	99.7	97.1	92.5	86.1	87.7	93.9	99.4			96.3
66°F or below			100.0	99.9	98.5	95.3	91.8	92.9	96.4	99.7			97.7
68°F or below				100.0	99.2	97.5	95.2	96.5	98.1	99.9			98.7
70°F or below					99.6	98.7	97.2	98.2	99.1	99.9			99.3
72°F or below					100.0	99.3	98.3	99.0	99.6	99.9			99.5
74°F or below						99.7	99.1	99.5	99.9	99.9			99.6
76°F or below						99.9	99.5	99.8	100.0	100.0			99.7
78°F or below						99.9	99.8	99.9					99.8
80°F or below						100.0	99.9	100.0					99.9
82°F or below							100.0						100.0

TABLE 2D

NUMBER OF DAYS WITH MAXIMUM AIR TEMPERATURES EXCEEDING 60°F, 65°F, 70°F  
75°F AND 80°F AT TURNHOUSE AIRPORT - 15 YEARS FROM 1953 TO 1967

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year Total
<u>Number of Days with Maximum Air Temperatures Exceeding 60°F</u>													
1953			2	1	19	16	30	29	17	2			116
1954					9	15	27	19	12	5			87
1955				3	4	18	28	30	22	6			111
1956				2	17	14	22	16	12	2			85
1957			1	3	12	22	28	25	12	4			107
1958				4	6	16	25	27	27	2			107
1959				3	13	22	31	30	24	13			136
1960				5	22	28	28	26	14	2			125
1961			1	5	8	25	28	27	23	7			124
1962				3	3	25	16	25	8	7			87
1963				2	4	16	21	21	12	4			80
1964				1	8	22	27	24	19	2			103
1965			2	2	6	22	19	25	14	2			92
1966				2	10	21	30	20	20	1			104
1967				3	4	22	28	27	19	2			105
15-year average	0	0	<1	3	10	20	26	25	17	4	0	0	105
<u>Number of Days with Maximum Air Temperatures Exceeding 65°F</u>													
1953				1	5	7	14	17	4				48
1954					4	1	5	7	3				20
1955				1	2	9	24	24	10	1			71
1956					3	7	10	1	4				25
1957					1	13	13	10	1				38
1958				1	1	6	12	13	10				43
1959				1	3	9	24	23	14	7			81
1960					11	19	17	12	6				65
1961					2	6	9	14	10	1			42
1962				1	1	10	11	5	2				30
1963						3	8	5	3				19
1964					1	9	17	11	8				46
1965			2	0	2	12	3	11	2	1			33
1966				1	5	9	14	5	6				40
1967				2	0	7	18	13	4				44
15-year average	0	0	<1	1	3	8	13	11	6	1	0	0	43

TABLE 2D (contd.)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year Total
<u>Number of Days with Maximum Air Temperatures Exceeding 70°F</u>													
1953					2	3	0	4	3				12
1954									1				1
1955							14	11	1				26
1956					1	2	1						4
1957						6	5	1					12
1958					1	0	4	1	2				8
1959						3	10	13	8	1			35
1960					1	5	1	2					9
1961						2	0	3	1				6
1962						3							3
1963						1	4	1					6
1964						2	4	2	1				9
1965					2	2	0	3					7
1966					2	0	3						5
1967						4	5	4					13
15-year average	0	0	0	0	1	2	3	3	1	< 1	0	0	10
<u>Number of Days with Maximum Air Temperatures Exceeding 75°F</u>													
1953						1	0	1					2
1954													0
1955							6	3					9
1956						1							1
1957						1							1
1958							1						1
1959						1	2	3	2	1			9
1960						3							3
1961								1					1
1962						3							3
1963							1						1
1964													0
1965													0
1966							1						1
1967						1	0	1					2
15-year average	0	0	0	0	0	1	1	1	< 1	< 1	0	0	3

Note: During the 15 years from 1953 to 1967 there was a total of 5 days on which the maximum air temperature at Turnhouse Airport reached or exceeded 80°F viz:-

16th July 1955 = 80°F  
 27th July 1955 = 81°F  
 1st August 1955 = 80°F  
 4th June 1960 = 80°F  
 29th August 1961 = 83°F

TABLE 2E

NUMBERS OF DAYS OF AIR FROST (MINIMUM AIR TEMPERATURE LESS THAN 32°F)  
AT TURNHOUSE AIRPORT AND CARNWATH  
DURING 13 YEARS FROM 1955 TO 1967

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year Total
<u>TURNHOUSE AIRPORT - Altitude 114 feet</u>													
1955	17	24	23	9	6	0	0	0	0	10	6	12	107
1956	18	21	7	11	3	0	0	0	0	3	8	6	77
1957	15	15	3	4	1	0	0	0	1	0	9	12	60
1958	18	13	17	7	3	0	0	0	0	1	6	12	77
1959	26	11	5	4	3	0	0	0	0	1	6	6	62
1960	18	21	6	2	1	0	0	0	0	2	10	15	75
1961	18	8	3	4	1	0	0	0	0	0	10	22	66
1962	9	7	18	7	0	1	0	0	0	3	11	17	73
1963	22	25	5	1	0	0	0	0	0	2	8	13	76
1964	9	9	8	2	0	0	0	0	1	5	9	14	57
1965	15	10	14	4	1	0	0	0	0	4	17	14	79
1966	13	12	5	7	0	0	0	0	0	2	8	13	60
1967	11	6	3	5	3	0	0	0	0	1	7	14	50
13-year average	16	14	9	5	2	< 1	0	0	< 1	3	9	13	71

CARNWATH - Altitude 706 feet

1955	19	25	28	10	8	1	0	1	0	12	8	14	126
1956	21	23	12	18	4	1	0	1	2	4	11	8	105
1957	19	18	1	7	8	4	0	0	4	4	9	14	88
1958	19	17	21	13	5	0	0	0	0	2	12	16	105
1959	25	11	8	6	3	0	0	0	0	1	7	9	70
1960	23	20	6	7	3	0	0	0	3	2	10	20	94
1961	19	9	4	5	2	3	0	0	0	3	12	25	82
1962	15	17	23	10	4	2	0	1	1	4	11	22	110
1963	29	28	8	5	2	0	0	0	1	1	9	14	97
1964	9	10	15	2	0	0	0	3	2	10	12	20	83
1965	20	22	19	12	3	0	1	1	0	11	21	17	127
1966	19	14	8	12	3	0	0	2	0	12	16	16	102
1967	14	11	6	10	4	0	0	0	4	5	16	17	87
13-year average	19	17	12	9	4	1	< 1	1	1	5	12	16	98

LONGEST PERIODS OF CONTINUOUS AIR FROST

TURNHOUSE AIRPORT: Air Temperatures continuously below freezing point for 6½ days in January 1955.

CARNWATH: Air temperatures continuously below freezing point for 10 days in February 1955.

TABLE 2F

AVERAGE NUMBER OF DAYS OF AIR FROST (MINIMUM AIR TEMPERATURE LESS THAN 32°F)  
AT STATIONS SPECIFIED

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
<u>TURNHOUSE AIRPORT</u> - altitude 114 feet (13 years 1955 to 1967)													
	16	14	9	5	2	<1	0	0	<1	3	9	13	71
<u>MIDCALDER</u> - altitude 400 feet (10 years 1952 to 1961)													
	19	17	10	7	2	<1	0	0	<1	3	8	13	79
<u>FALKIRK</u> - altitude 100 feet (13 years 1955 to 1967)													
	16	14	8	4	1	0	0	0	0	2	8	13	66
<u>CARNWATH</u> - altitude 706 feet (13 years 1955 to 1967)													
	19	17	12	9	4	1	<1	1	1	5	12	16	98

AVERAGE AND EXTREME DATES OF FIRST AND LAST AIR FROSTS

		<u>Average Date of First Air Frost</u>	<u>Average Date of Last Air Frost</u>
TURNHOUSE AIRPORT	(1955-1967)	16 October	7 May
MIDCALDER	(1952-1961)	13 October	11 May
FALKIRK	(1955-1967)	29 October	26 April
CARNWATH	(1955-1967)	17 September	31 May
		<u>Earliest Date of First Air Frost</u>	<u>Latest Date of Last Air Frost</u>
TURNHOUSE AIRPORT	(1955-1967)	21 September	1 June
MIDCALDER	(1952-1961)	26 September	7 June
FALKIRK	(1955-1967)	12 October	21 May
CARNWATH	(1955-1967)	20 August	27 June

NOTE: Air Frosts occurred at CARNWATH on 6 July 1954, 8 August 1955, 14 August 1962, 16 July 1965 and 15 August 1966 but these isolated occurrences have not been counted when determining the average, earliest and latest dates quoted above.

TABLE 2G

TOTAL NUMBER OF DAYS IN EACH MONTH WITH AN HOURLY AIR TEMPERATURE READING OF LESS THAN 31.6°F BETWEEN 0700 AND 1700 HOURS GREENWICH MEAN TIME AT TURNHOUSE (EDINBURGH) AIRPORT (10 years 1958 to 1967)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year Total
	<u>Number of days</u>												
1958	11	9	12	3	0	0	0	0	0	0	4	6	45
1959	19	6	2	1	0	0	0	0	0	0	1	2	31
1960	6	15	3	0	0	0	0	0	0	0	5	11	40
1961	6	2	0	3	0	0	0	0	0	0	7	16	34
1962	6	2	12	3	0	0	0	0	0	0	6	10	39
1963	12	17	5	1	0	0	0	0	0	0	6	5	46
1964	5	5	2	1	0	0	0	0	1	2	5	8	29
1965	10	7	6	1	0	0	0	0	0	0	11	7	42
1966	9	4	1	3	0	0	0	0	0	1	4	5	27
1967	6	3	1	1	0	0	0	0	0	0	3	10	24
10 year mean	9.0	7.0	4.4	1.7	0.0	0.0	0.0	0.0	0.1	0.3	5.2	8.0	35.7

TOTAL NUMBER OF HOURS BETWEEN 0700 AND 1700 HOURS GREENWICH MEAN TIME IN EACH MONTH WITH AIR TEMPERATURES LESS THAN 31.6°F AT TURNHOUSE (EDINBURGH) AIRPORT (10 years 1958 to 1967)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year Total
	<u>Number of Hours</u>												
1958	72	39	28	5	0	0	0	0	0	0	11	28	183
1959	111	37	2	1	0	0	0	0	0	0	4	8	163
1960	22	60	6	0	0	0	0	0	0	0	16	75	179
1961	25	2	0	3	0	0	0	0	0	0	12	95	137
1962	29	7	31	3	0	0	0	0	0	0	25	42	137
1963	68	81	20	1	0	0	0	0	0	0	23	33	226
1964	28	16	5	1	0	0	0	0	1	2	26	35	114
1965	50	28	22	1	0	0	0	0	0	0	37	35	173
1966	42	19	1	5	0	0	0	0	0	2	12	26	107
1967	22	8	1	1	0	0	0	0	0	0	7	48	87
10 year mean	46.9	29.7	11.6	2.1	0.0	0.0	0.0	0.0	0.1	0.4	17.3	42.5	150.6
10 year mean expressed as percentage of total working time	15%	11%	4%	1%	0%	0%	0%	0%	<1%	<1%	6%	14%	4%

TABLE 2H

TOTAL NUMBER OF DAYS IN EACH MONTH WITH AN HOURLY AIR TEMPERATURE READING OF LESS THAN 33.6°F BETWEEN 0700 AND 1700 HOURS GREENWICH MEAN TIME AT TURNHOUSE (EDINBURGH) AIRPORT (10 years 1958 to 1967)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year Total
<u>Number of Days</u>													
1958	14	11	14	5	0	0	0	0	0	1	6	8	59
1959	22	10	5	1	0	0	0	0	0	1	2	4	45
1960	11	19	5	2	0	0	0	0	0	2	7	14	60
1961	7	4	3	3	0	0	0	0	0	0	9	21	47
1962	7	6	16	3	0	0	0	0	0	1	10	16	59
1963	23	26	6	1	0	0	0	0	0	2	7	8	73
1964	6	6	9	1	0	0	0	0	1	4	8	13	48
1965	11	9	13	1	1	0	0	0	0	3	15	11	64
1966	11	13	4	6	0	0	0	0	0	1	6	6	47
1967	8	4	2	5	1	0	0	0	0	1	5	11	37
10 year mean	12.0	10.8	7.7	2.8	0.2	0.0	0.0	0.0	0.1	1.6	7.5	11.2	53.9

TOTAL NUMBER OF HOURS BETWEEN 0700 AND 1700 HOURS GREENWICH MEAN TIME IN EACH MONTH WITH AIR TEMPERATURES LESS THAN 33.6°F AT TURNHOUSE (EDINBURGH) AIRPORT (10 years 1958 to 1967)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year Total
<u>Number of Hours</u>													
1958	96	63	51	8	0	0	0	0	0	1	14	43	276
1959	151	49	6	1	0	0	0	0	0	1	6	14	228
1960	48	87	10	2	0	0	0	0	0	3	24	91	265
1961	34	9	3	5	0	0	0	0	0	0	23	146	220
1962	39	16	44	3	0	0	0	0	0	2	38	83	225
1963	112	135	22	3	0	0	0	0	0	2	32	44	350
1964	34	21	15	1	0	0	0	0	1	7	35	57	171
1965	69	40	52	1	1	0	0	0	0	4	66	57	290
1966	61	75	6	12	0	0	0	0	0	3	22	42	221
1967	43	14	4	5	1	0	0	0	0	1	14	68	150
10 year mean	68.7	50.9	21.3	4.1	0.2	0.0	0.0	0.0	0.1	2.4	27.4	64.5	239.6
10 year mean expressed as percentage of total working time	22%	18%	7%	1%	<1%	0%	0%	0%	<1%	1%	9%	21%	7%

TABLE 2I

TOTAL NUMBER OF DAYS IN EACH MONTH WITH AN HOURLY AIR TEMPERATURE READING OF LESS THAN 35.6°F BETWEEN 0700 AND 1700 HOURS GREENWICH MEAN TIME AT TURNHOUSE (EDINBURGH) AIRPORT (10 years 1958 to 1967)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year Total
<u>Number of Days</u>													
1958	15	13	18	7	0	0	0	0	0	1	7	9	70
1959	25	11	7	3	0	0	0	0	0	1	3	6	56
1960	21	20	6	2	0	0	0	0	1	3	7	16	76
1961	12	7	4	4	0	0	0	0	0	1	13	23	64
1962	11	13	18	8	0	0	0	0	0	2	11	19	82
1963	28	28	8	3	0	0	0	0	0	2	8	11	88
1964	7	12	15	2	0	0	0	0	2	8	9	15	70
1965	18	17	17	5	1	0	0	0	0	7	16	17	98
1966	16	15	6	10	0	0	0	0	0	4	9	11	71
1967	9	8	4	5	1	0	0	0	0	4	7	12	50
10 year mean	16.2	14.4	10.3	4.9	0.2	0.0	0.0	0.0	0.3	3.3	9.0	13.9	72.5

TOTAL NUMBER OF HOURS BETWEEN 0700 AND 1700 HOURS GREENWICH MEAN TIME IN EACH MONTH WITH AIR TEMPERATURES LESS THAN 35.6°F AT TURNHOUSE (EDINBURGH) AIRPORT (10 years 1958 to 1967)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year Total
<u>Number of Hours</u>													
1958	110	76	73	18	0	0	0	0	0	2	23	67	369
1959	190	79	13	3	0	0	0	0	0	2	9	24	320
1960	98	131	18	2	0	0	0	0	1	5	35	114	404
1961	56	20	6	7	0	0	0	0	0	1	39	190	319
1962	55	44	65	10	0	0	0	0	0	5	67	116	362
1963	198	206	28	8	0	0	0	0	0	4	40	64	548
1964	44	45	38	2	0	0	0	0	3	14	40	101	287
1965	113	76	79	5	2	0	0	0	0	13	96	83	467
1966	108	109	11	22	0	0	0	0	0	7	31	54	342
1967	63	22	6	5	1	0	0	0	0	5	25	88	215
10 year mean	103.5	80.8	33.7	8.2	0.3	0.0	0.0	0.0	0.4	5.8	40.5	90.1	363.3

10 year mean expressed as percentage of total working time

33% 29% 11% 3% <1% 0% 0% 0% <1% 2% 14% 29% 10%

TABLE 2J

TABLE FOR CONVERTING DEGREES FAHRENHEIT TO DEGREES CENTIGRADE

<u>°F</u>	<u>°C</u>	<u>°F</u>	<u>°C</u>	<u>°F</u>	<u>°C</u>
0	minus 17.8	32	0.0	64	17.8
2	minus 16.7	34	1.1	66	18.9
4	minus 15.6	36	2.2	68	20.0
6	minus 14.4	38	3.3	70	21.1
8	minus 13.3	40	4.4	72	22.2
10	minus 12.2	42	5.6	74	23.3
12	minus 11.1	44	6.7	76	24.4
14	minus 10.0	46	7.8	78	25.6
16	minus 8.9	48	8.9	80	26.7
18	minus 7.8	50	10.0	82	27.8
20	minus 6.7	52	11.1	84	28.9
22	minus 5.6	54	12.2	86	30.0
24	minus 4.4	56	13.3	88	31.1
26	minus 3.3	58	14.4		
28	minus 2.2	60	15.6		
30	minus 1.1	62	16.7		

### 3. RELATIVE HUMIDITY

In West Lothian as elsewhere in the British Isles, the relative humidity reaches 90 per cent or thereabouts on most nights of the year. As a good general rule, the highest values of relative humidity occur in association with the lowest air temperature of the day i.e. usually around dawn, while the lowest values of relative humidity occur in association with the highest air temperature of the day i.e. usually in the middle of the afternoon. The main departures from this general rule occur in misty or foggy weather or when rain is falling.

In addition to the well marked diurnal range of relative humidity, there is also a change from season to season and the mean relative humidity is highest during the winter months and lowest in the months of April, May and June.

No records of relative humidity are available from West Lothian but one would not expect a significant difference in the relative humidity regime from place to place within the county, although considerable differences could exist at a particular time of day depending on the local weather prevailing at the time.

Turnhouse Airport is the nearest place to the county for which detailed records of relative humidity, wet bulb temperatures etc. are available and the Turnhouse Airport data quoted in Tables 3 to 3C should be broadly representative of West Lothian.

Averages and Extremes of Relative Humidity and Air Temperature for each hour of the day are given on a monthly basis in Table 3.

The Percentage Amounts of Time with Relative Humidity between Certain Limits are given in Table 3A.

The Percentage Amounts of Time with Wet Bulb Temperatures between Certain Limits are given in Table 3B.

The Highest Values of Wet Bulb Temperature are given in Table 3C.

TABLE 3  
 HOURLY AVERAGES AND EXTREMES OF AIR TEMPERATURE AND RELATIVE HUMIDITY FOR TURNHOUSE (EDINBURGH) AIRPORT - FROM  
 HOURLY OBSERVATIONS MADE AT EACH HOUR ON THE HOUR DURING THE 10 YEARS FROM 1957 TO 1966

Time of Observation G.M.T.	J A N U A R Y					F E B R U A R Y						
	Air Temperature Of		Relative Humidity per cent		Average Of	Air Temperature Of		Relative Humidity per cent		Average %		
	Absolute Maximum Of	Absolute Minimum Of	Average %	Absolute Maximum %		Absolute Minimum %	Absolute Maximum Of	Absolute Minimum Of				
0000	36	56	12	87	100	59	37	51	6	85	100	48
0100	36	55	13	87	100	60	36	51	4	85	100	55
0200	36	55	12	87	100	61	36	52	5	86	100	53
0300	35	54	12	87	100	61	36	52	11	86	100	63
0400	35	54	13	87	100	60	36	52	11	86	100	53
0500	35	54	12	87	100	61	36	52	12	86	100	58
0600	35	54	13	87	100	60	36	52	13	86	100	64
0700	35	53	14	87	100	62	36	53	13	87	100	63
0800	35	53	13	87	100	64	36	53	13	86	100	54
0900	35	53	13	86	100	58	36	53	15	85	100	58
1000	36	54	16	85	100	56	38	53	17	83	100	54
1100	38	54	20	83	100	50	40	54	20	79	100	43
1200	39	56	21	82	100	51	41	56	23	77	100	45
1300	40	57	24	80	100	50	42	57	25	75	100	34
1400	40	56	23	79	100	56	42	58	27	75	100	34
1500	40	58	25	80	100	53	42	56	28	76	100	35
1600	39	57	23	82	100	57	41	55	27	77	100	38
1700	38	56	19	84	100	54	40	55	24	80	100	31
1800	37	55	16	85	100	56	39	53	19	82	100	41
1900	37	55	15	85	100	54	38	53	14	84	100	46
2000	37	56	15	85	100	60	38	53	11	84	100	40
2100	36	56	13	86	100	57	37	52	10	85	100	42
2200	36	56	13	86	100	61	37	50	9	85	100	48
2300	36	54	12	86	100	60	37	50	10	85	100	49
Average for Month	37	-	-	85	-	-	38	-	-	83	-	-
Extremes for Month	-	58	12	-	100	50	-	58	4	-	100	31

TABLE 3 (Contd.)

Time of Observation G.M.T.	M A R C H						A P R I L					
	Air Temperature Of			Relative Humidity per cent			Air Temperature Of			Relative Humidity per cent		
	Average Of	Absolute Maximum Of	Absolute Minimum Of	Average %	Absolute Maximum %	Absolute Minimum %	Average Of	Absolute Maximum Of	Absolute Minimum Of	Average %	Absolute Maximum %	Absolute Minimum %
0000	4.0	55	21	85	100	53	42	56	27	85	100	57
0100	3.9	54	22	85	100	55	42	55	26	86	100	56
0200	3.9	53	19	86	100	56	41	56	25	87	100	54
0300	3.9	52	16	86	100	56	41	55	23	88	100	57
0400	3.9	52	17	86	100	51	41	54	24	88	100	57
0500	3.8	52	15	86	100	49	41	53	24	88	100	60
0600	3.8	52	16	87	100	58	41	53	24	88	100	42
0700	3.8	52	14	86	100	57	42	54	26	86	100	54
0800	3.9	52	16	85	100	58	44	55	27	82	100	49
0900	4.1	54	19	82	100	45	46	57	31	77	100	53
1000	4.2	57	24	78	100	45	48	61	33	73	100	37
1100	4.4	61	27	74	99	40	49	63	34	70	100	41
1200	4.5	66	30	71	98	29	50	66	31	68	100	38
1300	4.6	68	31	70	98	25	50	68	35	67	100	34
1400	4.6	68	32	70	98	24	51	68	36	66	100	33
1500	4.6	67	31	70	97	28	51	67	35	67	100	31
1600	4.5	65	32	71	97	33	50	67	35	67	100	24
1700	4.5	65	31	73	98	27	49	66	33	69	100	38
1800	4.3	60	30	76	98	30	48	63	33	72	99	41
1900	4.2	57	27	80	98	40	47	61	31	76	100	43
2000	4.1	55	25	82	98	45	45	58	32	80	100	47
2100	4.1	53	25	82	99	51	44	57	31	82	100	52
2200	4.0	53	22	83	100	49	43	55	30	84	100	48
2300	4.0	53	21	84	100	50	43	55	28	85	100	61
Average for Month	4.1	-	-	80	-	-	45	-	-	78	-	-
Extremes for Month	-	68	14	-	100	24	-	68	23	-	100	24

TABLE 3 (Contd.)

Time of Observation G.M.T.	M A Y				J U N E				Time of Observation G.M.T.				
	Air Temperature °F		Relative Humidity per cent		Air Temperature °F		Relative Humidity per cent						
	Average °F	Absolute Maximum °F	Average %	Absolute Minimum %	Average °F	Absolute Maximum °F	Average %	Absolute Minimum %					
0000	46	56	33	86	100	62	51	63	36	88	100	59	0000
0100	45	57	33	87	100	56	51	62	33	89	100	57	0100
0200	45	57	33	88	100	54	50	62	33	90	100	56	0200
0300	44	55	32	88	100	61	50	62	32	90	100	56	0300
0400	44	55	31	89	100	63	49	61	34	91	100	60	0400
0500	44	55	30	89	100	63	50	62	36	90	100	59	0500
0600	45	56	32	87	100	57	51	63	39	88	100	61	0600
0700	48	57	33	83	100	50	53	64	43	84	100	50	0700
0800	50	59	35	78	100	43	55	66	45	79	100	51	0800
0900	51	63	38	74	100	38	57	69	46	75	100	45	0900
1000	53	67	38	71	100	37	58	71	46	72	100	39	1000
1100	54	70	39	69	100	31	59	74	47	70	100	35	1100
1200	55	72	40	67	100	30	60	76	47	68	99	36	1200
1300	55	73	41	65	100	35	60	78	47	67	99	35	1300
1400	56	73	42	65	99	34	61	78	47	67	98	31	1400
1500	56	74	42	66	98	35	60	78	47	67	98	31	1500
1600	55	74	41	67	99	28	60	79	47	68	100	32	1600
1700	54	74	41	68	99	34	60	79	47	69	100	32	1700
1800	53	73	41	70	100	33	59	76	47	71	100	38	1800
1900	52	70	40	73	100	35	57	75	45	74	100	40	1900
2000	50	65	40	77	100	41	56	71	45	78	100	43	2000
2100	49	60	39	81	100	46	54	66	45	82	100	53	2100
2200	48	58	36	83	100	52	53	65	45	85	100	51	2200
2300	47	57	35	85	100	58	52	64	42	87	100	57	2300
Average for Month	50	-	-	77	-	-	55	-	-	79	-	-	-
Extremes for Month	-	74	30	-	100	28	-	79	32	-	100	31	31

TABLE 3 (Contd.)

AUGUST

JULY

Time of Observation G.M.T.	Air Temperature Of			Relative Humidity per cent			Air Temperature Of			Relative Humidity per cent			Time of Observation G.M.T.	
	Average		Absolute	Average		Absolute	Average		Absolute	Average		Absolute		
	Of	Of	Minimum	Of	Of	Of	Minimum	Of	Of	Of	Minimum	Of		
0000	53	64	42	89	100	55	67	53	67	41	90	100	67	0000
0100	52	63	40	90	100	67	67	53	67	39	90	100	68	0100
0200	52	63	39	91	100	55	66	52	66	38	91	100	70	0200
0300	51	63	40	91	100	58	66	52	66	37	91	100	71	0300
0400	51	63	38	91	100	66	66	52	66	37	91	100	64	0400
0500	52	64	39	91	100	63	66	52	66	36	92	100	61	0500
0600	53	66	41	89	100	61	65	52	65	37	91	100	65	0600
0700	55	67	45	85	100	51	66	53	66	39	90	100	68	0700
0800	57	68	49	80	100	52	68	56	68	44	85	100	58	0800
0900	58	69	50	76	100	42	72	58	72	50	80	100	47	0900
1000	59	73	50	73	100	47	75	59	75	51	76	100	48	1000
1100	60	75	50	72	100	43	76	60	76	51	74	100	48	1100
1200	61	77	49	70	99	38	78	61	78	52	72	99	45	1200
1300	62	77	49	68	100	31	80	61	80	51	71	99	43	1300
1400	62	78	49	68	100	37	79	62	79	51	71	98	33	1400
1500	62	78	47	68	99	35	83	62	83	50	70	100	39	1500
1600	62	78	47	69	99	37	80	61	80	50	71	98	37	1600
1700	61	79	46	70	99	39	77	61	77	50	73	100	42	1700
1800	60	77	46	72	100	43	75	59	75	49	75	100	44	1800
1900	59	73	46	75	100	39	72	58	72	49	79	100	50	1900
2000	58	71	46	79	100	53	69	56	69	47	83	100	57	2000
2100	56	67	45	83	100	62	67	55	67	46	86	100	58	2100
2200	55	64	45	86	100	63	67	54	67	45	88	100	60	2200
2300	54	64	44	87	100	64	67	54	67	43	89	100	62	2300
Average for Month	57	-	-	80	-	-	-	57	-	-	82	-	-	-
Extreme for Month	-	79	38	-	100	31	83	-	83	36	-	100	33	-

TABLE 3 (Contd.)

Time of Observation G.M.T.	S E P T E M B E R						O C T O B E R					
	Air Temperature Of			Relative Humidity per cent			Air Temperature Of			Relative Humidity per cent		
	Average Of	Maximum Of	Minimum Of	Average %	Maximum %	Minimum %	Average Of	Maximum Of	Minimum Of	Average %	Maximum %	Minimum %
0000	51	63	35	89	100	65	47	58	32	89	100	58
0100	51	63	34	90	100	64	47	59	30	89	100	61
0200	50	63	34	90	100	65	47	59	30	89	100	60
0300	50	63	34	90	100	66	46	59	30	89	100	60
0400	50	63	31	90	100	67	46	60	30	89	100	59
0500	50	64	31	91	100	68	46	60	29	89	100	60
0600	49	64	30	91	100	69	46	60	29	89	100	55
0700	50	63	31	90	100	67	46	61	28	90	100	60
0800	52	63	35	88	100	65	47	61	27	88	100	58
0900	55	67	40	83	100	59	49	62	32	86	100	55
1000	57	70	48	78	99	53	51	64	36	83	100	50
1100	58	71	49	74	99	49	53	66	38	79	100	52
1200	59	72	46	72	99	48	53	69	41	77	100	45
1300	59	75	48	71	100	41	54	75	42	75	100	44
1400	59	76	47	70	100	37	54	76	42	74	100	40
1500	59	76	48	71	100	36	54	75	41	75	100	43
1600	59	75	48	72	100	38	53	73	40	77	100	50
1700	58	73	48	74	100	42	52	69	38	80	100	51
1800	57	71	47	78	100	48	50	67	35	83	100	56
1900	55	64	44	82	100	50	49	62	34	85	100	62
2000	53	63	43	85	100	53	48	61	33	86	100	56
2100	53	64	41	87	100	64	48	61	31	87	100	60
2200	52	64	40	88	100	63	47	59	31	88	100	58
2300	51	64	37	89	100	65	47	59	31	88	100	60
Average for Month	54	-	-	83	-	-	49	-	-	84	-	-
Extreme for Month	-	76	30	-	100	36	-	76	27	-	100	40

TABLE 3 (Contd.)

				N O V E M B E R				D E C E M B E R									
Time of Observation G.M.T.	Air Temperature °F		Relative Humidity per cent		Air Temperature °F		Relative Humidity per cent		Air Temperature °F		Relative Humidity per cent		Air Temperature °F		Relative Humidity per cent		Time of Observation G.M.T.
	Average	Absolute	Average	Absolute	Average	Absolute	Average	Absolute	Average	Absolute	Average	Absolute	Average	Absolute	Average	Absolute	
	°F	Minimum	%	Minimum	°F	Minimum	%	Minimum	°F	Minimum	%	Minimum	°F	Minimum	%	Minimum	
0000	41	56	88	100	37	52	14	100	87	100	61	0000	87	100	61	0000	
0100	41	56	89	100	37	52	13	100	87	100	62	0100	87	100	62	0100	
0200	41	55	89	100	37	53	13	100	87	100	57	0200	87	100	57	0200	
0300	40	55	89	100	37	53	13	100	87	100	49	0300	87	100	49	0300	
0400	40	55	89	100	37	54	9	100	87	100	51	0400	87	100	51	0400	
0500	40	55	88	100	37	52	9	100	86	100	57	0500	86	100	57	0500	
0600	40	54	88	100	37	54	9	100	86	100	57	0600	86	100	57	0600	
0700	40	54	89	100	37	54	11	100	86	100	54	0700	86	100	54	0700	
0800	40	56	88	100	37	51	15	100	87	100	41	0800	87	100	41	0800	
0900	41	56	88	100	37	51	16	100	87	100	43	0900	87	100	43	0900	
1000	42	57	86	100	38	51	18	100	86	100	53	1000	86	100	53	1000	
1100	44	58	84	100	39	52	22	100	84	100	53	1100	84	100	53	1100	
1200	45	57	82	100	40	53	25	100	82	100	54	1200	82	100	54	1200	
1300	45	57	80	100	41	53	27	100	81	100	54	1300	81	100	54	1300	
1400	46	58	80	99	41	54	28	100	81	100	50	1400	81	100	50	1400	
1500	45	56	81	100	40	53	27	100	83	100	50	1500	83	100	50	1500	
1600	44	56	83	100	39	53	25	100	85	100	59	1600	85	100	59	1600	
1700	43	56	85	100	38	52	23	100	85	100	48	1700	85	100	48	1700	
1800	42	56	86	100	38	53	20	100	85	100	43	1800	85	100	43	1800	
1900	42	56	87	100	38	54	15	100	86	100	55	1900	86	100	55	1900	
2000	41	56	87	100	38	53	15	100	87	100	56	2000	87	100	56	2000	
2100	41	55	88	100	38	53	14	100	86	100	60	2100	86	100	60	2100	
2200	41	56	88	100	37	53	14	100	86	100	58	2200	86	100	58	2200	
2300	41	55	89	100	37	52	14	100	87	100	53	2300	87	100	53	2300	
Average for Month	42	-	86	-	38	-	-	-	85	-	-	-	85	-	-	-	-
Extreme for Month	-	58	-	100	-	54	9	41	-	100	41	41	-	100	41	41	41

TABLE 3A

PERCENTAGE AMOUNT OF TIME WITH RELATIVE HUMIDITY BETWEEN CERTAIN LIMITS AT TURNHOUSE  
(EDINBURGH) AIRPORT - 10 years from 1957 to 1966

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
	%	%	%	%	%	%	%	%	%	%	%	%	%
0-20%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20-24%	0.0	0.0	0.0+	0.0+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0+
25-29%	0.0	0.0	0.1	0.0	0.0+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0+
30-34%	0.0	0.1	0.1	0.1	0.1	0.1	0.0+	0.0+	0.0	0.0	0.0	0.0	0.0+
35-39%	0.0	0.1	0.5	0.3	0.6	0.5	0.1	0.0+	0.1	0.0	0.0	0.0	0.2
40-44%	0.0	0.2	0.6	1.1	0.9	1.0	0.4	0.2	0.1	0.1	0.0+	0.1	0.4
45-49%	0.0	0.5	1.1	2.1	2.2	2.3	1.6	1.0	0.2	0.1	0.1	0.0+	0.9
50-54%	0.1	0.6	2.2	3.6	3.9	4.2	3.7	2.5	1.4	0.6	0.2	0.2	1.9
55-59%	0.4	1.6	3.3	4.6	5.5	5.4	5.6	3.8	3.2	1.5	0.7	0.4	3.0
60-64%	1.2	3.2	5.1	6.1	7.5	6.8	5.6	5.1	5.3	2.8	1.5	1.4	4.3
65-69%	3.7	5.9	6.9	7.3	8.3	6.9	7.4	5.8	6.6	4.7	3.2	3.2	5.8
70-74%	7.3	8.3	8.9	9.1	9.6	8.3	9.2	7.2	7.2	6.9	5.6	5.5	7.8
75-79%	12.9	12.5	12.2	11.1	11.4	9.7	9.8	9.9	9.8	11.7	9.3	11.1	10.9
80-84%	17.9	17.9	15.6	14.1	12.5	12.0	11.8	11.3	13.4	16.0	14.9	19.9	14.8
85-89%	23.0	20.3	17.7	15.5	14.0	13.9	14.8	16.8	17.8	20.2	21.6	23.4	18.3
90-94%	21.0	17.0	15.9	14.6	13.5	13.8	15.2	19.3	18.3	18.0	23.6	20.4	17.6
95-98%	10.5	8.9	8.7	7.9	7.4	10.1	11.4	14.0	13.0	12.6	15.7	11.9	11.0
99%	1.1	0.9	0.6	1.3	1.3	2.8	2.3	2.1	2.2	2.5	2.6	1.5	1.8
100%	0.9	2.0	0.5	1.2	1.3	2.2	1.1	1.0	1.4	2.3	1.0	1.0	1.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 3B

PERCENTAGE AMOUNT OF TIME WITH WET BULB TEMPERATURES BELOW CERTAIN LIMITS - DEGREES  
FAHRENHEIT at TURNHOUSE (EDINBURGH) AIRPORT - 9 years 1952-1960

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
	%	%	%	%	%	%	%	%	%	%	%	%	%
32°F or below	31.3	30.2	10.8	4.1	0.6	0.0	0.0	0.0	0.3	2.1	8.3	16.3	8.6
34°F or below	43.0	44.2	18.8	7.6	1.6	0.0	0.0	0.0	0.5	3.8	11.8	23.9	12.8
36°F or below	55.6	57.0	29.1	12.3	3.3	0.1	0.0	0.0	0.7	5.4	17.2	33.5	17.7
38°F or below	66.5	66.9	42.1	20.9	6.2	0.5	0.0	0.1	1.5	9.1	24.9	46.7	23.6
40°F or below	75.4	74.4	56.3	31.9	10.4	1.4	0.2	0.4	3.1	14.3	36.4	60.3	30.2
42°F or below	82.2	81.1	69.1	45.5	16.6	3.4	0.5	1.0	5.9	20.0	49.3	71.9	37.0
44°F or below	88.2	87.1	81.3	58.5	26.1	6.6	1.3	2.0	9.5	28.3	64.5	80.9	44.3
46°F or below	92.8	92.2	89.9	72.3	38.8	14.0	2.6	4.0	15.1	40.2	77.2	87.3	52.0
48°F or below	96.8	96.8	95.2	83.4	55.0	25.4	5.8	8.1	24.7	53.6	87.3	92.5	60.2
50°F or below	99.2	99.3	97.8	92.2	72.2	40.1	12.6	16.4	37.1	68.2	95.0	96.7	68.8
52°F or below	99.9	99.9	99.5	97.4	83.8	54.8	23.5	29.9	52.7	80.8	98.4	98.7	76.5
54°F or below	100.0	100.0	99.8	99.2	91.6	70.5	41.4	44.7	66.9	89.8	99.9	99.7	83.6
56°F or below			100.0	99.7	96.1	83.5	62.6	66.2	79.3	95.2	100.0	100.0	89.9
58°F or below				99.8	97.9	91.4	80.3	78.9	89.5	97.7			94.7
60°F or below				100.0	99.3	95.1	89.6	89.1	95.5	99.2			97.4
62°F or below					99.9	97.9	94.9	95.7	98.1	99.9			99.0
64°F or below					99.9	99.4	97.5	97.9	99.3	100.0			99.6
66°F or below					100.0	99.9	99.0	99.4	99.7				99.9
68°F or below						99.9	99.7	99.8	99.9				99.9
70°F or below						100.0	99.9	100.0	100.0				99.9
72°F or below							99.9						99.9
74°F or below							100.0						100.0

TABLE 3C

Absolute Highest Values of Wet Bulb Temperature and Highest Values of Wet Bulb Temperature Associated with Relative Humidities of 100 per cent extracted from Hourly Readings of Wet Bulb Temperature made at TURNHOUSE (EDINBURGH) AIRPORT during the 9 years from 1952 to 1960 - (degrees Fahrenheit)

	<u>Absolute Highest Value of Wet Bulb Temperature</u>	<u>Highest Value of Wet Bulb Temperature Associated with Relative Humidity of 100 per cent</u>
	<u>°F.</u>	<u>°F.</u>
January	54	52
February	54	52
March	56	54
April	60	54
May	66	62
June	70	66
July	74	66
August	70	66
September	70	66
October	64	62
November	56	56
December	56	56
Year	74	66

4. SUNSHINE

West Lothian has a fairly good sunshine record particularly when its northerly latitude is taken into account. No measurements of sunshine duration are available from places within the county but the average annual duration of sunshine is likely to range from about 1325 hours per year in the flatter drier parts of the county near the Forth coastline to about 1270 hours in the higher wetter parts of the county. Estimated monthly averages of sunshine duration (in hours) for altitudes of 100 feet and 600 to 700 feet above sea level are given below but it should be borne in mind that these averages will relate only to places where the horizon is not obstructed by nearby hills, buildings or trees with an elevation exceeding about 3 degrees.

TABLE 4                      100 feet above mean sea level

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year</u>
Monthly Total	50	70	100	145	180	185	160	135	120	90	55	35	1,325 hours
Daily Mean	1.6	2.5	3.2	4.8	5.8	6.2	5.2	4.4	4.0	2.9	1.8	1.1	3.6 hours

600 to 700 feet above mean sea level

Monthly Total	50	70	100	135	170	175	145	135	115	90	55	35	1,275 hours
Daily Mean	1.6	2.5	3.2	4.5	5.5	5.8	4.7	4.4	3.8	2.9	1.8	1.1	3.5 hours

The sunniest places in West Lothian should have an average annual duration more or less the same as the Central London districts of Kingsway and Regent's Park which have 1,359 hours and 1,353 hours per year respectively. However, there is a seasonal difference between West Lothian and Central London in that the sunnier parts of West Lothian will normally have a longer duration of sunshine during the winter and early spring but London will have the better record during the summer.

/The

The path of the sun across the sky depends on the latitude and the time of year. Figure 3 is a solar chart for latitude 56 degrees North (i.e. the latitude of West Lothian) which shows the elevation and azimuth of the sun at various times of day, for the solstices, equinoxes and for certain intermediate dates. For a given site the various obstructions can be plotted on the chart and their effect in cutting off the sun's radiation at various times can then be evaluated. For example, it can be seen from Figure 3 that at 8.30 a.m. on 23 August, the sun is at an altitude of 30 degrees with an azimuth of 117 degrees. It can also be seen that on 22nd December, the maximum altitude of the sun is  $10\frac{1}{2}$  degrees at 12 noon with an azimuth of 180 degrees. Thus, in midwinter, a hill to the south in West Lothian with an altitude greater than  $10\frac{1}{2}$  degrees would cut off practically all the sunshine.

## 5. WINDS

At an open level site near the Forth coastline of West Lothian, the average wind speed near the ground is of the order of 12 mph. Over the Forth itself the wind speed is appreciably higher owing to funnelling effects and the lack of surface obstructions. The average wind speed near the water surface is probably nearer 15 mph. As mentioned previously, the topography of the county exposes much of it to the full effect of the wind and local increases in the general wind speed are experienced on ridges or where features of the landscape form a wind funnel. There is a considerable variation in shelter to the wind from place to place depending on the lie and orientation of the high ground but the general windiness is one of the most unpleasant features of the climate.

In the "average" year, about 45 to 50 per cent of all winds are likely to blow from directions in the quadrant between south and west.

/However,

However, in common with other places on the eastern side of Scotland, West Lothian will have a high frequency of winds from between north-east and east in the spring and early summer and during this period of the year, the frequency of easterly winds could be higher than the frequency of winds from any other point of the compass.

A special mention should be made of the high gustiness of winds from directions in the quadrant between south and west because fine sunny days in the summer are often marred by the boisterous nature of the winds from these directions. The gustiness is usually greatest in the middle of the afternoon when the speed reached in gusts is often more than twice the average wind speed.

No wind records are available from West Lothian but open sites near the Forth coastline are likely to experience wind directions and speeds very similar to those recorded at Turnhouse (Edinburgh) Airport. The Pentland Hills immediately to the south of Turnhouse Airport provide some shelter to strong winds from the south, and places along or near the Forth coastline of West Lothian which lie much further away from the sheltering influence of the Pentlands may have a higher frequency of strong winds from the south, particularly high gusts of wind.

Owing to the complex topography, it is not possible to generalise about wind directions and speeds in the higher parts of West Lothian away from the Forth. However, the high wind speeds recorded at the Royal Observatory at Blackford Hill, Edinburgh, and the Meteorological Office at Turnhouse (Edinburgh) Airport serve as a useful indication of the high speeds likely to be experienced at quite moderate altitudes in West Lothian. Perhaps it should be mentioned that the former wind recording station at the Royal Observatory, where recordings were terminated in March 1967, was sited on a very exposed ridge (altitude 450 feet) on the south side of Edinburgh.

/About

About 50 years of recorded maximum wind speeds are available from this location. Records of maximum speeds at Turnhouse Airport are only available for a relatively short period of years, but during the very severe gale of 15 January 1968 it is worthy of note that Turnhouse Airport recorded a maximum hourly mean wind speed of 71 mph from direction 250 degrees (west-south-west) and a highest gust of 104 mph.

It is considered that the best estimates of extreme wind speeds can be obtained from the 50 years of maximum speeds recorded at the Royal Observatory combined with the maximum speeds recorded at Turnhouse Airport on 15 January 1968. A statistical treatment of these combined records yields the following results:-

A. Maximum Hourly Mean Wind Speeds at 33 feet (10 metres) above the ground likely to be exceeded only once in the stated number of years:

<u>10 years</u>	<u>20 years</u>	<u>50 years</u>	<u>100 years</u>
60 mph	64 mph	69 mph	72 mph

B. Maximum Gust Speeds at 33 feet (10 metres) above the ground likely to be exceeded only once in the stated number of years:

<u>10 years</u>	<u>20 years</u>	<u>50 years</u>	<u>100 years</u>
99 mph	104 mph	111 mph	115 mph

This would seem to be an appropriate point at which to remind the reader that a "once-in-50 years" occurrence really means a probability of  $\frac{1}{50} = .02$  (or a 2 per cent probability) in any one year. Similarly a "once-in-100 years" occurrence really means a probability of  $\frac{1}{100} = .01$  (or a 1 per cent probability) in any one year.

Estimation of Maximum Wind Speeds for Building Design Purposes

Design wind speeds for the calculation of wind loads on buildings are now based on the maximum 3 second gust speed likely to be exceeded on the average only once in 50 years at a height of 10 metres (33 feet) above ground level.

/From

From the standard anemograph records, the Meteorological Office practice is to extract the mean speed averaged over each hour of the day and also the maximum "gust" of the day. In strong winds, this gust speed is thought to represent a value of wind speed averaged over a time interval of 2 to 3 seconds and is often referred to as the 3 second gust. It may also be called that speed with an averaging time of 3 seconds. Similarly an hourly mean speed has an averaging time of 1 hour.

The ratio of the maximum 3 second gust to the maximum hourly mean speed can be calculated from statistics of the type quoted at 'A' and 'B' above and by using the results of special experiments with open time-scale recordings of wind speeds it has proved possible to estimate the ratio of the speed with an averaging time of "t" seconds to that with a 3 second averaging time for values of "t" ranging from 5 seconds to half an hour.

The averaging time has been associated by the Building Research Station with the maximum dimension (length or height) of the building affected. Thus, a speed with a short averaging time such as a 3 second gust is considered to affect small buildings or components of a building (i.e. cladding, glazing, fixings etc.) whereas a longer averaging time, such as a 15 second speed, is appropriate to a very tall or very wide building more than 50 metres (164 feet) maximum dimension. The load due to wind on a building whose maximum dimension is 50 metres or more is calculated by assuming that the 15 second speed affects the whole face of the building. For the purposes of calculation, since the wind speed varies with height according to the well known power law, multiplying factors have been derived which convert the maximum 3 second gust at 10 m over open level country to the approximate time-averaged gust at other heights.

The power law exponent depends both on the averaging time and on the surface roughness in the vicinity of the site.

/This

This surface roughness is itself dependent on the number and size of obstacles near the ground and has been classified as "smooth" in open level country, "moderate" in country with windbreaks and scattered houses, "rough" in woods, towns or the outskirts of cities and "very rough" in the centres of large cities. Broadly speaking, it is a measure of the power of these obstacles to slow down the wind in the layers near the ground.

The available evidence suggests that for open level country in West Lothian with "smooth" conditions, the maximum 3 second gust speed likely to be exceeded on the average only once in 50 years at a height of 10 metres (33 feet) above ground level is 50 metres per second (112 mph). Combining this value of 50 metres per second with the factors which take into account the effects of surface roughness and power law variations of strong winds with height, the Table on page 50 (Table "C") shows the design wind speeds to be used in various parts of West Lothian.

The effect of topography has not been incorporated in the speeds quoted in Table "C". However, advice on topographical effects can be given for specific sites and if there are any unusual features of local topography, exposure or of the structure itself, advice on the appropriate gust speed to be used should be sought from the Meteorological Office quoting the National Grid Reference of the site in question.

Terms used by the Meteorological Office for describing the wind strength

<u>Term</u>	<u>Average speed near the ground</u>
Calm	less than 1 mph (1 knot)
Light	1 to 12 mph (1 to 10 knots)
Moderate	13 to 18 mph (11 to 16 knots)
Fresh	19 to 24 mph (17 to 21 knots)
Strong	25 to 38 mph (22 to 33 knots)
Gale	39 to 46 mph (34 to 40 knots)
Severe Gale	over 46 mph (over 40 knots)

"C." Maximum speeds at specified heights above the ground likely to be exceeded on the average only once in 50 years for stated averaging times

Surface Category		1. Open Country in West Lothian				2. Outskirts of towns or districts on or near the fringe of the main built-up areas				3. More densely built-up areas where existing buildings are fairly tall and closely packed together			
Height above ground level		3-sec gust		5-sec gust		15-sec gust		3-sec gust		5-sec gust		15-sec gust	
metres	feet	m/s	mph	m/s	mph	m/s	mph	m/s	mph	m/s	mph	m/s	mph
5 or less	16 or less	47	105	44	98	42	94	46	103	43	96	40	90
10	33	50	112	48	107	45	101	49	110	46	103	44	98
15	49	52	116	50	112	47	105	51	114	48	107	46	103
20	66	53	119	51	114	49	110	52	116	49	110	47	105
30	98	55	123	53	119	51	114	54	121	52	116	49	110
40	131	57	128	55	123	53	119	56	125	53	119	51	114
50	164	58	130	56	125	54	121	57	128	54	121	52	116
60	197	58	130	57	128	56	125	57	128	55	123	54	121
80	263	60	134	59	132	57	128	59	132	57	128	55	123
100	328	61	137	60	134	59	132	60	134	58	130	55	123
120	394	62	139	61	137	60	134	61	137	59	132	56	125
140	459	63	141	62	139	61	137	62	139	60	134	57	128
160	525	64	143	63	141	62	139	62	139	61	137	58	130
180	591	64	143	64	143	63	141	63	141	62	139	60	134
200	656	65	145	64	143	64	143	63	141	62	139	60	134

NOTE: In the above table, speeds of half a metre per second have been rounded upwards to the nearest whole metre per second and the speeds in miles per hour are the equivalents of the rounded-up metres per second values.

The average speeds quoted (page 49) would be considerably exceeded in gusts. For example, in a gale, gusts of over 50 mph are common and may exceed 100 mph at exposed places in a severe gale. A gale warning is issued when the gusts are expected to reach 50 mph or more even if the average speed may be rather less than the limits shown in the above table.

As mentioned previously, the duration of a high gust of wind is of the order of three seconds but nevertheless, gusts are usually responsible for the more common types of "gale damage" e.g. the removal of roof tiles and chimney pots, blown-down fences and hoardings, damage to trees, crops and glass window panes etc.

Most gales in West Lothian blow from directions in the quadrant between south and west but easterly gales, although much less frequent are not uncommon. Mention of the very severe westerly gale of 15th January 1968 has already been made in this Report but one of the worst easterly gales during recent years occurred around midday on 20th January 1963 when the anemograph at Turnhouse Airport recorded a highest hourly mean wind speed of 48 mph from a due easterly direction with a highest gust of 76 mph also from due east. Gales can occur in West Lothian in any month of the year but the months of December, January and February usually have the highest frequencies and July and August the lowest.

Annual and Monthly Frequencies of Wind Direction and Velocity for Turnhouse Airport are given in Tables 5 and 5A.

The Actual and Average Numbers of Days of Gales at Turnhouse Airport are given in Table 5B.

The Numbers of Days and Hours with Gusts to 39 mph or more and 55 mph or more during the 10 years from 1958 to 1967 are given in Tables 5C and 5D.

High Winds during the Working Part of the Day

Strong winds often lead to hazardous working conditions on building sites and can also cause serious interruptions of work particularly at sites where tower cranes are in use.

It is not possible to decide a precise threshold of wind speed above which work on a building site would be hampered or have to stop because this will clearly depend on a number of complex factors including the exposure of the site, the type of work, the height above ground level at which men are working, the materials being used etc. However, experience suggests that in general, conditions become critical when high gusts of wind of about 40 mph or more are blowing.

Records showing the incidence of gusts of 40 mph or more during the working part of the day are not readily available but at Turnhouse Airport, gusts of 40 mph or more first start to occur when the average wind speed reaches the level of about 20 mph and gusts to 40 mph or more become quite frequent with average speeds of 25 mph or more. Accordingly, in view of the gusty nature of the winds in Edinburgh and West Lothian, statistics showing the incidence of average wind speeds of 25 mph or more should serve as a good indication of the incidence of fairly frequent gusts to 40 mph or more.

Table 5E gives the total number of days at Turnhouse Airport on which an average wind speed of 25 mph or more was recorded between 0700 and 1700 hours Greenwich Mean Time during the 10 years from 1958 to 1967 and also the total number of hours in which average speeds of 25 mph or more were recorded between 0700 and 1700 hours GMT.

It should be borne in mind when studying Table 5E that the average wind speeds of 25 mph or more were recorded at a height of 33 feet above ground level and that considerably higher speeds could be experienced at heights in excess of 33 feet above ground level, e.g. on exposed multi-storey buildings or high up on tower cranes. For example, an hourly mean speed of 25 mph or more with gusts to 40 mph or more at a height of 33 feet above the ground would become something like an hourly mean speed of 30 mph or more with gusts to 45 mph or more at a height of 150 feet above the ground at an exposed site. When consulting Table 5E it should be noted that the figures relate to a 7-day working week and not to a 5-day working week.

TABLE 5

ANNUAL PERCENTAGE FREQUENCY OF WIND DIRECTION AND VELOCITY AT  
TURNHOUSE (EDINBURGH) AIRPORT - (10 YEARS 1957 TO 1966)

Mean Wind Speed (mph)	Wind Directions in Degrees (true)												All Directions
	350- 10	20- 40	50- 70	80- 100	110- 130	140- 160	170- 190	200- 220	230- 250	260- 280	290- 310	320- 340	
0	-	-	-	-	-	-	-	-	-	-	-	-	15.9%
1-3	0.3	0.4	0.5	0.4	0.2	0.2	0.2	0.3	0.8	0.9	0.3	0.3	4.8%
4-7	0.6	1.5	2.3	1.5	0.6	0.4	0.4	0.8	2.7	2.4	0.7	0.5	14.4%
8-12	0.7	2.0	5.2	2.6	1.1	0.6	0.7	2.2	6.5	3.6	0.9	0.8	26.9%
13-18	0.4	0.8	2.8	1.6	0.7	0.3	0.7	3.0	6.8	3.1	0.6	0.4	21.2%
19-24	0.1	0.2	0.7	0.6	0.2	0.1	0.4	2.0	4.5	2.4	0.2	0.1	11.5%
25-31	0 <sup>+</sup>	0 <sup>+</sup>	0.1	0.1	0.1	0 <sup>+</sup>	0.1	0.9	1.7	0.9	0 <sup>+</sup>	0 <sup>+</sup>	3.9%
32-38			0 <sup>+</sup>	0.3	0.4	0.3	0 <sup>+</sup>		1.0%				
39-46				0 <sup>+</sup>			0 <sup>+</sup>	0.1	0.1	0.1			0.3%
47-54							0 <sup>+</sup>	0 <sup>+</sup>	0 <sup>+</sup>	0 <sup>+</sup>			0.0 <sup>+</sup> %
55-63								0 <sup>+</sup>		0 <sup>+</sup>			0.0 <sup>+</sup> %
Total	2.1	4.9	11.6	6.8	2.9	1.6	2.5	9.6	23.5	13.7	2.7	2.1	99.9%

Notes

1. Wind directions are measured in degrees from True North and relate to the direction from which the wind is blowing. For example:

Direction 360 degrees = wind blowing from North  
 " 090 " = " " " East  
 " 180 " = " " " South  
 " 270 " = " " " West

2. Adding the columns of the above table vertically gives the percentage amount of time in the year with winds from the stated directions.
3. Adding the columns of the above table horizontally gives the percentage amount of time in the year with winds in the stated speed ranges.

TABLE 5A

MONTHLY PERCENTAGE FREQUENCIES OF WIND DIRECTION AND VELOCITY AT  
TURNHOUSE (EDINBURGH) AIRPORT  
(10 YEARS FROM 1957 TO 1966)

Mean Wind Speed (mph)	Wind Direction in Degrees (True)												All Directions
	350- 10	20- 40	50- 70	80- 100	110- 130	140- 160	170- 190	200- 220	230- 250	260- 280	290- 310	320- 340	
<u>JANUARY</u>													
Under 4	-	-	-	-	-	-	-	-	-	-	-	-	25.2%
4-12	1.5	2.6	2.8	3.2	1.8	1.2	1.1	2.5	9.2	6.9	1.6	1.2	35.6%
13-24	0.8	1.2	1.6	3.2	1.0	0.7	1.5	5.9	11.4	3.1	0.5	0.4	31.3%
25-38		0+	0.1	0.3	0+	0.1	0.4	2.1	2.8	1.2	0.1	0.1	7.2%
39 or more				0.1			0.1	0.2	0.3	0.1			0.8%
Total	2.3	3.8	4.5	6.8	2.8	2.0	3.1	10.7	23.7	11.3	2.2	1.7	100.1%
<u>FEBRUARY</u>													
Under 4	-	-	-	-	-	-	-	-	-	-	-	-	22.0%
4-12	1.3	2.3	4.0	5.1	1.7	0.8	0.7	1.8	8.4	6.2	1.8	1.7	35.8%
13-24	0.3	0.7	3.4	5.7	1.5	0.3	0.8	4.4	10.5	4.7	0.9	0.8	34.0%
25-38			0.3	0.3	0.1		0.2	2.2	2.6	1.7	0+	0+	7.4%
39 or more							0+	0.2	0.4	0.4			1.0%
Total	1.6	3.0	7.7	11.1	3.3	1.1	1.7	8.6	21.9	13.0	2.7	2.5	100.2%
<u>MARCH</u>													
Under 4	-	-	-	-	-	-	-	-	-	-	-	-	17.1%
4-12	1.2	3.4	8.7	6.1	3.2	1.5	1.5	2.3	5.7	3.6	1.3	1.2	39.7%
13-24	0.5	0.6	5.2	3.9	3.8	0.7	1.3	4.2	10.4	4.8	1.3	0.8	37.5%
25-38			0+	0.2	0.3	0+	0.1	1.0	2.3	1.3	0.1	0+	5.3%
39 or more									0.1	0+			0.1%
Total	1.7	4.0	13.9	10.2	7.3	2.2	2.9	7.5	18.5	9.7	2.7	2.0	99.7%
<u>APRIL</u>													
Under 4	-	-	-	-	-	-	-	-	-	-	-	-	16.2%
4-12	1.4	3.3	9.0	4.6	1.7	1.0	1.0	2.7	7.1	5.1	1.6	1.4	39.9%
13-24	0.5	1.0	6.0	4.4	1.0	0.6	1.2	5.4	10.2	6.4	1.0	0.4	38.1%
25-38		0+	0.2	0+	0+	0+	0.2	1.2	2.0	1.7	0+	0+	5.3%
39 or more									0.1	0+			0.1%
Total	1.9	4.3	15.2	9.0	2.7	1.6	2.4	9.3	19.4	13.2	2.6	1.8	99.6%

TABLE 5A Continued

MONTHLY PERCENTAGE FREQUENCIES OF WIND DIRECTION AND VELOCITY AT  
TURNHOUSE (EDINBURGH) AIRPORT  
 (10 YEARS FROM 1957 TO 1966)

Mean Wind Speed (mph)	Wind Direction in Degrees (True)												All Directions
	350- 10	20- 40	50- 70	80- 100	110- 130	140- 160	170- 190	200- 220	230- 250	260- 280	290- 310	320- 340	
<u>MAY</u>													
Under 4	-	-	-	-	-	-	-	-	-	-	-	-	17.0%
4-12	1.5	4.9	11.7	5.7	1.9	0.7	1.1	3.0	7.4	4.7	1.6	1.6	45.8%
13-24	0.3	1.1	6.2	1.2	0.5	0.4	1.4	5.4	8.2	6.3	1.0	0.3	32.3%
25-38					0+		0.2	1.0	2.0	1.1	0+		4.3%
39 or more								0+	0.1	0.1			0.2%
Total	1.8	6.0	17.9	6.9	2.4	1.1	2.7	9.4	17.7	12.2	2.6	1.9	99.6%
<u>JUNE</u>													
Under 4	-	-	-	-	-	-	-	-	-	-	-	-	15.9%
4-12	1.2	5.5	13.6	4.0	0.8	0.5	0.8	3.1	8.2	5.7	1.5	1.1	46.0%
13-24	0.4	1.6	4.5	0.6	0.3	0.1	0.6	4.0	12.3	8.6	0.6	0.3	33.9%
25-38			0.1				0.1	0.9	1.6	1.6			4.3%
39 or more								0.1	0+	0+			0.1%
Total	1.6	7.1	18.2	4.6	1.1	0.6	1.5	8.1	22.1	15.9	2.1	1.4	100.2%
<u>JULY</u>													
Under 4	-	-	-	-	-	-	-	-	-	-	-	-	17.7%
4-12	1.2	4.9	11.5	3.3	1.1	0.5	0.6	3.2	11.4	8.0	2.4	1.4	49.5%
13-24	0.1	0.9	4.1	0.5	0.1	0+	0.6	3.3	10.9	8.2	0.6	0.2	29.5%
25-38	0+		0+				0+	0.1	1.6	1.0	0+	0+	2.7%
39 or more									0.1				0.1%
Total	1.3	5.8	15.6	3.8	1.2	0.5	1.2	6.6	24.0	17.2	3.0	1.6	99.5%
<u>AUGUST</u>													
Under 4	-	-	-	-	-	-	-	-	-	-	-	-	19.2%
4-12	1.1	4.3	9.3	3.0	1.5	0.9	1.1	3.1	10.3	7.9	1.9	1.1	45.5%
13-24	0.3	1.1	2.9	0.4	0.2	0.3	0.7	4.4	11.8	8.4	0.5	0.4	31.4%
25-38						0+	0+	0.7	2.1	1.1			3.9%
39 or more									0.1	0+			0.1%
Total	1.4	5.4	12.2	3.4	1.7	1.2	1.8	8.2	24.3	17.4	2.4	1.5	100.1%

TABLE 5A Continued

MONTHLY PERCENTAGE FREQUENCIES OF WIND DIRECTION AND VELOCITY AT  
TURNHOUSE (EDINBURGH) AIRPORT  
(10 YEARS FROM 1957 TO 1966)

Mean Wind Speed (mph)	Wind Direction in Degrees (True)												All Directions
	350- 10	20- 40	50- 70	80- 100	110- 130	140- 160	170- 190	200- 220	230- 250	260- 280	290- 310	320- 340	
<u>SEPTEMBER</u>													
Under 4	-	-	-	-	-	-	-	-	-	-	-	-	23.4%
4-12	1.1	2.9	6.7	3.4	1.4	1.3	1.8	4.4	11.2	6.7	1.4	1.3	43.6%
13-24	0.3	0.7	2.1	0.9	0.4	0.6	1.1	5.9	11.0	5.1	0.6	0.2	28.9%
25-38		0+	0.1		0+	0+	0.1	0.8	1.6	0.9	0+		3.5%
39 or more								0.1	0.2	0.1			0.4%
Total	1.4	3.6	8.9	4.3	1.8	1.9	3.0	11.2	24.0	12.8	2.0	1.5	99.8%
<u>OCTOBER</u>													
Under 4	-	-	-	-	-	-	-	-	-	-	-	-	22.3%
4-12	1.0	2.6	6.1	4.0	1.7	1.1	1.5	3.6	10.3	4.5	1.0	1.4	38.8%
13-24	0.7	0.5	2.2	1.5	0.9	0.6	0.6	6.1	14.4	5.0	0.5	0.9	33.9%
25-38	0+	0+				0.1	0.2	1.4	2.1	0.7	0.1	0.1	4.7%
39 or more							0+	0.1	0.1	0+			0.2%
Total	1.7	3.1	8.3	5.5	2.6	1.8	2.3	11.2	26.9	10.2	1.6	2.4	99.9%
<u>NOVEMBER</u>													
Under 4	-	-	-	-	-	-	-	-	-	-	-	-	26.7%
4-12	1.4	2.7	4.1	3.9	1.7	1.3	1.8	2.9	10.3	5.9	1.6	1.7	39.3%
13-24	0.9	1.1	2.4	2.3	0.6	0.6	1.2	4.8	11.2	2.7	0.9	0.6	29.3%
25-38	0+	0.1	0.2	0.4	0+	0+	0.1	1.4	1.8	0.8	0+		4.8%
39 or more								0.1	0+	0+			0.1%
Total	2.3	3.9	6.7	6.6	2.3	1.9	3.1	9.2	23.3	9.4	2.5	2.3	100.2%
<u>DECEMBER</u>													
Under 4	-	-	-	-	-	-	-	-	-	-	-	-	25.9%
4-12	1.3	2.2	2.2	2.9	1.4	1.0	1.3	3.5	10.9	6.5	1.7	1.0	35.9%
13-24	0.3	0.7	1.7	2.3	0.8	0.4	1.4	6.3	12.6	3.1	0.8	0.5	30.9%
25-38			0.1	0.3	0.1	0+	0.2	1.7	3.1	1.4	0+	0+	6.9%
39 or more							0+	0.2	0.2	0.1			0.5%
Total	1.6	2.9	4.0	5.5	2.3	1.4	2.9	11.7	26.8	11.1	2.5	1.5	100.1%

TABLE 5B

ACTUAL AND AVERAGE NUMBER OF DAYS WITH GALES DURING THE 19 YEARS FROM  
1949 TO 1967 AT TURNHOUSE (EDINBURGH) AIRPORT

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year Total
1949	6	4	2	2	0	1	0	1	0	1	0	1	18
1950	0	2	0	0	1	0	0	0	1	2	1	0	7
1951	0	1	0	2	0	0	0	0	0	0	0	4	7
1952	3	1	0	0	0	0	0	1	2	3	0	1	11
1953	3	1	0	2	0	0	0	0	1	0	1	0	8
1954	6	2	0	0	0	0	0	0	0	2	6	7	23
1955	1	2	1	0	1	1	0	0	0	0	0	6	12
1956	3	0	2	0	0	1	0	1	1	0	2	4	14
1957	8	2	1	1	0	0	0	1	1	2	1	3	20
1958	2	2	1	0	2	0	0	0	1	1	0	1	10
1959	1	4	0	0	0	1	0	0	0	0	2	3	11
1960	0	2	0	2	0	1	0	0	0	0	1	1	7
1961	2	3	2	0	0	1	1	1	2	1	0	0	13
1962	5	4	0	1	2	1	0	1	0	0	0	3	17
1963	1	0	2	1	0	0	0	0	1	2	1	1	9
1964	1	2	0	0	2	0	1	0	0	0	0	3	9
1965	1	2	0	1	1	1	0	0	0	1	1	1	9
1966	0	0	2	0	0	1	0	0	1	0	1	1	6
1967	0	4	6	1	0	0	0	0	0	0	0	0	11
19 years average	2	2	1	1	< 1	< 1	< 1	< 1	1	1	1	2	12

TABLE 5C

NUMBER OF DAYS AND HOURS WITH GUSTS OF 39 MPH OR MORE  
AT WIND RECORDING STATIONS IN EDINBURGH\*  
(10 YEARS FROM 1958 TO 1967)

<u>Year</u>		<u>Jan.</u>	<u>Feb.</u>	<u>Mar.</u>	<u>Apr.</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sep.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>	<u>Year</u> <u>Total</u>
1958	Days	7	6	2	2	4	1	0	2	2	9	1	4	40
	Hours	33	18	10	3	19	1	0	6	18	27	6	33	174
1959	Days	4	11	6	10	1	7	4	5	1	8	12	15	84
	Hours	19	118	15	42	5	64	17	25	4	50	63	114	536
1960	Days	7	14	2	6	2	5	0	0	0	2	6	12	56
	Hours	47	57	8	63	7	23	0	0	0	2	35	77	319
1961	Days	8	16	17	1	3	9	5	7	5	13	6	7	97
	Hours	75	129	103	3	39	42	41	48	34	106	30	12	662
1962	Days	16	15	3	5	4	9	2	14	4	9	4	12	97
	Hours	126	140	7	37	43	60	5	89	26	51	7	81	672
1963	Days	5	3	9	6	9	2	0	2	10	10	7	6	69
	Hours	26	17	49	40	61	5	0	4	53	62	62	40	419
1964	Days	10	6	5	10	12	7	10	5	12	3	13	12	105
	Hours	58	45	23	52	89	23	96	26	35	11	87	84	629
1965	Days	14	4	6	7	3	9	1	5	4	5	7	8	73
	Hours	72	31	32	39	23	61	1	27	17	57	50	15	425
1966	Days	9	10	13	3	5	2	1	1	8	2	7	11	72
	Hours	38	55	61	12	29	10	4	9	45	3	47	86	399
1967	Days	5	12	26	10	3	6	4	2	3	15	5	6	97
	Hours	16	126	292	83	13	33	11	4	16	81	32	40	747
10-year means	Days	8.5	9.7	8.9	6.0	4.6	5.7	2.7	4.3	4.9	7.6	6.8	9.3	79.0
	Hours	51.0	73.6	60.0	37.4	32.8	32.2	17.5	23.8	24.8	45.0	41.9	58.2	498.2

\*1958 to 1961 - Royal Observatory, Blackford Hill  
 1962 to 1967 - Turnhouse Airport

TABLE 5D

NUMBER OF DAYS AND HOURS WITH GUSTS OF 55 MPH OR MORE AT WIND  
RECORDING STATIONS IN EDINBURGH\*  
(10 YEARS FROM 1958 TO 1967)

<u>Year</u>		<u>Jan.</u>	<u>Feb.</u>	<u>Mar.</u>	<u>Apr.</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sep.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>	<u>Year</u> <u>Total</u>
1958	Days	3	0	0	0	0	0	0	0	1	2	1	1	8
	Hours	7	0	0	0	0	0	0	0	1	2	2	1	13
1959	Days	1	6	0	2	0	1	0	0	0	2	5	4	21
	Hours	5	12	0	2	0	1	0	0	0	2	13	24	59
1960	Days	1	2	0	3	0	1	0	0	4	0	2	3	16
	Hours	2	9	0	26	0	2	0	0	5	0	5	3	52
1961	Days	4	6	3	0	1	1	2	1	2	2	2	1	25
	Hours	13	13	10	0	4	1	4	5	12	10	2	1	75
1962	Days	7	6	0	1	2	1	0	1	1	2	0	3	24
	Hours	27	48	0	1	17	12	0	6	2	3	0	14	130
1963	Days	1	0	3	1	2	0	0	0	1	4	3	0	15
	Hours	7	0	9	1	3	0	0	0	7	7	6	0	40
1964	Days	1	3	1	1	3	0	2	1	0	0	3	6	21
	Hours	3	7	1	1	9	0	5	2	0	0	6	14	48
1965	Days	5	2	1	1	1	3	0	1	0	2	1	1	18
	Hours	7	9	2	1	2	4	0	1	0	4	6	1	37
1966	Days	1	2	3	1	1	1	0	1	1	0	2	4	17
	Hours	1	3	7	2	1	3	0	1	14	0	5	14	51
1967	Days	0	3	14	4	0	0	0	0	0	2	2	1	26
	Hours	0	16	52	10	0	0	0	0	0	5	2	2	87
10-year means	Days	2.4	3.0	2.5	1.4	1.0	0.8	0.4	0.5	1.0	1.6	2.1	2.4	19.1
	Hours	7.2	11.7	8.1	4.4	3.6	2.3	0.9	1.5	4.1	3.3	4.7	7.4	59.2

\*1958 to 1961 - Royal Observatory, Blackford Hill  
1962 to 1967 - Turnhouse Airport.

TABLE 5E

NUMBER OF DAYS ON WHICH THE AVERAGE WIND SPEED REACHED 25 MPH OR MORE  
BETWEEN 0700 HOURS AND 1700 HOURS GREENWICH MEAN TIME AT  
TURNHOUSE (EDINBURGH) AIRPORT  
(10 years 1958 to 1967)

<u>Year</u>	<u>Jan.</u>	<u>Feb.</u>	<u>Mar.</u>	<u>Apr.</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sep.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>	<u>Year</u> <u>Total</u>
	<u>Number of Days</u>												
1958	8	11	3	11	7	0	1	4	1	7	1	5	59
1959	2	9	8	11	1	9	7	5	0	6	6	7	71
1960	5	7	4	7	2	8	2	2	2	1	4	6	50
1961	6	12	18	1	7	9	5	12	6	8	1	1	86
1962	13	13	2	6	3	7	2	12	4	6	2	8	78
1963	4	3	6	9	9	3	2	3	9	8	5	6	67
1964	8	4	5	8	10	6	10	6	8	2	8	5	80
1965	6	3	5	7	3	6	1	5	3	3	4	2	48
1966	2	5	11	2	3	1	3	1	5	1	5	6	45
1967	3	10	22	9	1	4	3	1	4	9	4	3	73
10-year mean	5.7	7.7	8.4	7.1	4.6	5.3	3.6	5.1	4.2	5.1	4.0	4.9	65.7

NUMBER OF HOURS BETWEEN 0700 HOURS AND 1700 HOURS GREENWICH MEAN TIME  
DURING WHICH THE AVERAGE WIND SPEED REACHED 25 MPH OR MORE AT  
TURNHOUSE (EDINBURGH) AIRPORT  
(10 years 1958 to 1967)

<u>Year</u>	<u>Jan.</u>	<u>Feb.</u>	<u>Mar.</u>	<u>Apr.</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sep.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>	<u>Year</u> <u>Total</u>
	<u>Number of Hours</u>												
1958	33	27	15	42	44	0	2	9	8	22	1	11	214
1959	6	53	19	40	2	39	26	29	0	17	18	33	282
1960	18	27	14	36	6	24	2	3	5	1	12	16	164
1961	23	37	67	3	23	35	27	34	22	31	2	4	308
1962	52	65	4	28	22	23	7	52	14	18	4	35	324
1963	15	13	17	30	31	7	3	3	31	32	25	23	230
1964	23	26	19	37	49	22	55	23	28	6	27	15	330
1965	20	16	15	23	16	25	2	14	11	13	26	8	189
1966	16	15	46	6	14	5	5	3	15	1	17	34	177
1967	5	61	120	42	8	13	6	1	14	32	14	13	329
10-year mean	21.1	34.0	33.6	28.7	21.5	19.3	13.5	17.1	14.8	17.3	14.6	19.2	254.7
10-year mean expressed as percentage of total working time	7%	12%	11%	10%	7%	6%	4%	6%	5%	6%	5%	6%	7%

6. FOG

On the whole, most of the eastern side of Scotland experiences very good visibility and its remoteness from the industrial and populous areas of Great Britain and their smoke-soiled air means that smoke fogs are relatively unknown except in the immediate surroundings of Edinburgh, Dundee and Aberdeen. Although thick fogs (visibility less than 220 yards) are likely to occur in West Lothian on about 20 days per year, the persistence of thick fog for more than a few hours is a fairly rare event especially when West Lothian is compared say with Glasgow, London or the Midlands of England.

No visibility records are available for West Lothian but the records from Turnhouse Airport, which like West Lothian lies to the west (i.e. mainly to the windward) of Edinburgh, are likely to be broadly representative of most of West Lothian although the Dalmeny/Forth Road Bridge area and the adjacent coastal strip of West Lothian may suffer rather more than Turnhouse from the incidence of North Sea fogs (haars). These North Sea fogs occur from time to time during the period from April to September and are perhaps the most unpleasant type of fog in that they often ruin potentially brilliantly fine days during the spring and summer. The basic cause of these fogs is the moistening and cooling of warm air from the Continent by the cold waters of the North Sea and the Firth of Forth. Haars are especially prevalent during the spring and summer following a particularly cold winter when the sea temperature of the coastal waters is well below average. The haar is normally fairly shallow. When it occurs at ground level in the lower parts of West Lothian near the Forth coast line, the higher districts may be in sunshine above it. Frequently by the time it has reached West Lothian, the haar has lifted into an unbroken layer of low stratus cloud, obscuring the higher ground and buildings but with reasonably good visibility beneath it. Where it reaches the ground, visibilities of less than 25 yards are not unknown. Occasionally, the haar may have sufficient depth to give rise to drizzle, particularly when it encounters rising ground. During daylight hours, the sun's heat tends to "burn

off" the haar. The thinner haars may disappear with dramatic suddenness leaving a cloudless sky but they are likely to reform again towards sunset. The deeper haars may persist all day, a frustrating situation which is not helped by the knowledge that places a few miles further inland or further west are enjoying glorious sunshine.

The higher hills or a long land track tend to break up the haar, and areas to the west of the county, particularly those which are sheltered from the east by the Pentlands, suffer less from haar than do the eastern parts of the county or those parts with no high ground to the east of them.

The areas most prone to winter fogs are the lower lying more densely built up areas of West Lothian particularly those near the Forth. Thick fogs during the winter half year are usually associated with calm or light easterly winds but light westerly winds sometimes thicken the fogs with industrial and domestic smoke from Glasgow, Falkirk and Grangemouth and other places in the Forth-Clyde valley. There are a few occasions in most winters when low cloud reduces visibility on the roads traversing the high ground in West Lothian but visibility on these occasions is seldom bad enough to impede seriously the flow of traffic.

In the summer half year, thick fogs are nearly always associated with light easterly winds which bring the troublesome haar from the Firth of Forth.

Percentage Frequencies of Occurrence of Visibilities less than 1,100 yards and 220 yards according to month and hour are given for Turnhouse Airport in Tables 6 and 6A.

The variations of poor visibilities with wind directions are shown in Table 6B.

The number of days and hours with "Fog", "Thick Fog" and "Dense Fog" are given for Turnhouse Airport in Tables 6C and 6D.

TABLE 6  
PERCENTAGE FREQUENCY OF OCCURRENCE OF VISIBILITIES LESS THAN  
1,100 YARDS ACCORDING TO MONTH AND HOUR  
AT TURNHOUSE (EDINBURGH) AIRPORT  
(10 YEARS 1957 TO 1966\*)

Time - G.M.T.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
	%	%	%	%	%	%	%	%	%	%	%	%	%
00h. midnight	5.2	3.9	1.3	2.3	3.5	5.3	2.3	2.3	3.0	5.2	4.7	4.5	3.6
01h.	4.8	4.3	1.3	2.7	2.3	7.0	2.6	2.3	2.7	5.8	4.7	4.2	3.7
02h.	3.5	5.0	1.9	3.3	3.2	8.3	3.2	1.9	2.3	8.1	4.3	4.2	4.1
03h.	3.5	5.3	1.9	3.0	3.5	9.0	4.2	2.6	3.3	8.1	4.0	3.9	4.4
04h.	3.9	6.0	2.3	3.7	5.2	10.7	3.9	3.2	3.3	7.7	4.0	2.9	4.7
05h.	3.2	4.6	3.2	2.7	4.5	8.0	2.9	3.2	5.7	9.0	3.3	3.2	4.5
06h.	2.3	4.6	2.9	3.0	2.6	6.3	2.6	2.3	5.3	7.4	3.3	3.5	3.8
07h.	3.2	4.6	4.5	4.3	1.6	5.3	1.9	1.6	4.7	9.0	4.0	2.9	4.0
08h.	2.6	4.6	2.9	2.3	1.3	3.3	0.6	0.6	4.0	7.4	6.3	3.5	3.3
09h.	3.9	6.0	1.9	0.7	0.3	3.3	1.3	1.0	1.3	4.2	6.7	4.8	2.9
10h.	3.9	6.4	1.3	0.7	0.3	1.3	0.6	0.3	0.7	3.5	6.3	4.5	2.5
11h.	3.2	6.0	1.3	1.0	0.6	1.0	0.3	0.3	0.3	2.3	4.7	4.5	2.1
12h. noon	5.2	4.6	0.3	1.3	0.0	0.7	0.3	0.0	0.3	1.9	3.7	5.8	2.0
13h.	3.2	3.9	0.3	1.0	0.3	0.7	0.0	0.0	0.3	1.6	2.7	7.1	1.8
14h.	2.6	3.2	0.0	0.7	0.0	0.0	0.3	0.3	0.0	1.3	3.7	6.1	1.5
15h.	2.6	1.8	0.0	1.0	0.0	0.3	0.3	0.0	0.0	1.9	4.3	7.7	1.7
16h.	4.5	2.5	0.3	0.7	0.6	1.0	0.6	0.0	0.3	1.9	4.7	8.4	2.1
17h.	5.8	3.5	1.3	0.7	0.6	1.7	1.3	0.3	0.3	1.9	5.7	7.4	2.5
18h.	3.5	3.2	1.9	0.7	0.3	2.0	1.6	0.6	1.3	2.6	6.0	6.1	2.5
19h.	3.5	2.8	1.6	1.3	0.6	2.3	1.3	0.6	1.3	2.3	5.3	5.8	2.4
20h.	2.9	3.2	0.3	1.3	1.9	4.0	1.0	0.0	1.0	3.2	5.0	6.1	2.5
21h.	2.6	3.2	0.6	1.0	2.3	3.7	1.3	0.3	2.0	4.2	5.3	4.8	2.6
22h.	4.5	4.3	1.9	1.0	2.6	5.3	1.0	0.6	2.0	4.8	6.3	4.5	3.2
23h.	3.9	3.9	1.6	1.3	3.5	5.0	0.3	1.0	2.3	6.8	6.3	4.5	3.4

Percentage Amount of Total Time in Each Month with  
 Visibilities less than 1,100 yards at  
TURNHOUSE (EDINBURGH) AIRPORT

%	%	%	%	%	%	%	%	%	%	%	%	%	%
3.7	4.2	1.5	1.7	1.7	4.0	1.5	1.1	2.0	4.7	4.8	5.0	3.0	

\*Note: The above frequencies have been calculated from observations of visibility made at each hour on the hour during the 10 year period from 1957 to 1966.

/TABLE 6A

TABLE 6A  
PERCENTAGE FREQUENCY OF OCCURRENCE OF VISIBILITIES LESS THAN  
220 YARDS ACCORDING TO MONTH AND HOUR  
AT TURNHOUSE (EDINBURGH) AIRPORT  
 (10 YEARS 1957 TO 1966\*)

Time - G.M.T.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
	%	%	%	%	%	%	%	%	%	%	%	%	%
00h. midnight	1.3	1.1	0.0	1.3	0.0	0.7	0.0	0.3	1.0	2.3	1.0	2.3	0.9
01h.	1.6	1.1	0.0	1.3	0.3	0.7	1.0	0.3	1.3	2.3	1.3	2.6	1.1
02h.	1.3	2.5	0.6	1.7	0.0	2.3	0.6	0.3	1.3	2.3	1.0	1.6	1.3
03h.	1.6	2.8	1.3	1.7	0.3	2.9	0.3	0.3	1.3	3.2	0.7	1.0	1.5
04h.	1.3	1.4	0.6	0.7	1.0	2.3	0.3	0.3	1.0	3.2	1.0	1.6	1.2
05h.	1.0	1.4	0.6	1.3	0.6	1.3	0.0	0.3	2.0	2.6	1.3	1.6	1.2
06h.	0.3	1.8	1.3	1.0	0.3	1.3	0.0	0.0	3.3	2.9	0.7	2.6	1.3
07h.	1.0	2.8	1.0	1.0	0.0	0.3	0.0	0.3	2.0	3.9	1.0	2.6	1.3
08h.	0.6	3.2	1.0	0.7	0.0	0.0	0.0	0.3	0.3	4.2	1.7	2.3	1.2
09h.	1.3	1.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	1.7	3.5	0.9
10h.	1.6	2.1	0.3	0.0	0.0	0.0	0.0	0.3	0.0	0.6	1.7	2.9	0.8
11h.	1.0	2.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.3	2.6	0.7
12h. noon	0.6	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	2.6	0.5
13h.	0.3	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.9	0.4
14h.	0.6	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.9	0.4
15h.	0.6	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.5	0.6
16h.	1.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	3.2	0.6
17h.	1.0	1.1	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.3	3.0	2.9	0.7
18h.	1.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.3	2.9	0.8
19h.	1.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	2.7	2.9	0.7
20h.	1.3	1.1	0.0	0.3	0.0	0.3	0.6	0.0	0.3	1.0	3.0	2.9	0.9
21h.	0.6	1.1	0.0	0.3	0.3	0.7	0.3	0.0	0.3	1.6	2.7	2.3	0.9
22h.	0.6	1.4	0.0	0.3	0.3	1.0	0.0	0.0	0.3	1.3	3.0	1.6	0.8
23h.	1.6	1.1	0.0	0.7	0.3	1.3	0.0	0.0	1.0	2.3	2.0	1.9	1.0

Percentage Amount of Total Time in Each Month with  
 Visibilities less than 220 yards at  
TURNHOUSE (EDINBURGH) AIRPORT

%	%	%	%	%	%	%	%	%	%	%	%	%	%
1.0	1.5	0.3	0.5	0.1	0.6	0.1	0.1	0.6	1.6	1.8	2.5	0.9	

\*Note: The above frequencies have been calculated from observations of visibility made at each hour on the hour during the 10 year period from 1957 to 1966.

/TABLE 6B

TABLE 6B

VISIBILITY AT TURNHOUSE (EDINBURGH) AIRPORT DURING THE WINTER HALF-YEAR  
(OCTOBER TO MARCH) AND THE SUMMER HALF-YEAR (APRIL-SEPTEMBER),  
ACCORDING TO WIND DIRECTION\*

Wind Direction	Winter Half-Year % probability			Summer Half-Year % probability		
	Visibility less than 440 yards	Visibility less than 1100 yards	Visibility less than 2200 yards	Visibility less than 440 yards	Visibility less than 1100 yards	Visibility less than 2200 yards
(degrees)	%	%	%	%	%	%
350-010	0.2	0.7	3.1	0.0	0.3	1.7
020-040	0.8	3.2	8.3	0.8	1.9	6.2
050-070	0.6	2.2	7.2	2.3	7.2	14.4
080-100	0.2	0.8	2.8	1.3	5.1	9.9
110-130	0.6	1.0	2.1	0.0	0.0	0.6
140-160	1.1	1.8	3.2	0.4	0.4	0.8
170-190	0.3	0.9	1.6	0.0	0.0	0.0
200-220	0.2	0.6	0.8	0.1	0.2	0.2
230-250	0.4	0.6	1.3	0.1	0.1	0.2
260-280	0.7	1.2	3.2	0.0	0.2	0.4
290-310	1.0	1.5	2.0	0.2	0.2	0.7
320-340	0.2	0.4	3.0	0.0	0.0	0.0
Calms	7.1	13.2	26.2	4.6	8.0	12.6

\*Calculated from hourly observations during the 5 years, 1963 to 1967.

/TABLE 6C

TABLE 6C

NUMBER OF DAYS WITH "FOG", "THICK FOG" AND "DENSE FOG" AT ANY TIME OF DAY\*  
 AT TURNHOUSE (EDINBURGH) AIRPORT  
 (10 years from 1958 to 1967)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year Total
<u>Number of Days with "Fog" - Visibility less than 1,100 yards</u>													
1958	6	5	2	2	2	10	6	3	8	2	12	6	64
1959	13	10	3	1	5	5	1	1	6	10	3	5	63
1960	5	11	4	1	3	3	1	7	3	9	12	10	69
1961	7	4	1	6	2	0	2	0	1	5	7	14	49
1962	6	2	5	3	0	0	3	0	5	7	5	6	42
1963	5	6	4	3	0	10	6	1	1	5	6	2	49
1964	9	2	6	6	9	4	2	3	4	10	7	3	65
1965	3	1	7	2	3	6	5	6	5	11	5	6	60
1966	8	7	0	3	4	11	1	1	5	5	1	2	48
1967	2	2	1	1	2	7	2	1	8	1	6	0	33
10-year mean	6.4	5.0	3.3	2.8	3.0	5.6	2.9	2.3	4.6	6.5	6.4	5.4	54.2
<u>Number of Days with "Thick Fog" - Visibility less than 220 yards</u>													
1958	0	0	1	1	1	6	1	1	4	1	6	2	24
1959	3	8	0	0	2	1	0	0	3	6	3	0	26
1960	1	3	1	0	1	1	1	3	0	5	5	6	27
1961	1	2	0	3	1	0	0	0	0	1	4	7	19
1962	4	0	1	2	0	0	0	0	2	3	0	2	14
1963	1	3	2	0	0	3	0	0	0	3	3	2	17
1964	3	1	1	3	2	2	1	0	4	5	6	1	29
1965	3	0	1	1	1	1	0	3	1	9	3	4	27
1966	5	3	0	0	0	6	1	0	2	2	0	0	19
1967	1	1	0	0	1	4	0	1	5	0	4	0	17
10-year mean	2.2	2.1	0.7	1.0	0.9	2.4	0.4	0.8	2.1	3.5	3.4	2.4	21.9
<u>Number of Days with "Dense Fog" - Visibility less than 55 yards</u>													
1958	0	0	0	0	0	0	0	0	1	0	1	1	3
1959	0	2	0	0	1	0	0	0	3	1	0	0	7
1960	0	1	0	0	0	1	0	0	0	2	2	4	10
1961	0	0	0	1	0	0	0	0	0	0	2	2	5
1962	1	0	1	0	0	0	0	0	0	0	0	0	2
1963	0	0	1	0	0	0	0	0	0	0	0	1	2
1964	0	0	0	1	0	0	0	0	0	0	2	0	3
1965	0	0	0	0	0	1	0	0	0	5	1	0	7
1966	1	0	0	0	0	0	0	0	0	0	0	0	1
1967	0	0	0	0	0	0	0	1	1	0	0	0	2
10-year mean	0.2	0.3	0.2	0.2	0.1	0.2	0.0	0.1	0.5	0.8	0.8	0.8	4.2

\*Calculated from hourly observations of visibility made at each hour on the hour.

TABLE 6D

NUMBER OF HOURS\* WITH "FOG", "THICK FOG" AND "DENSE FOG"  
 AT TURNHOUSE (EDINBURGH) AIRPORT  
 (10 years 1958 to 1967)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year Total
<u>Number of Hours with "Fog" - Visibility less than 1,100 yards</u>													
1958	10	19	5	7	10	55	28	17	34	5	60	40	290
1959	47	121	16	1	9	20	1	2	17	56	19	22	331
1960	22	59	13	4	6	12	5	16	8	32	71	125	373
1961	25	13	1	36	6	0	4	0	1	15	58	98	257
1962	50	4	17	22	0	0	9	0	19	57	13	27	218
1963	19	24	18	4	0	69	29	1	2	53	35	19	273
1964	43	11	24	36	63	11	12	9	41	43	67	8	368
1965	14	7	12	4	13	23	12	18	9	91	34	29	266
1966	42	28	0	8	10	90	6	1	12	13	1	2	213
1967	9	6	1	1	3	28	4	5	58	2	46	0	163
10-year mean	28.1	29.2	10.7	12.3	12.0	30.8	11.0	6.9	20.1	36.7	40.4	37.0	275.2
<u>Number of Hours with "Thick Fog" - Visibility less than 220 yards</u>													
1958	0	0	1	4	1	17	1	2	14	3	16	21	80
1959	9	72	0	0	3	1	0	0	10	26	11	0	132
1960	2	13	6	0	1	2	1	7	0	10	22	97	161
1961	4	2	0	8	0	0	0	0	0	1	27	31	73
1962	35	0	1	10	0	0	0	0	3	19	0	12	80
1963	3	8	7	0	0	13	0	0	0	24	12	18	85
1964	9	4	7	14	4	3	2	0	23	12	45	1	124
1965	3	0	1	1	2	4	0	5	1	35	12	7	71
1966	21	9	0	0	0	19	4	0	3	2	0	0	58
1967	1	3	0	0	2	9	0	3	35	0	18	0	71
10-year mean	8.7	11.1	2.3	3.7	1.3	6.8	0.8	1.7	8.9	13.2	16.3	18.7	93.5
<u>Number of Hours with "Dense Fog" - Visibility less than 55 yards</u>													
1958	0	0	0	0	0	0	0	0	1	0	2	1	4
1959	0	11	0	0	1	0	0	0	5	3	0	0	20
1960	0	4	0	0	0	1	0	0	0	3	2	19	29
1961	0	0	0	2	0	0	0	0	0	0	6	4	12
1962	2	0	1	0	0	0	0	0	0	0	0	0	3
1963	0	0	1	0	0	0	0	0	0	0	0	2	3
1964	0	0	0	1	0	0	0	0	0	0	25	0	26
1965	0	0	0	0	0	1	0	0	0	10	1	0	12
1966	2	0	0	0	0	0	0	0	0	0	0	0	2
1967	0	0	0	0	0	0	0	1	1	0	0	0	2
10-year mean	0.4	1.5	0.2	0.3	0.1	0.2	0.0	0.1	0.7	1.6	3.6	2.6	11.3

\*Calculated from hourly observations of visibility made at each hour on the hour.

/In

## 7. SNOW

In West Lothian, as elsewhere in the British Isles, the incidence of snow falling and the persistence of snow cover are two of the most variable of all the meteorological elements. For example, in the severe winter of 1962/63 there were 39 mornings with snow lying on the ground at Turnhouse Airport compared with only 2 mornings during the following winter of 1963/64.

At Turnhouse Airport there are, on average, about 30 days per year with snow or sleet falling. The highest number of days in a year during the 19 years from 1949 to 1967 with snow or sleet falling is 46 days during 1965 and the lowest number of days in a year is 11 days during 1953. Most of the days with snowfall occur in December, January, February and March but snow can fall on low ground in West Lothian as late as May or as early as October, although snow falling in May or October seldom lies on the ground for any length of time.

Up to heights of about 200 feet, there is not much variation from place to place in the incidence of snowfall and the Turnhouse Airport figures of the number of days of snow or sleet falling can be taken as reasonably representative of the lower lying parts of West Lothian. The Meteorological Office at Turnhouse Airport is the only weather station in the Lothians keeping a 24 hour watch on the weather and is therefore the only weather station for which complete records of snow falling at any time of the day or night are available. However, the number of days with snow falling increases fairly rapidly with the height above sea level and as a good approximate rule, there is one day more per year with snow falling in West Lothian for each 50 feet of elevation above 200 feet.

Whether snow will lie, after it has fallen, in sufficient depth to cause difficulty to transport, depends on a number of complex factors but a greater height above sea level and a north or east facing aspect of the surface will certainly increase the number of days with snow lying. As most of the slopes in West Lothian face north or east, the persistence of snow cover can be a nuisance particularly over the high ground. No systematic records are available but after a fall of snow in West Lothian, the variation in snow cover and depth between the

lower lying parts of the county near the Forth and over the higher parts of the county is often quite remarkable.

During a severe winter with snow lying on the ground, the partial thaws during the daytime do little to clear the roads traversing the higher ground in the county where the snow becomes compacted and even more treacherous to road users especially at night when the compacted snow or wet parts of the road have an icy surface. There is the further point that the daily expansion and contraction caused by the freezing and thawing processes plays havoc with the tarmacadam road surfaces which often need extensive repairs after a severe winter. Because of its ability to penetrate into the snow, rain is a good thawing agent but it should be remembered that precipitation falling in temperatures up to about 36 degrees Fahrenheit will almost certainly fall as snow.

It should be mentioned that in the Meteorological Office, a 'day with snow lying' is counted only when half or more of the ground surrounding the weather station is covered with snow and the snow depth is only measured on these occasions. The depths of snow measured daily at 9 a.m. relate to the uniform "undrifted" depth. The criterion "half or more than half the ground covered" is difficult to apply at stations where the view is restricted and small depths of snow may accumulate to cover more than half the ground locally in a sheltered site when it would not do so at an open airfield. This may well account for the occasional considerable differences between Turnhouse Airport and the Royal Botanic Garden, Edinburgh (see Table 7A) particularly in the smaller depths where general considerations would lead one to expect similar figures at both places.

The Actual and Average Number of Days with Snow or Sleet Falling at Turnhouse Airport are given in Table 7.

The Number of Mornings per Winter with Snow Lying at Specified Depths are given in Table 7A for the Royal Botanic Garden, Edinburgh, Turnhouse Airport and Carnwath, Lanarkshire. These figures should give a reasonably reliable guide to the variation of snow cover and depths between places at similar elevations in West Lothian.

Monthly Frequencies of Snow Depths are given in Table 7B for the Royal Botanic Garden, Edinburgh and for Carnwath.

TABLE 7

ACTUAL AND AVERAGE NUMBER OF DAYS WITH SNOW OR SLEET FALLING  
AT TURNHOUSE (EDINBURGH) AIRPORT - 19 YEARS FROM 1949 TO 1967

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year Total
1949	2	2	4	1							1	5	15
1950	3	5	2	3	1						3	9	26
1951	8	8	10	7								5	38
1952	13	3	5								3	10	34
1953	2	7	0	1								1	11
1954	5	7	3	1	1						2	3	22
1955	7	14	8	0	3					1	0	6	39
1956	8	14	4	1	1						3	4	35
1957	7	7	1								1	4	20
1958	9	8	13	2								7	39
1959	7	1	1							1	2	1	13
1960	9	10	2									2	23
1961	5	4	2	1							3	10	25
1962	3	8	6	4							2	9	32
1963	17	16	0	1							4	5	43
1964	3	6	6	1	1						1	8	26
1965	11	4	12	1	1						12	5	46
1966	9	12	4	10							2	7	44
1967	6	4	9	1	2					1	1	7	31
19 year average	7	7	5	2	1	0	0	0	0	< 1	2	6	30

/TABLE 7A

TABLE 7A

NUMBER OF DAYS WITH SNOW LYING AT 0900 HOURS GMT AT  
DEPTHS BETWEEN SPECIFIED LIMITS

TURNHOUSE AIRPORT - Altitude 114 feet								Maximum Depth = 6 inches	
Depth - Inches	0-1	2	3-4	5-6	7-8	9-12	13-16	Over 16	Total
Winter of:									
1956-57	4								4
1957-58	11	1	1	2					15
1958-59	10	1							11
1959-60	1	4	6	2					13
1960-61	1	1							2
1961-62	7	2	4						13
1962-63	17	11	6	5					39
1963-64	1	1							2
1964-65	7	8	3						18
1965-66	20	3	1						24
1966-67	5	1							6
1967-68	11	2							13
Total	95	35	21	9					160
% Total	59	22	13	6					100%
ROYAL BOTANIC GARDEN - Altitude 74 feet								Maximum Depth = 9 inches	
Winter of:									
1949-50	2								2
1950-51	14	4	3						21
1951-52	20	3	4						27
1952-53	5								5
1953-54	6								6
1954-55	8	4	15		4	2			33
1955-56	18		5						23
1956-57	1								1
1957-58	18		2						20
1958-59	11								11
1959-60	14	2	3						19
1960-61	2	1							3
1961-62	15		1						16
1962-63	34	14	8						56
1963-64	1								1
1964-65	12	6	4						22
1965-66	21	1							22
1966-67	4		1						5
1967-68	10	1							11
Total	216	36	46	0	4	2			304
% Total	71	12	15	0	1	1			100%

/(contd.)

TABLE 7A (Contd.)

NUMBER OF DAYS WITH SNOW LYING AT 0900 HOURS GMT AT  
DEPTHS BETWEEN SPECIFIED LIMITS

CARNWATH - Altitude 706 feet		Maximum Depth = 12 inches							
Depth - Inches	0-1	2	3-4	5-6	7-8	9-12	13-16	Over 16	Total
Winter of:									
1953-54	16	1	1						18
1954-55	31	4	11						46
1955-56	33	3	2						38
1956-57	12								12
1957-58	16	6	4						26
1958-59	24	4							28
1959-60	11	5	1	5	1				23
1960-61	8								8
1961-62	26	6	2						34
1962-63	13	13	40	19					85
1963-64	13		1						14
1964-65	15	14	4		1	1			35
1965-66	18	4	6	1					29
1966-67	14	1			1	1			17
1967-68	30	15	6	1					52
Total	280	76	78	26	3	2			465
% Total	60	16	17	6	1	< 1			100%

TABLE 7B

ROYAL BOTANIC GARDEN - Altitude 74 feet

Monthly Frequencies for Each Year during the Eighteen Years from 1950 to 1967 of Days with Snow Lying at 0900 hours GMT. at Depths between the Specified Limits

DEPTH : Inches	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	Total
<b>NOVEMBER</b>																			
0-1													1			6			7
2																1			1
3-4																			0
5-6																			0
7-8																			0
9-12																			0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	7	0	0	8
<b>DECEMBER</b>																			
0-1	5	1	3			4	1					10	2		3	4	2	2	37
2	2											1	2						4
3-4					1								2						5
5-6	2												1						0
7-8																			0
9-12																			0
TOTAL	9	1	3	0	1	4	1	0	0	0	0	11	5	0	3	4	2	2	46
<b>JANUARY</b>																			
0-1	2	8	15	1	3	2	3		8	11	3	1	4	23		2	3	2	91
2		1	3			2					1			1					8
3-4		1	4			2													19
5-6		1				10										3			0
7-8																			0
9-12																			0
TOTAL	2	10	22	1	3	14	3	0	8	11	4	1	4	25	0	5	3	2	118

/FEBRUARY

TABLE 7B (contd.)

DEPTH : Inches	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	Total
<b>FEBRUARY</b>																			
0-1		1	3	1	3	3	11		5		10	1	1	8	1	1	7		56
2						1					1	1		11					18
3-4						4	5		2		3			6		4		1	21
5-6																			0
7-8						4													4
9-12						2													2
<b>TOTAL</b>	0	1	3	1	3	14	16	0	7	0	14	2	1	25	1	5	7	1	101
<b>MARCH</b>																			
0-1		1	1			3			5		1					6			16
2						1										2			4
3-4																1			1
5-6																			0
7-8																			0
9-12																			0
<b>TOTAL</b>	0	1	1	0	0	4	0	0	5	0	1	0	0	0	0	9	0	0	21
<b>APRIL - ALL DEPTHS</b>																			
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1*	0	1

\*Depth = 0-1 inches.

TABLE 7B (contd.)  
 CARNWATH - Altitude 706 feet  
 Monthly Frequencies for Each Year During the Fifteen Years from 1953 to 1967 of Days  
 with Snow Lying at 9 a.m. at Depths Between the Specified Limits

DEPTH : Inches	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	Total
<b>NOVEMBER</b>																
0-1				2	1		1		2	2	3	1	4	3		19
2										6			2			2
3-4													3			9
5-6													1			1
7-8																
9-12																
<b>TOTAL</b>	0	0	0	2	1	0	1	0	2	8	3	1	10	3	0	31
<b>DECEMBER</b>																
0-1		4	8	3		5		1	7	9	5	4	4	2	6	58
2			1						3	1		1	2	1		8
3-4										1		1	2			3
5-6													2			2
7-8													1			1
9-12																2
<b>TOTAL</b>	0	4	9	3	0	5	0	1	10	11	5	5	9	3	6	71
<b>JANUARY</b>																
0-1		3	11	14	5	7	19	2	4	1	12		4	5	9	84
2			1	1		1	4	2		3	10		5			29
3-4			3	1		1		2		1	9		1			16
5-6								2								11
7-8																
9-12																
<b>TOTAL</b>	0	3	15	15	5	9	23	6	4	5	31	0	10	5	9	140

TABLE 7B (cont.)  
 CARNWATH - Altitude 706 feet

Monthly Frequencies for Each Year During the Fifteen Years from 1953 to 1967 of Days with Snow Lying at 9 a.m. at Depths Between the Specified Limits

DEPTH : Inches	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	Total
<b>FEBRUARY</b>																
0-1	5	9	8	10	2	1		7	3	5		5	1	5		61
2			3	1		4		3		1						16
3-4			7	2		3		1			19	1				34
5-6								3			9				1	12
7-8								1							1	2
9-12															1	1
TOTAL	5	9	18	13	2	8	0	15	3	6	28	6	6	5	2	126
<b>MARCH</b>																
0-1		4	8			6		1		7	1		5			32
2		1				1					1		3			6
3-4		1	1								4		3			9
5-6		1											1			1
7-8													1			1
9-12																
TOTAL	0	6	9	0	0	7	0	1	0	7	6	0	13	0	0	49
<b>APRIL</b>																
0-1				1		1				4	1					7
2																
3-4																
5-6																
7-8																
9-12																
TOTAL	0	0	0	1	0	1	0	0	0	4	1	0	0	0	0	7

8. THUNDERSTORMS

As mentioned previously in the section dealing with rainfall, West Lothian has a low incidence of thunderstorms and damaging hail. On the long term average, Turnhouse (Edinburgh) Airport, the nearest location for which records are available, has about 7 days with thunderstorms per year, compared with 8 days in Glasgow, 14 days in Birmingham and 16 days in London. Thunderstorms can occur in West Lothian in any month of the year but the frequency during the months of October to April is very low and thunderstorms occur most often in the months of May to September but even in these months the long term average works out at only one day with a thunderstorm per month.

There are no records of thunderstorms from the high ground to the south and west of the county but there is little doubt that these areas will have a higher frequency of thunderstorm than the low lying parts.

REFERENCES

1. E. G. Bilham - "Classification of Heavy Falls of Rain in Short Periods" - British Rainfall 1935
2. D. J. Holland - "Rain Intensity Frequency Relationships in Britain" - British Rainfall 1961
3. D. J. Holland - "The Cardington Rainfall Experiment" - Meteorological Magazine 1967, Vol. 96
4. H. C. Shellard - "Microclimate and Housing" - The Architects' Journal Information Library - 6th and 13th January 1965  
- "Extreme Wind Speeds over the United Kingdom for periods ending 1963" - Clim. Memo. No. 50
5. Building Research Station, Garston, Herts. - "Wind Loadings on Buildings" - Building Research Station Digest No. 99 (second series) - November 1968
6. H. C. Shellard and R. E. Lacy - "Index of Driving Rain" - Meteorological Magazine 1962, Vol. 91
7. P. R. Brown - "Rain and/or Temperatures as Factors Interrupting External Building Work in the Glasgow Area" - Clim. Memo. No. 30
8. A. B. Thomson and J. MacKenzie - "Combined Distribution of Hourly Values of Dry and Wet Bulb Temperatures, Turnhouse Airport 1952 to 1960" - Clim. Memo. No. 35
9. A. B. Thomson and H. Rowsell - "Rainfall over Forth, Lothians and Tweed River Purification Board Areas" - Hydrological Memo. No. 32
10. R. E. Booth - "Averages of Temperature and Sunshine for Stations not included in M.O.735 and M.O.743" - Clim. Memo. No. 38A
11. F. Burns - "Frequencies of Snow Depths for Given Ranges at Selected Stations in Scotland" - Clim. Memo. No. 40
12. P. M. Sola - Parts 16 to 18 of "The Report of the Land Utilisation Survey of Britain"
13. Planning Department, West Lothian County Council, Linlithgow - "A Physical, Social and Economic Survey of West Lothian - 1958"
14. J. A. Plant - "The Climate of Edinburgh" - Clim. Memo. No. 54A  
- "The Climate of Glasgow" - Clim. Memo. No. 60

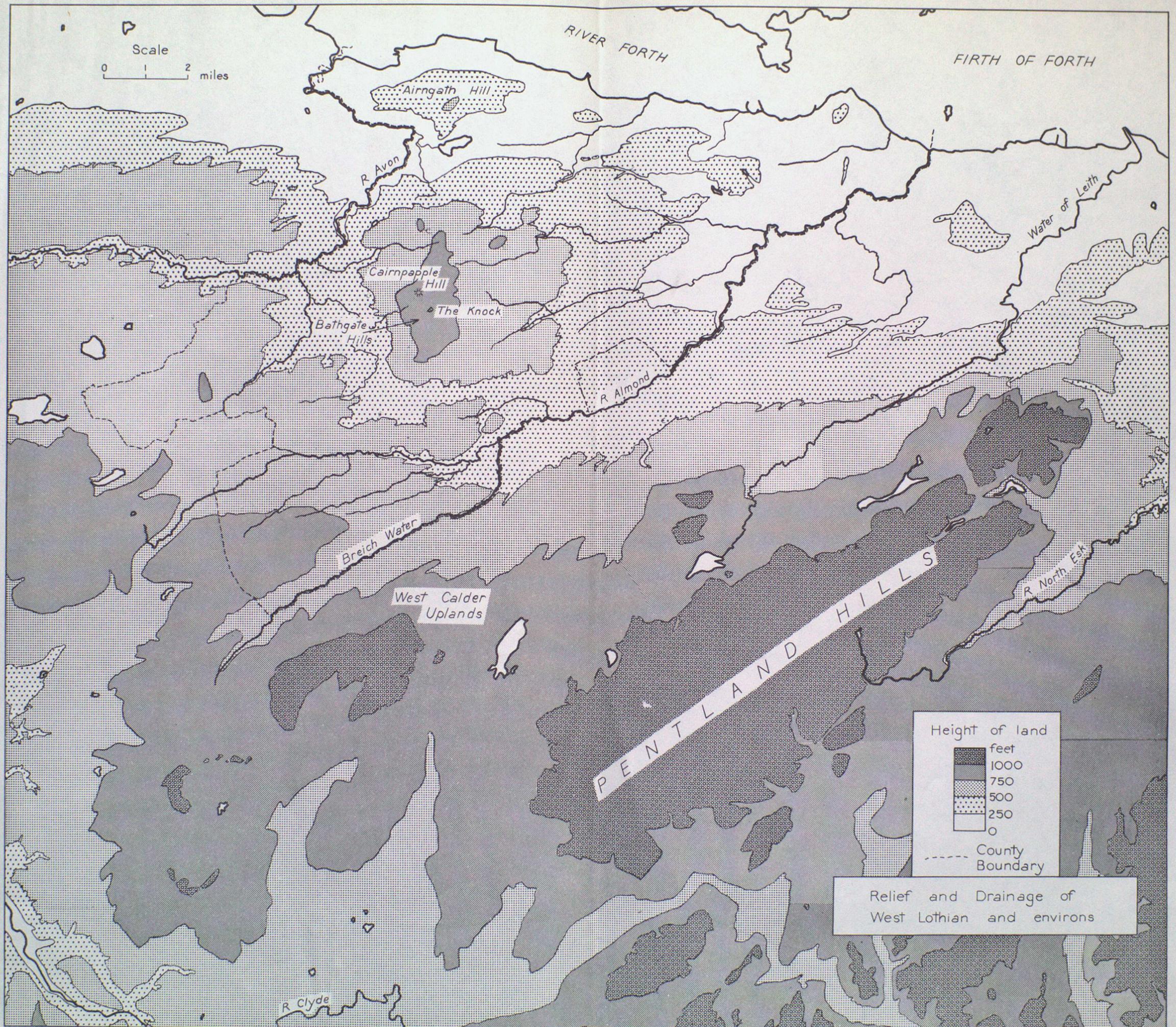
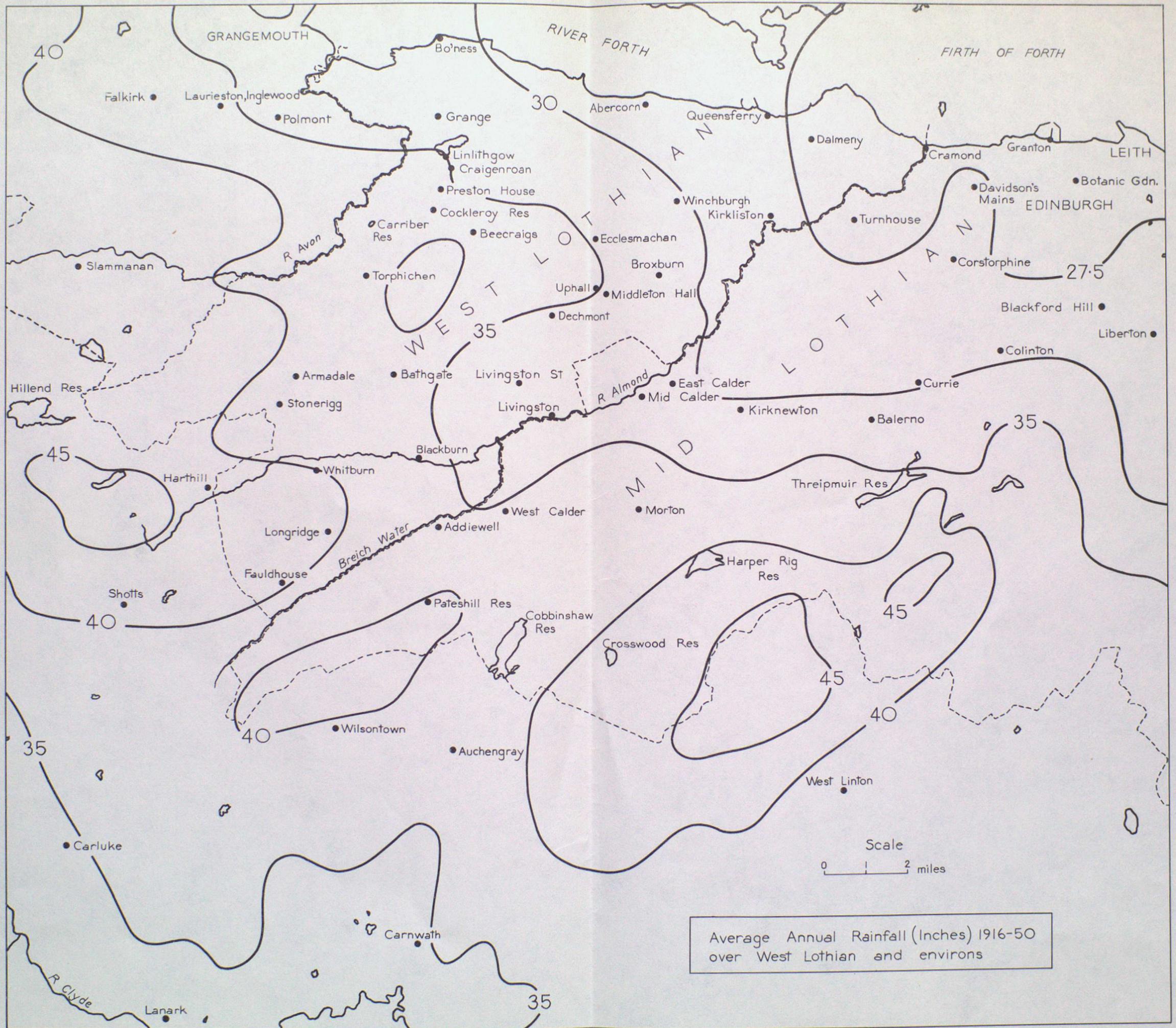


Fig 1



Average Annual Rainfall (Inches) 1916-50  
over West Lothian and environs

Fig 2

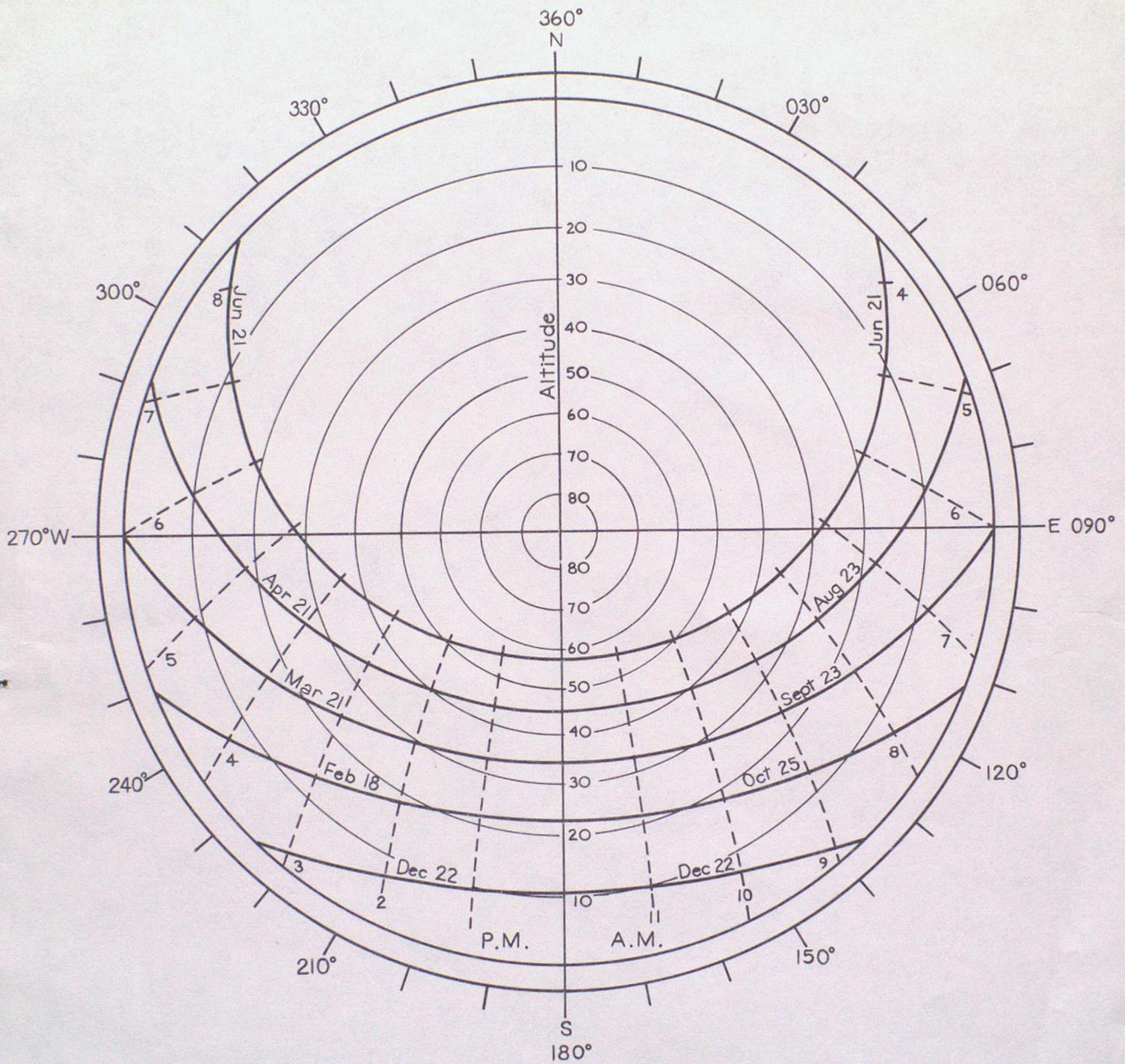


Fig 3. SOLAR CHART FOR Latitude 56°N