

METEOROLOGICAL OFFICE

CLIMATOLOGICAL MEMORANDUM

No. 65

THE CLIMATE OF THE  
TAYSIDE REGION  
OF SCOTLAND

by J.A.Plant and A.Dunsire

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June 1972

AMENDMENT NO 1 TO  
CLIMATOLOGICAL MEMORANDUM NO 65 - "THE CLIMATE OF THE TAYSIDE REGION OF SCOTLAND"

When consulting the solar chart at Figure 2, page 85 and the explanatory note on page 82 it should be borne in mind that the times on the chart and in the note are in Local Apparent Time i.e. the time registered by sundials and sunshine recorders.

In the Tayside region, the combined corrections for longitude and equation of time necessary to convert from Local Apparent Time to Greenwich Mean Time range from about minus 7 minutes to plus 25 minutes - see Table X, Appendix V to the 3rd Edition of "The Observer's Handbook" - HMSO.

In the example quoted on page 82 of the Tayside memorandum, the sun is at the position given on 23 August at 0830 hours Local Apparent Time, 0842 hours Greenwich Mean Time and 0942 hours British Summer Time.

Meteorological Office  
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January 1973

## FOREWORD

The Meteorological Office at 26 Palmerston Place, Edinburgh, EH12 5AN and the Glasgow Weather Centre at 118 Waterloo Street, Glasgow, G2 7DN, receive an ever increasing number of requests from all sections of the community, especially from members of the building and construction industries, for information about the past weather at places in Scotland.

It is not yet possible to issue precise long range weather forecasts and one can only plan or design on the basis of past experience i.e. by consulting recorded facts and statistics of the type contained in this memorandum, but from these one can at least set limits and assess the probabilities.

This memorandum on the Tayside Region of Scotland is similar in general content to the previously published Meteorological Office memoranda on Edinburgh, Glasgow, Aberdeen, the Coastal Region of the Moray Firth, West Lothian and the Ayr-Kilmarnock-Irvine Region of Ayrshire. It includes certain data which will be of particular interest at the tendering or design stages of a building contract. For example, building contractors will be interested in the figures showing the probable amount of working time during which outdoor work may be hampered or have to cease because of rainfall, low temperatures and high winds. Similarly, engineers concerned with the design and efficiency of heating and air conditioning installations will wish to consult the detailed statistics of temperature and relative humidity. Advice is also given on maximum windspeeds for the calculation of wind loading on buildings, glass specifications etc. Statistics of rainfall amounts and intensities have been included for the guidance of drainage engineers concerned with the design of sewers and culverts etc and there are many other facts and figures which will be of interest to architects and engineers. It is hoped that the information contained in this memorandum will also be of interest to students and the general reader.

### Metrication

Metric units have now been in use in the Meteorological Office for several years. For example, in the case of temperature, the changeover from degrees Fahrenheit to degrees Centigrade took place on 1 January 1961. However, Leuchars is the only Meteorological Office weather station in the Tayside region and most of the available records are from other weather stations like the ones in Dundee, Perth and St Andrews which co-operate with the Meteorological Office on a voluntary basis. Until very recently, all of these co-operating stations recorded rainfall in inches and temperature in degrees Fahrenheit.

Accordingly, when compiling this memorandum, it has been necessary to present the available records and statistics in both metric and non-metric units. Generally speaking, the rainfall and temperature data have been presented in the units in which these elements were originally recorded at the individual stations but in some cases, the metric values from Leuchars have been converted to non-metric values for ease of comparison with the data from the co-operating stations.

Many of the tables of data in this memorandum bear headings in metric units with equivalent values in non-metric units but in some cases, conversion to metric units has not been practicable because of restrictions in overall page size or because the inclusion of precise metric equivalents would be too cumbersome. Tables for converting amounts of rainfall from inches to millimetres,

temperatures from degrees Fahrenheit to degrees Centigrade, and wind speeds from miles per hour to metres per second, have been included in the sections dealing with rainfall, temperature and winds.

June 1972

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Acknowledgements

The authors are indebted to Messrs P F Illsley, R Cranna and J W Noble for their helpful comments on the draft manuscript of this memorandum.

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## The climate of the Tayside region of Scotland

by J A Plant\* and A Dunsire\*

### Introduction

The area under review is the region stretching eastwards from Perth to the North Sea along the northern and southern sides of the Firth of Tay. The Sidlaw Hills and their continuation eastwards to Montrose in a series of separate ridges mark the northern boundary of the region while on the southern side of the Firth of Tay, two belts of high ground reach eastwards into the county of Fife. One belt extends from the Ochils in the west along the south bank of the Tay while the other is the central hill belt of Fife comprising the Lomond Hills and the hills of the East Neuk which together form the southern boundary of the region. Between the two belts of high ground on the Fife side of the Tay lies the Howe of Fife or valley of the River Eden which extends for nearly 30 miles.

Although often described as a coastal lowland area, the region is by no means all flat. For example, Dundee, the main centre of population, lies on a distinct south facing slope and Craigowl Hill (altitude 1,492 feet) the highest point in the Sidlaw Hills, lies only 6 miles to the north of Dundee. Perth, the second city of the region lies on flat ground but is almost completely surrounded by hills while on the southern side of the Tay the terrain in Fife has a mainly undulating or "tumbled" type of appearance. Norman's Law (altitude 935 feet) is the highest point in the hills bordering the south bank of the Tay while in the central hill belt of Fife further to the south, West Lomond Hill rises to a height of 1,712 feet.

Between Monifieth and Montrose on the northern side of the Tay estuary and between Tayport and St Andrews on the southern side, the coastal terrain is very similar to the terrain near the estuaries of other Firths on the east coast of Scotland and could perhaps best be described as typical seaside "golf links" country consisting mainly of raised beaches and tracts of sand dunes. Tentsmuir in the northeast corner of Fife between the estuaries of the Tay and Eden used to be claimed as one of the largest tracts of sand dunes in Scotland but nowadays supports about 5,000 acres of Forestry Commission conifers.

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With a relatively low rainfall and a duration of sunshine which is high in relation to the latitude, the Tayside region has a climate which is broadly typical of the east coast of Scotland as a whole. Although in common with Edinburgh and the Firth of Forth region most of the gales and strong winds experienced on Tayside come from westerly directions, it could be said that nearly all the worst aspects of the local climate are associated with winds which have had a track over the North Sea. For example, during the winter and spring months, fresh easterly winds on days with high relative humidities and low air temperatures bring a distinct touch of rawness to the weather and in the late spring and summer, North Sea fog sometimes brings unpleasant weather conditions particularly to eastern coastal districts near the estuaries of the Tay and Eden.

The separate aspects of the climate of the Tayside region are discussed in more detail in the remainder of this memorandum.

## 1. Rainfall

It can be seen from the rainfall map at Figure 1 that the annual average rainfall at the main centres of population in the Tayside region ranges from about 26 to 31 inches per year but increases to more than 35 inches over the high ground of the Sidlaws and to more than 40 inches per year over the Ochil and Lomond Hills. Annual averages of rainfall for a small selection of other locations in the British Isles are given below for purposes of comparison.

	<u>inches</u>
Edinburgh	27
Glasgow	40
Dumfries	43
London	25
Birmingham	31
Liverpool	35
Belfast	38
Huddersfield	38
Morecambe	38
Plymouth	38
Cardiff	42

Monthly and annual averages of rainfall for a number of rainfall measuring stations in or near the region 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 the British Isles), while the averages in Table 1A have been estimated from shorter term or broken periods of records.

Cumulative averages of daily rainfall from which the average rainfall over any period of the year can be calculated are given for Montrose and Perth in Table 1B.

Statistics of monthly and annual rainfalls for Dundee are given in Table 1C.

Total monthly and annual durations of rainfall recorded at Leuchars during the 20 years from 1951 to 1970 are given in Table 1D. The Meteorological Office at Leuchars is the only location in the region for which this type of information is available.

It can be seen from Table 1D that at Leuchars, rain falls in measurable amounts for 585 hours per year, that is about one hour in 15. Over nearly all southeast England, rain falls in measurable amounts for about 500 hours in the year, that is about one hour in 17.

Cumulative frequencies of daily rainfall for Dundee which show the total number of days in 30 years with specified amounts of rain (i.e. the number of days in 30 years with 0.5 inches or more, 1 inch or more, 2 inches or more etc) are given in Table 1E.

Maximum daily rainfalls recorded at Montrose, Arbroath, Dundee, Perth, Leuchars and St Andrews are given in Table 1F.

Maximum and minimum monthly and annual totals of rainfall recorded at Montrose, Arbroath, Dundee, Perth, Leuchars and St Andrews are given in Tables 1G and 1H.

#### Wettest months

The daily rainfalls recorded at Dundee in October 1932, August 1948, September 1950, November 1951 and November 1963 are given in Table 1I. These months, which all had more than 6.50 inches of rain, were the five wettest months at Dundee during the 48 years from 1923 to 1970.

#### Intense falls of rain in short periods of time

Examination of rainfall records reveals that the intensity is always changing and that within any period of rain, a shorter period will always be found where the intensity is greater than that of the whole. Usually, the most intense falls of short duration are associated with thunderstorms or thundery activity. Tayside does experience intense falls of short duration but since the frequency of thunderstorms in this region is less than in the upland parts of Scotland and

the more thundery areas in central and southwest Scotland, it is reasonable to suppose that the probability of an intense fall of rain in a short period of time is less than in these more thundery areas. Parts of central and southern England have two to three times as many thunderstorms and therefore the probability of an intense rainfall of short duration in the area under consideration is much less than in those areas.

Table 1J gives the number of days in each year from 1937 to 1970 with specified amounts of rain falling in specified times at the Meteorological Office at Leuchars. The total number of days over the whole period of 34 years is shown at the foot of the Table. Leuchars is the only location in the region for which statistics of this type are available. However, it is by no means certain whether the intensities of rainfall recorded at Leuchars during the years from 1937 to 1970 are typical of the intensities experienced at other locations in the region.

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<sup>(1)</sup> for obtaining probabilities of intense falls of rain in short periods of time. Following a recent investigation by D J Holland<sup>(2)</sup> 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 1K 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 1L which compares the estimated frequencies obtained from the modified Bilham formula with observed frequencies obtained from the Leuchars records, that for durations up to about 2 hours, the frequencies obtained from the modified Bilham formula appear to be much too high when related to Leuchars.

Experience suggests that for durations up to about 2 hours, the frequencies obtained from the modified Bilham formula could be halved when applied to cities and towns like Montrose, Arbroath, Dundee, Perth, Cupar and St Andrews i.e. a

return period of "5 years" obtained from the upper table of Table 1K would become "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 1K to relate the intensities calculated from the modified Bilham formula to these centres of population.

The Perth area is probably a border line case as far as reductions to the Bilham frequencies are concerned and although the reductions mentioned in the previous paragraph should be in order for the city of Perth, reductions can not be recommended for locations in or nearer the hills surrounding Perth in view of the possible higher frequency of thunderstorms and thundery downpours over these hills. Similarly, until much more recorded evidence becomes available, reductions to the Bilham frequencies can not be recommended at the present time for other areas of high ground in the region.

The reader will notice from Table 1L that for rainfalls with durations in excess of 2 hours, the observed frequencies at Leuchars are much nearer to the frequencies estimated from the Bilham formula and in the case of falls with durations of 8 hours or more, the observed frequencies are actually higher than the estimated frequencies. Investigation has shown<sup>(3)</sup> that there is a link between annual average rainfall and the more prolonged falls with durations of 4 to 8 hours or more and over the wetter parts of the region, the frequency of falls with duration of 4 to 8 hours or more is almost certainly higher than the frequencies recorded at Leuchars.

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 1K. 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. The formula is based on results from an experimental raingauge network at Cardington near Bedford<sup>(4)</sup>. Advice on how to apply these factors to the more difficult cases can usually be given by the Meteorological Office or the Transport and Road Research Laboratory of the Ministry of Transport.

### Rain as a factor interrupting outdoor work

Table 1M gives the total number of days per month during the 10 years from 1961 to 1970 on which 0.1 millimetres (.004 inches) or more of rain fell at Leuchars during the working part of the day i.e. between 0700 and 1700 hours Greenwich Mean Time (8 am and 6 pm British Standard Time). Table 1M 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 1M but otherwise this Table includes all occasions of "measurable" rain i.e. all occasions of 'slight', 'moderate' or 'heavy' rain.

There is practically no experimental evidence on the subject of rain as a factor affecting outdoor work but it is thought that a rate of rainfall of 0.5 mm/hr or more is a reasonable figure to adopt in assessing how rain might interfere with building operations. This rate of 0.5 mm/hr corresponds to the lower limit of the Meteorological Office classification of "moderate" rainfall i.e. rain falling fast enough to form puddles rapidly. Thus, occasions with rain falling at a rate of 0.5 mm/hr or more can be thought of more simply as occasions with "moderate" or "heavy" rain.

Table 1N gives the total duration in hours and tenths of rain falling at a rate of 0.5 mm/hr or more between the hours of 0700 and 1700 GMT during the 10 years from 1961 to 1970. However, the actual amount of working time lost in a day because of rain will seldom keep in step with the duration of moderate or heavy rain on that day. For example, if moderate or heavy rain fell continuously for a period of say 30 minutes during part of the working day, the working time lost from the cessation to the resumption of work would almost certainly be considerably more than 30 minutes. It should also be borne in mind that, more often than not, a period of "moderate" or "heavy" rain is preceded or followed by a period of "slight" rain.

Thus, it should be realised, that in the majority of cases, the duration figures quoted in Table 1N underestimate, perhaps grossly underestimate, the probable amount of time which would be lost on outdoor work. However, the duration figures in Table 1N are useful in that they serve as an indication of the extreme lower limit of the working time likely to be lost because of rain.

A more satisfactory alternative to the figures in Table 1N are figures which show the number of hours during which moderate or heavy rain fell for some time during the hour. Table 10 provides this type of information and comprises the total number of days per month over the 10 years from 1961 to 1970 on which moderate or heavy rain fell at some time during the working day from 0700 to 1700 hours GMT. Similarly, this Table also gives the total number of "hours" per month between 0700 and 1700 hours GMT in which moderate or heavy rain fell at some time during the hour. The figures in Table 10 may overestimate the actual time lost on outdoor work because of rain although there is little doubt that these figures will provide a safer and perhaps more realistic guide for planning or tendering purposes than the figures giving the actual durations of moderate or heavy rain.

Perhaps it should be stressed that while the figures in Tables 1M, 1N and 10 provide a guide to the duration of rainfall during the working part of the day, the figures do not provide a guide to the duration of the effects of the rain. For example, a localised heavy downpour of rain of short duration could flood a building site (especially at the excavation or earth-moving stage) bringing work to a standstill for several days, but such a downpour might contribute a value of say only one or two extra hours with moderate or heavy rain. Clearly, a heavy downpour of rain falling outside the 10 hour period from 0700 to 1700 hours could bring about a similar stoppage.

The Meteorological Office at Leuchars is the only location in the region for which it is possible to provide the types of data contained in Tables 1M, 1N and 10. However, it is considered that the figures in Tables 1M and 10 should give a reasonably good guide to the region as a whole although the duration figures in Table 1N may be a little on the low side when applied to Dundee, Perth and

other places in the region which have a higher rainfall than Leuchars.

When consulting Tables 1M to 1O it should be borne in mind that the figures relate to a 7-day working week and not to a 5-day working week.

A table for converting amounts of rainfall in millimetres into amounts in inches is given at Table 1P.

#### Evaporation

Estimated average values of potential transpiration (ie the water loss from an established turf surface assuming that the roots never run short of water) for the Tayside counties of Angus, Perth and Fife are given in "Potential transpiration" - Technical Bulletin No. 16 of the Ministry of Agriculture, Fisheries and Food. Further information on this subject is contained in "The calculation of irrigation need" - Technical Bulletin No. 4. Both of these Bulletins are published by HM Stationery Office.

The water losses due to potential transpiration are not directly comparable with water losses from an open water surface. However, from some seasonal ratios of potential transpiration to open water evaporation given below it can be seen that, during the main evaporation period of the year, the evaporation from an open water surface is of the order of 25 per cent higher than the losses due to potential transpiration.

	<u>Ratio of Potential Transpiration to Open Water Evaporation</u>
May to August	0.8
September to October and March to April	0.7
November to February	0.6

The available evidence suggests that the maximum evaporation from an open water surface in the area under consideration (ie during very warm weather with low humidities and fresh winds) is likely to be of the order of 0.3 inches in a day, 1.25 to 1.50 inches in a week and 3.00 to 4.00 inches in a month.

### Driving Rain

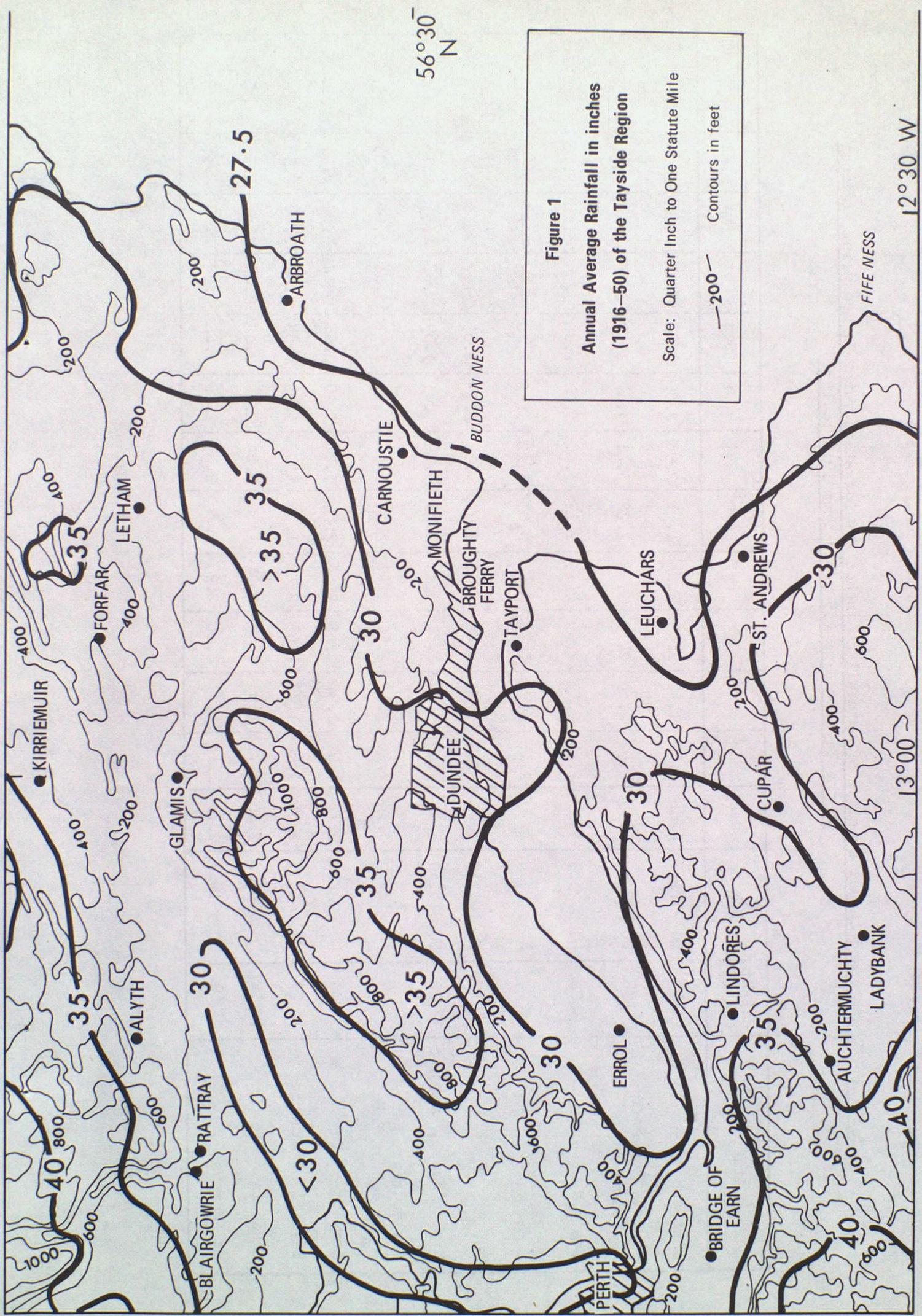
Statistics of wind driven rain are not available for the Tayside region but a study of the Leuchars records suggests that the most frequent occasions of driving rain will occur with winds from the sector between southwest and west. However, in the Tayside region, the most prolonged and heaviest downpours of rain, of the order of 1 inch or more in 24 hours, are usually associated with easterly winds. Easterly winds in the region are normally much less strong than westerly winds but nevertheless there are occasions when strong winds bring driving rain from the east, particularly from the sector between northeast and east. Although the incidence of driving rain from the east appears to be much less frequent than the incidence from the west, the occasions from the east are likely to be more prolonged and perhaps more severe.

In considering the exposure of a building to driving rain, it has hitherto been necessary to use rather indefinite terms such as "sheltered", "moderate" or "severe". However, Building Research Station Digest No. 127 "An index of exposure to driving rain" by R E Lacy, published in March 1971, describes the development of a numerical driving rain index and suggests how it can be used to give these terms a more quantitative basis. Maps are also included in BRS Digest No. 127 showing how the severity of driving rain conditions varies over Great Britain as a whole.

### Performance requirements for windows

Specifications of tests to be applied for weather tightness of windows including their resistance to wind driven rain, are given in Technical Note No. 1 "Performance requirements for windows" published in 1970 by the Directorate of Research and Information of the Department of the Environment on behalf of the Inter-departmental Sub-Committee for Component Co-ordination.

The available statistics of wind driven rain for places in Scotland are included in a report by the Scottish Working Party on Component Performance "1. Window Report", copies of which are available on request from The Architects Division, Room 415, Scottish Development Department, 83 Princes Street, Edinburgh EH2 2ER.



**Figure 1**  
**Annual Average Rainfall in inches**  
**(1916-50) of the Tayside Region**  
 Scale: Quarter Inch to One Statute Mile  
 —200— Contours in feet

Table 1 Monthly and annual averages of rainfall in inches for long-term rainfall measuring stations in the Tayside area (35 years from 1916 to 1950)

Station	Height (feet)	NGR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year (inches)
Montrose	186	NO 707167	2.48	1.87	1.65	1.85	2.26	1.81	2.93	2.80	2.61	3.10	2.82	2.47	28.65
Crombie Reservoir, near Monikie	528	NO 520405	3.33	2.62	2.33	2.19	2.80	2.22	3.41	3.47	3.07	3.73	3.48	3.09	35.74
Monikie Reservoir	494	NO 502383	3.17	2.41	2.19	2.09	2.73	2.17	3.40	3.42	2.88	3.54	3.18	2.78	33.96
Dundee, Camperdown Works	286	NO 382318	2.79	2.18	1.95	1.76	2.60	2.01	3.22	3.42	2.70	3.26	2.83	2.42	31.14
Perth	77	NO 101239	3.02	2.19	1.91	1.72	2.31	1.92	3.18	2.97	2.65	3.30	2.80	2.72	30.69
Kippen House, Dunning	450	NO 018130	5.18	3.42	3.01	2.71	3.14	2.63	3.88	4.03	3.69	4.68	4.37	4.76	45.50
Ballengrick, near Bridge of Earn	50	NO 119175	3.36	2.26	2.12	2.00	2.61	2.11	3.34	3.22	2.91	3.43	3.00	3.05	33.41
Newport-on-Tay	100	NO 422274	2.78	2.02	1.97	1.69	2.53	2.03	3.20	3.20	2.66	3.14	2.82	2.41	30.45
Tayport Lighthouse	27	NO 447293	2.64	1.90	1.79	1.65	2.48	1.93	3.02	3.05	2.55	3.02	2.68	2.35	29.06
Leuchars	34	NO 468208	2.46	1.71	1.63	1.53	2.21	1.70	2.84	2.68	2.42	2.82	2.54	2.15	26.69
St Andrews	60	NO 503167	2.73	1.83	1.77	1.58	2.29	1.78	2.80	2.79	2.44	2.90	2.77	2.38	28.06

Table 1A Monthly and annual averages of rainfall in inches estimated for short-term rainfall measuring stations in the Tayside area (35 years from 1916 to 1950)

Station	Height (feet)	NGR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year (inches)
Arbroath	95	NO 649411	2.28	1.86	1.60	1.55	2.13	1.65	2.63	2.44	2.49	2.89	2.52	2.21	26.25
Carmouatie	29	NO 558344	2.62	1.92	1.81	1.78	2.39	1.90	2.97	3.00	2.62	3.03	2.74	2.36	29.14
Buddonness	15	NO 539309	2.53	1.86	1.74	1.71	2.30	1.83	2.87	2.89	2.53	2.92	2.64	2.28	28.10
Clatto Res (Angus)	500	NO 368344	3.08	2.30	2.01	1.88	2.66	2.01	3.18	3.47	2.76	3.34	3.15	2.59	32.43
Dundee	147	NO 422313	2.83	2.17	1.96	1.74	2.61	1.99	3.20	3.32	2.70	3.26	2.86	2.42	31.06
Stobsmuir Reservoir, Dundee	285	NO 414321	2.81	2.14	1.87	1.78	2.45	1.87	3.02	3.23	2.63	3.08	2.90	2.41	30.19
Mylnefield, near Invergowrie	100	NO 341299	2.67	1.97	1.74	1.63	2.28	1.77	2.84	3.07	2.39	2.89	2.70	2.16	28.11
Fingask	545	NO 223294	2.99	2.19	1.91	1.73	2.44	1.97	3.12	3.09	2.59	3.19	2.96	2.69	30.87
Montague Reservoir, near Balbeggie	530	NO 191281	3.18	2.30	2.01	1.85	2.50	2.04	3.27	3.24	2.69	3.38	3.11	2.85	32.42
Perth, Craigie Haugh	14	NO 113226	2.91	2.06	1.80	1.69	2.12	1.86	2.94	2.82	2.41	3.09	2.79	2.59	29.08
Ramsheugh, near Bridge of Earn	310	NO 136151	4.02	2.54	2.39	2.17	2.65	2.28	3.53	3.42	3.16	3.79	3.46	3.38	36.79
Balmerino Manse	200	NO 367245	2.70	1.93	1.79	1.62	2.33	1.88	2.96	2.90	2.47	2.93	2.67	2.25	28.43
Pitlair, near Cupar	116	NO 317122	3.07	2.07	1.95	1.79	2.37	2.04	2.98	2.95	2.68	3.11	2.83	2.59	30.43
Cupar, Sugar Beet Factory	82	NO 388152	2.91	1.94	1.85	1.62	2.29	1.94	2.93	2.84	2.55	2.95	2.69	2.46	28.97
Clatto Reservoir (Fife)	505	NO 366078	3.35	2.33	2.16	2.02	2.70	2.36	3.35	3.35	3.05	3.51	3.18	2.88	34.24

TABLE 1B

Cumulative mean daily rainfall, in inches, 35 years from 1916 to 1950

Montrose

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.10	2.54	4.45	6.04	7.88	10.19	11.99	14.97	17.75	20.38	23.48	26.27
2	0.19	2.63	4.48	6.14	7.94	10.25	12.04	15.07	17.84	20.47	23.60	26.34
3	0.24	2.71	4.57	6.22	8.03	10.30	12.18	15.08	17.93	20.62	23.69	26.39
4	0.31	2.76	4.61	6.28	8.14	10.38	12.28	15.14	18.05	20.71	23.79	26.46
5	0.38	2.85	4.67	6.33	8.28	10.47	12.40	15.22	18.08	20.88	23.89	26.51
6	0.46	2.94	4.70	6.39	8.40	10.57	12.48	15.32	18.19	20.95	23.96	26.59
7	0.52	3.00	4.74	6.45	8.48	10.63	12.65	15.40	18.28	21.08	24.03	26.68
8	0.57	3.07	4.77	6.50	8.59	10.73	12.74	15.49	18.39	21.20	24.10	26.76
9	0.66	3.14	4.81	6.54	8.66	10.81	12.83	15.53	18.46	21.34	24.18	26.86
10	0.74	3.20	4.87	6.60	8.70	10.88	12.90	15.59	18.53	21.44	24.28	26.95
11	0.79	3.23	4.92	6.65	8.78	10.91	12.96	15.68	18.57	21.49	24.36	27.09
12	0.88	3.29	4.97	6.75	8.85	10.98	13.02	15.84	18.65	21.58	24.41	27.16
13	0.96	3.33	5.02	6.79	8.96	11.02	13.13	15.94	18.79	21.66	24.49	27.25
14	1.04	3.42	5.08	6.91	9.01	11.12	13.18	16.02	18.86	21.68	24.58	27.35
15	1.09	3.49	5.13	6.95	9.12	11.16	13.26	16.13	18.92	21.73	24.66	27.47
16	1.16	3.55	5.19	7.02	9.17	11.20	13.34	16.25	19.07	21.79	24.76	27.56
17	1.23	3.60	5.24	7.11	9.26	11.23	13.49	16.41	19.17	21.90	24.92	27.62
18	1.35	3.65	5.30	7.15	9.31	11.26	13.58	16.47	19.24	21.97	25.12	27.68
19	1.43	3.72	5.35	7.21	9.34	11.30	13.68	16.55	19.38	22.02	25.23	27.71
20	1.50	3.78	5.40	7.25	9.42	11.35	13.83	16.69	19.53	22.09	25.37	27.78
21	1.59	3.86	5.45	7.30	9.46	11.43	13.97	16.78	19.62	22.22	25.47	27.85
22	1.67	3.92	5.50	7.35	9.53	11.51	14.03	16.81	19.73	22.37	25.54	27.94
23	1.79	3.98	5.54	7.41	9.59	11.56	14.11	16.90	19.83	22.51	25.71	28.00
24	1.90	4.01	5.58	7.48	9.65	11.59	14.20	16.94	19.89	22.60	25.76	28.06
25	2.00	4.08	5.62	7.55	9.71	11.62	14.29	17.11	19.95	22.75	25.82	28.17
26	2.05	4.18	5.67	7.58	9.77	11.69	14.38	17.20	20.03	22.86	25.92	28.29
27	2.10	4.25	5.73	7.68	9.83	11.77	14.46	17.28	20.08	22.94	25.99	28.34
28	2.18	4.30	5.76	7.74	9.89	11.83	14.58	17.41	20.14	23.10	26.06	28.42
29	2.29	4.35	5.84	7.79	9.92	11.87	14.66	17.50	20.18	23.20	26.12	28.51
30	2.35		5.92	7.85	9.99	11.92	14.75	17.57	20.26	23.29	26.18	28.59
31	2.48		6.00		10.11		14.85	17.65		23.36		28.65

Note: The entry opposite any particular date is the mean rainfall from the beginning of the year to that date. The mean rainfall for any period of the year can be obtained from the table by subtracting the cumulative total at the beginning of the required period from the corresponding total at the end of the required period.

TABLE 1B (Contd)

Cumulative mean daily rainfall, in inches, 35 years from 1916 to 1950

## Perth

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.12	3.16	5.26	7.18	8.89	11.24	13.13	16.36	19.37	22.01	25.30	28.04
2	0.23	3.27	5.29	7.25	8.94	11.31	13.19	16.45	19.46	22.14	25.40	28.14
3	0.29	3.37	5.34	7.31	8.98	11.37	13.31	16.48	19.57	22.27	25.47	28.21
4	0.36	3.44	5.41	7.38	9.10	11.44	13.49	16.53	19.71	22.36	25.59	28.28
5	0.41	3.54	5.53	7.44	9.22	11.50	13.62	16.59	19.76	22.51	25.71	28.35
6	0.50	3.64	5.57	7.48	9.31	11.60	13.71	16.69	19.84	22.62	25.78	28.43
7	0.61	3.74	5.60	7.55	9.39	11.69	13.90	16.81	19.94	22.73	25.85	28.50
8	0.69	3.84	5.64	7.61	9.46	11.75	14.02	16.92	20.00	22.85	25.91	28.56
9	0.83	3.95	5.69	7.67	9.50	11.85	14.10	16.97	20.09	23.08	25.99	28.68
10	0.92	4.00	5.76	7.73	9.54	11.93	14.21	17.07	20.16	23.18	26.07	28.78
11	0.99	4.06	5.86	7.79	9.59	11.99	14.29	17.17	20.23	23.24	26.16	28.87
12	1.12	4.11	5.92	7.86	9.66	12.05	14.35	17.29	20.29	23.35	26.23	28.95
13	1.22	4.18	5.96	7.91	9.74	12.09	14.48	17.36	20.43	23.42	26.33	29.01
14	1.32	4.26	6.01	8.00	9.83	12.17	14.56	17.48	20.51	23.46	26.44	29.10
15	1.40	4.35	6.18	8.08	9.92	12.22	14.66	17.57	20.57	23.51	26.53	29.19
16	1.49	4.38	6.20	8.15	9.95	12.27	14.75	17.71	20.73	23.60	26.61	29.30
17	1.56	4.43	6.26	8.23	10.07	12.31	14.91	17.84	20.88	23.75	26.72	29.40
18	1.68	4.50	6.33	8.25	10.14	12.36	15.03	17.92	20.94	23.82	26.92	29.51
19	1.79	4.56	6.41	8.29	10.18	12.40	15.11	18.02	21.09	23.90	27.07	29.62
20	1.90	4.62	6.48	8.35	10.25	12.46	15.20	18.20	21.21	23.98	27.18	29.69
21	2.00	4.69	6.55	8.40	10.35	12.55	15.30	18.28	21.29	24.12	27.26	29.76
22	2.11	4.75	6.59	8.46	10.41	12.65	15.37	18.34	21.40	24.25	27.35	29.83
23	2.22	4.81	6.62	8.52	10.49	12.69	15.46	18.40	21.45	24.40	27.50	29.87
24	2.34	4.88	6.67	8.62	10.57	12.74	15.52	18.46	21.52	24.52	27.56	29.95
25	2.50	4.95	6.73	8.68	10.66	12.79	15.60	18.63	21.57	24.64	27.64	30.09
26	2.55	5.05	6.79	8.71	10.75	12.84	15.68	18.77	21.64	24.75	27.71	30.23
27	2.63	5.12	6.83	8.75	10.82	12.92	15.75	18.86	21.69	24.83	27.77	30.31
28	2.72	5.14	6.86	8.79	10.91	12.97	15.89	18.99	21.77	24.91	27.83	30.43
29	2.82	5.21	6.97	8.82	10.96	13.02	16.00	19.09	21.79	25.01	27.90	30.53
30	2.87		7.06	8.84	11.04	13.07	16.11	19.16	21.87	25.09	27.97	30.62
31	3.02		7.12		11.15		16.25	19.22		25.17		30.69

Note: The entry opposite any particular date is the mean rainfall from the beginning of the year to that date. The mean rainfall for any period of the year can be obtained from the table by subtracting the cumulative total at the beginning of the required period from the corresponding total at the end of the required period.

TABLE 1C

Statistics of monthly and annual rainfalls for Dundee  
(Period of record - 48 years from 1923 to 1970)

Statistics of monthly rainfalls

<u>Month</u>	<u>Highest Rainfall</u>	<u>Rainfall Seldom* Above</u>	<u>Median†</u>	<u>Rainfall Seldom* Below</u>	<u>Lowest Rainfall</u>
January	4.85 inches in January 1948	3.98 inches	2.21 inches	1.59 inches	0.66 inches in January 1953
February	4.98 inches in February 1926	2.88 inches	1.69 inches	1.07 inches	0.07 inches in February 1934
March	5.73 inches in March 1958	2.40 inches	1.61 inches	0.82 inches	0.19 inches in March 1929
April	5.06 inches in April 1934	2.52 inches	1.63 inches	1.08 inches	0.05 inches in April 1938
May	5.77 inches in May 1969	3.73 inches	2.09 inches	1.49 inches	0.73 inches in May 1959
June	4.76 inches in June 1931	3.02 inches	2.14 inches	1.12 inches	0.46 inches in June 1940
July	5.81 inches in July 1940	4.11 inches	3.13 inches	2.05 inches	0.93 inches in July 1955
August	6.80 inches in August 1948	4.87 inches	3.20 inches	1.68 inches	0.49 inches in August 1955
September	6.63 inches in September 1950	3.69 inches	2.59 inches	1.59 inches	0.59 inches in September 1929
October	6.69 inches in October 1932	4.23 inches	2.79 inches	1.42 inches	0.45 inches in October 1946
November	6.80 inches in November 1951	4.19 inches	2.29 inches	1.29 inches	0.46 inches in November 1942
December	5.72 inches in December 1945	3.58 inches	2.34 inches	1.27 inches	0.21 inches in December 1926

Statistics of annual rainfalls

<u>Period of Record</u>	<u>Highest Annual Rainfall</u>	<u>Annual Rainfall Seldom* above</u>	<u>Median†</u>	<u>Annual Rainfall Seldom* below</u>	<u>Lowest Annual Rainfall</u>
48 years	40.16 inches in 1948	33.74 inches	30.17 inches	25.25 inches	20.53 inches in 1955

\*Seldom = 20 per cent of occasions or one year in 5; the figures given are the upper and lower quintiles

†Median = the "middle" value i.e. half the rainfalls exceed it and half fall below it.

TABLE 1D

Total durations in hours of measurable\* rain recorded in each month and year during the 20 years from 1951 to 1970 by the autographic rain recording instrument at Leuchars

	<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 Total</u>
	(hours)												
1951	82.6	67.0	71.4	33.7	55.3	35.6	62.9	70.5	36.0	13.3	120.1	64.6	713.0
1952	34.7	16.9	59.5	22.6	44.1	75.6	32.8	57.0	23.7	51.3	66.1	49.8	534.1
1953	25.0	30.6	10.9	55.9	44.0	26.9	56.0	37.6	49.8	51.6	60.7	70.8	519.8
1954	43.8	70.2	52.1	39.4	80.0	61.2	42.6	62.6	47.8	89.0	78.6	62.2	729.5
1955	41.2	36.7	57.5	33.6	43.8	27.1	19.3	15.4	25.1	31.7	28.6	85.6	445.6
1956	57.7	37.0	30.7	18.9	18.0	47.2	61.0	88.3	58.0	32.3	12.0	80.4	541.5
1957	62.8	69.9	58.6	21.2	37.3	13.4	75.8	39.1	30.5	31.5	38.7	60.4	539.2
1958	42.3	58.3	86.7	47.0	52.1	54.6	73.1	55.9	31.9	28.2	21.0	70.1	621.2
1959	16.9	15.9	41.9	48.5	7.7	45.7	44.7	12.7	18.1	36.0	104.6	97.6	490.3
1960	90.5	53.8	60.0	50.0	22.9	36.9	57.6	70.7	46.4	112.3	56.3	54.7	712.1
1961	56.6	46.8	22.0	75.9	19.5	26.9	45.8	66.9	40.9	65.1	35.7	59.0	561.1
1962	61.0	22.9	33.4	52.3	30.2	17.2	40.1	83.2	76.6	10.0	73.8	68.6	569.3
1963	54.7	47.0	68.9	53.4	39.3	40.8	32.1	101.8	40.0	32.4	147.3	14.8	672.5
1964	27.2	29.9	80.6	43.0	25.1	48.8	27.8	62.0	45.0	40.1	20.1	60.3	509.9
1965	52.3	7.4	65.7	28.5	46.3	50.3	77.0	39.0	76.2	37.5	65.8	59.3	605.3
1966	73.2	90.2	20.1	104.6	61.4	67.6	26.5	90.3	37.2	47.2	28.5	67.0	713.8
1967	45.5	35.7	21.2	17.8	82.4	18.5	23.2	38.2	43.6	54.5	47.5	20.9	449.0
1968	39.0	35.1	22.3	35.6	89.2	14.8	61.9	30.1	39.9	97.9	47.1	35.3	548.2
1969	77.0	56.0	110.3	45.2	137.2	48.2	23.7	21.3	41.4	22.3	46.8	59.3	688.7
1970	112.0	39.6	20.7	25.8	18.7	28.4	47.8	37.0	49.2	42.6	82.3	24.9	529.0
20 year means	54.8	43.3	49.7	42.6	47.7	39.3	46.6	54.0	42.9	46.3	59.1	58.3	584.6

\*The autographic rain recording instrument does not register the duration of very small amounts of rain, drizzle, snow etc, eg occasions with only a "few spots" of rain.

TABLE 1E

Cumulative frequencies of daily rainfalls in inches with equivalents  
in millimetres at Dundee  
(30 years from 1941 to 1970)

Daily Rainfalls	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
(inches)														
(mm)														
2.50	63.4								1				1	
2.00	50.7		1					2	1			2	6	
1.50	38.0		2	1	2			6	3	2	1	3	20	
1.00	25.4	2	3	2	5	2	6	10	7	6	6	4	53	
0.50	12.6	28	17	14	16	24	26	51	58	34	34	38	29	369
0.20	5.0	130	98	85	87	141	116	147	138	132	127	140	138	1479
0.10	2.5	239	183	161	160	222	199	231	236	219	211	228	251	2540
0.04	1.0	344	298	270	272	336	330	335	351	331	340	354	358	3919
0.01	0.2	491	425	399	406	442	431	459	481	469	451	492	513	5459
* $\leq$ 0.004	* $\leq$ 0.15	439	422	531	494	488	469	471	449	431	479	408	417	5498
Total number of days in 30 years		930	847	930	900	930	900	930	930	900	930	900	930	10957

\*Including days with no rain.

Example: In the 30 Januarys during the years 1941 to 1970, there was a total of 28 days with 24 hour rainfall amounts of 0.50 inches or more (12.6 millimetres or more).

Note: The contents of the raingauge at Dundee are emptied and measured once-daily at 0900 hours Greenwich Mean Time to obtain the 24 hour amount of precipitation collected in the gauge since the measurement made at 0900 hours on the previous day.

When the gauge contains solid precipitation in the form of hail or snow, the contents are melted by warming to give the equivalent amount of rainwater.

The above frequency table has been calculated from records of the 24 hour (0900 hours on one day to 0900 hours on the next day) measurements made during the 30 year period from 1941 to 1970. The rainfall measured at 0900 hours GMT is credited to the previous day.

TABLE 1F

Maximum daily rainfall in inches

	<u>Period of record</u>	<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>Montrose</u>													
Maximum daily* fall	1900-1970	1.60	1.10	1.77	2.12	1.86	2.06	2.75	1.85	2.72	2.35	2.11	1.57
Year of occurrence		1900	1926	1958	1934	1943	1931	1970	1916	1927	1960	1951	1957
<u>Arbroath</u>													
Maximum daily* fall	1922-1970	1.15	.95	1.37	1.37	1.56	1.73	1.72	2.21	3.09	2.27	1.57	1.30
Year of occurrence		1931	1936	1958	1934	1943	1931	1970	1966	1927	1924	1931,	1957
												1935	
<u>Dundee</u>													
Maximum daily* fall	1923-1970	1.11	1.39	2.19	1.97	1.61	1.93	1.80	2.26	2.68	2.07	1.66	2.44
Year of occurrence		1951	1936	1958	1966	1947	1931	1937	1949	1950	1924	1946	1957
<u>Perth</u>													
Maximum daily* fall	1915-1970	1.80	1.07	1.83	1.30	2.43	1.40	3.42	1.70	1.69	1.70	1.53	1.84
Year of occurrence		1960	1936	1964	1964	1960	1931	1916	1961	1956	1965	1951	1957
<u>Leuchars</u>													
Maximum daily* fall	1922-1970	1.31	1.00	1.41	1.48	1.37	1.91	1.78	2.46	2.34	1.98	1.46	1.40
Year of occurrence		1928	1936	1958	1966	1960	1931	1958	1966	1950	1924	1935	1955,
													1957
<u>St Andrews</u>													
Maximum daily* fall	1914-1970	1.82	1.32	1.35	1.06	1.26	1.86	2.62	2.55	2.24	2.11	1.59	1.35
Year of occurrence		1931	1915	1950	1958	1960	1931	1916	1966	1950	1924	1926	1917

\*24 hours from 0900h GMT on one day to 0900h GMT on the next day.

Example: The maximum fall of 1.11 inches which occurred in January 1951 is the highest daily fall recorded at Dundee in any January during the years from 1923 to 1970

TABLE 1G

Maximum and minimum monthly totals of rainfall 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>Montrose</u>												
Maximum monthly total	5.61	4.94	5.06	6.32	6.62	4.56	6.73	6.37	5.96	8.75	7.61	6.72
Year of occurrence	1970	1923	1958	1934	1969	1907	1916	1963	1950	1960	1905	1915
Minimum monthly total	.72	.16	.17	.00	.44	.23	.58	.07	.44	.35	.38	.29
Year of occurrence	1905	1932, 1934	1929	1912	1956	1940	1919	1947	1941	1962	1942	1926
<u>Arbroath</u>												
Maximum monthly total	4.51	4.41	4.43	5.08	6.05	4.60	6.00	6.82	6.75	6.58	5.94	4.68
Year of occurrence	1936	1926	1958	1934	1969	1928	1940	1948	1927	1932	1946	1959
Minimum monthly total	.50	.07	.17	.14	.55	.27	.67	.19	.42	.42	.46	.23
Year of occurrence	1953	1934	1953	1938	1956	1940	1935	1947, 1955	1941	1962	1942	1926
<u>Dundee</u>												
Maximum monthly total	4.85	4.98	5.73	5.06	5.77	4.76	5.81	6.80	6.63	6.69	6.80	5.72
Year of occurrence	1948	1926	1958	1934	1969	1931	1940	1948	1950	1932	1951	1945
Minimum monthly total	.66	.07	.19	.05	.73	.46	.93	.49	.59	.45	.46	.21
Year of occurrence	1953	1934	1929	1938	1959	1940	1955	1955	1929	1946	1942	1926
<u>Perth</u>												
Maximum monthly total	6.25	5.19	4.73	4.54	5.78	5.67	9.44	7.86	6.73	6.81	6.88	6.27
Year of occurrence	1928	1915	1964	1934	1924	1966	1916	1948	1950	1916	1951	1915
Minimum monthly total	.55	.16	.19	.14	.36	.29	.71	.09	.40	.31	.44	.31
Year of occurrence	1953	1932	1944	1938	1936	1925	1919	1947	1929	1946	1942	1926

TABLE 1G (Contd)

	<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>Leuchars</u>												
Maximum monthly total	4.89	4.13	4.07	4.62	5.97	4.53	7.13	7.57	5.87	6.21	7.63	5.01
Year of occurrence	1928	1941	1958	1934	1969	1931	1940	1930	1950	1932	1963	1959
Minimum monthly total	.49	.07	.38	.08	.56	.26	.68	.27	.44	.19	.42	.32
Year of occurrence	1953	1932	1944	1938	1959	1940	1928	1955	1959	1951	1942	1926
<u>St Andrews</u>												
Maximum monthly total	5.95	5.13	3.88	3.76	5.56	4.20	6.80	6.05	6.48	6.80	7.64	6.09
Year of occurrence	1928	1941	1958	1934	1969	1931	1940	1930	1950	1932	1963	1915
Minimum monthly total	.66	.03	.33	.09	.63	.29	.78	.34	.49	.13	.31	.32
Year of occurrence	1953	1934	1929	1938	1956	1940	1935	1955	1929	1951	1937	1926

Example: The maximum monthly total of 4.85 inches which occurred in January 1948 and the minimum monthly total of .66 inch which occurred in January 1953 are the highest and lowest monthly totals recorded at Dundee in any January during the years from 1923 to 1970.

TABLE 1H

Maximum and minimum annual totals of rainfall in inches

	<u>Period of record</u>	<u>Highest annual rainfall</u>	<u>Year of occurrence</u>	<u>Lowest annual rainfall</u>	<u>Year of occurrence</u>
Montrose	1900-1970	40.43 inches	1960	18.45 inches	1921
Arbroath	1922-1970	33.66 inches	1948	17.39 inches	1955
Dundee	1923-1970	40.16 inches	1948	20.53 inches	1955
Perth	1915-1970	47.56 inches	1916	20.98 inches	1933
Leuchars	1922-1970	33.02 inches	1966	17.89 inches	1955
St Andrews	1914-1970	37.79 inches	1915	18.16 inches	1955

TABLE LI

Daily rainfalls at Dundee during the 5 wettest months in the  
48 years from 1923 to 1970

(Daily rainfalls in inches with equivalents in millimetres from 09h GMT  
on one day to 09h GMT on the next day)

Date	OCTOBER 1932		AUGUST 1948		SEPTEMBER 1950		NOVEMBER 1951		NOVEMBER 1963	
	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm
1	Nil	Nil	.18	4.6	.24	6.1	Trace	Trace	.16	4.1
2	.10	2.5	Trace	Trace	.01	0.3	.12	3.1	.05	1.3
3	Nil	Nil	Nil	Nil	.06	1.5	.02	0.5	.39	9.9
4	.04	1.0	Nil	Nil	.02	0.5	.62	15.8	.22	5.6
5	.04	1.0	Nil	Nil	Trace	Trace	1.48	37.6	.73	18.5
6	.04	1.0	.48	12.2	.78	19.8	.21	5.3	.24	6.1
7	.31	7.9	.40	10.2	.05	1.3	.01	0.3	.09	2.3
8	1.05	26.7	.09	2.3	Nil	Nil	.66	16.8	.25	6.3
9	.13	3.3	Nil	Nil	Nil	Nil	.13	3.3	.05	1.3
10	.36	9.1	Nil	Nil	.11	2.8	.82	20.8	1.09	27.7
11	Trace	Trace	.15	3.8	.59	14.9	.71	18.0	.48	12.2
12	.57	14.5	1.18	29.9	.03	0.8	.02	0.5	.06	1.5
13	.36	9.1	Nil	Nil	.06	1.5	Nil	Nil	Nil	Nil
14	Nil	Nil	.55	14.0	Trace	Trace	.32	8.1	Trace	Trace
15	.07	1.8	.54	13.7	Trace	Trace	.11	2.8	Trace	Trace
16	.01	0.3	.99	25.1	.66	16.8	.31	7.9	Trace	Trace
17	.86	21.8	.06	1.5	.04	1.0	.28	7.1	.59	14.9
18	Nil	Nil	Trace	Trace	Trace	Trace	.10	2.5	.09	2.3
19	.23	5.8	Trace	Trace	.04	1.0	.08	2.0	.38	9.7
20	.05	1.3	Nil	Nil	Trace	Trace	.02	0.5	.03	0.8
21	.61	15.5	.51	13.0	Nil	Nil	Nil	Nil	.07	1.8
22	.33	8.4	.03	0.8	.13	3.3	Nil	Nil	.02	0.5
23	Trace	Trace	.01	0.3	.27	6.8	.55	14.0	.59	14.9
24	.04	1.0	.34	8.6	2.68	68.1	.04	1.0	.25	6.4
25	.19	4.8	.59	14.9	.27	6.8	Nil	Nil	.02	0.5
26	.83	21.1	Nil	Nil	.03	0.8	Nil	Nil	Trace	Trace
27	.01	0.3	Nil	Nil	.01	0.3	.08	2.0	.13	3.3
28	Nil	Nil	.13	3.3	Nil	Nil	.11	2.8	.41	10.4
29	.24	6.1	Trace	Trace	Trace	Trace	Nil	Nil	.01	0.3
30	.22	5.6	.18	4.6	.55	14.0	Nil	Nil	.22	5.6
31	Nil	Nil	.39	9.9						
Total	6.69	169.9	6.80	172.7	6.63	168.4	6.80	172.7	6.62	168.2

Note: A 'Trace' of rainfall is a very small amount less than .005 inches (or .05 millimetres).

**TABLE 1J**

Intensities of rainfall recorded at Leuchars, Wife

Number of days with specified amounts of rain falling in specified times (34 years from 1937 to 1970)

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 mins	5 mins	15 mins	30 mins	1 hr	15 mins	30 mins	1 hr	1 hr	2 hrs	4 hrs	8 hrs	16 hrs
1970														
1969														
1968														
1967														
1966														
1965														
1964														
1963														
1962														
1961														
1960														
1959														
1958														
1957														
1956														
1955														
1954														
1953														
1952														
1951														
1950														
1949														
1948														
1947														
1946														

TABLE 1J (Contd.)

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 mins	15 mins	5 mins	15 mins	30 mins	1 hr	2 hrs	4 hrs	15 mins	30 mins	1 hr	2 hrs	4 hrs	1 hr	2 hrs	4 hrs	8 hrs	16 hrs			
1945	-	-	-	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2			
1944	-	-	-	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1			
1945	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1			
1942	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
1941	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
1940	-	-	-	0	0	0	1	0	0	0	0	0	0	2	0	0	0	1	3			
1939	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
1938	-	-	-	0	1	2	3	1	1	1	4	2	2	2	0	0	0	2	3			
1937	-	-	-	0	0	0	1	0	0	0	3	0	0	1	0	0	1	1	3			
Total	3	9	15	0	7	11	26	1	3	6	19	57	0	2	5	22	61	0	1	8	25	59
Number of years of record	15	15	15	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34

TABLE 1K

Maximum rainfall in inches from modified Bilham formula

Duration (minutes)	<u>Return Period (years)</u>						
	1 day per Annum	1 day per 2 yrs	1 day per 5 yrs	1 day per 10 yrs	1 day per 20 yrs	1 day per 50 yrs	1 day per 100 yrs
2 minutes or less	0.09	0.11	0.14	0.16	0.19	0.22	0.24
4 " " "	0.15	0.18	0.23	0.27	0.31	0.36	0.40
6 " " "	0.18	0.23	0.30	0.35	0.40	0.48	0.54
8 " " "	0.21	0.27	0.35	0.41	0.48	0.58	0.65
10 " " "	0.24	0.30	0.39	0.47	0.55	0.66	0.75
15 " " "	0.28	0.36	0.48	0.58	0.68	0.83	0.96
20 " " "	0.31	0.40	0.54	0.66	0.79	0.97	1.12
25 " " "	0.34	0.43	0.58	0.72	0.87	1.09	1.27
30 " " "	0.36	0.46	0.62	0.77	0.94	1.18	1.39
40 " " "	0.40	0.50	0.68	0.85	1.05	1.34	1.59
50 " " "	0.43	0.54	0.73	0.91	1.13	1.46	1.75
60 " " "	0.46	0.58	0.78	0.96	1.19	1.56	1.88
90 " " "	0.52	0.66	0.88	1.09	1.35	1.78	2.18
120 " " "	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 11

Comparison of observed and estimated intensities of rainfall at  
Leuchars, Fife

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

	A.	B.	C.	D.
	<u>Observed Frequency</u> (number of days in 10 years)	<u>Estimated Frequency</u> (number of days in 10 years)	<u>Observed Fre- quency as</u> <u>Percentage of</u> <u>Estimated</u> <u>Frequency</u>	<u>Period of</u> <u>Record used</u> <u>for Calcula-</u> <u>tion of A.</u> (years)
<u>Amount of 5 millimetres (0.2 inches) falling within:</u>				
5 minutes or less	2.0	5.5*	36%	15
10 minutes or less	6.0	14.9	40%	15
15 minutes or less	10.0	22.3	45%	15
<u>Amount of 10 millimetres (0.4 inches) falling within:</u>				
5 minutes or less	0.0	0.3*	0%	34
15 minutes or less	2.1	3.5*	60%	34
30 minutes or less	3.2	7.3	44%	34
60 minutes or less	7.6	14.6	52%	34
<u>Amount of 15 millimetres (0.6 inches) falling within:</u>				
15 minutes or less	0.3	0.9*	33%	34
30 minutes or less	0.9	2.2	41%	34
1 hour or less	1.8	4.4	41%	34
2 hours or less	5.6	8.8	64%	34
4 hours or less	16.8	17.6	95%	34
<u>Amount of 20 millimetres (0.8 inches) falling within:</u>				
30 minutes or less	0.0	0.8*	0%	34
1 hour or less	0.6	1.8	33%	34
2 hours or less	1.5	3.6	42%	34
4 hours or less	6.5	7.2	90%	34
8 hours or less	17.9	14.4	124%	34
<u>Amount of 25 millimetres (1.0 inches) falling within:</u>				
1 hour or less	0.0	0.9	0%	34
2 hours or less	0.3	1.8	17%	34
4 hours or less	2.3	3.6	61%	34
8 hours or less	7.3	7.2	101%	34
16 hours or less	17.3	14.4	120%	34

Notes

1. The observed frequencies in Column 'A' above were calculated from intensities of rainfall recorded at Leuchars during the period of years shown in Column 'D'.
2. The estimated frequencies in Column 'B' above were obtained from Bilham's formula:

$$n = \frac{1.25t}{(r + 0.1)^{3.55}} \quad \text{where: } n = \text{frequency (number of days in 10 years)}$$

$$t = \text{duration in hours}$$

$$r = \text{rainfall in inches}$$

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 1M

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 1961 to 1970 at Leuchars

<u>Year</u>	<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>
	<u>Number of days</u>												
1961	12	12	6	12	8	10	8	14	13	16	8	13	132
1962	14	8	8	11	11	4	10	16	9	7	14	11	123
1963	12	13	15	13	16	7	13	19	8	8	18	8	150
1964	7	9	14	10	12	10	7	12	10	9	6	13	119
1965	15	5	8	12	13	11	12	8	14	8	12	19	137
1966	16	21	5	12	12	10	8	17	10	9	10	12	142
1967	12	10	9	10	18	5	5	8	12	15	8	7	119
1968	12	9	7	9	11	6	11	3	9	14	12	13	116
1969	15	12	13	12	16	12	6	9	8	5	6	11	125
1970	13	7	8	10	6	6	14	7	11	8	16	6	112
10 year mean	12.8	10.6	9.3	11.1	12.3	8.1	9.4	11.3	10.4	9.9	11.0	11.3	127.5

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 1961 to 1970 at Leuchars

<u>Year</u>	<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 Total</u>
	<u>Number of hours</u>												
1961	50	39	14	45	26	20	24	45	31	48	27	54	423
1962	48	15	18	34	22	9	20	65	38	15	55	48	387
1963	34	40	42	29	42	28	34	60	21	23	90	22	465
1964	25	20	48	27	20	24	20	46	33	27	14	42	346
1965	43	11	33	27	37	26	50	18	41	23	49	62	420
1966	57	90	13	52	45	39	20	57	39	29	31	46	518
1967	36	31	21	19	51	16	14	30	38	36	24	17	333
1968	32	28	24	22	42	17	31	13	30	56	41	35	371
1969	48	48	59	40	48	26	18	18	33	16	24	47	425
1970	50	12	20	22	17	30	43	24	22	24	48	20	332
10 year mean	42.3	33.4	29.2	31.7	35.0	23.5	27.4	37.6	32.6	29.7	40.3	39.3	402.0
10 year mean expressed as percentage of total working time	14%	12%	9%	11%	11%	8%	9%	12%	11%	10%	13%	13%	11%

TABLE 1N

Total duration in hours and tenths of 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 ten years from 1961 to 1970 at Leuchars

<u>Year</u>	<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 Total</u>
<u>Total duration in hours and tenths</u>													
1961	20.9	19.9	6.2	20.3	9.7	5.5	10.1	24.3	12.8	19.3	10.6	28.0	187.6
1962	22.8	3.2	5.8	9.5	7.7	4.3	5.6	33.8	19.6	3.9	22.4	13.9	152.5
1963	13.0	17.8	18.4	10.7	14.5	14.3	11.7	32.0	7.3	11.9	45.6	6.2	203.4
1964	7.7	8.7	26.8	15.1	5.7	9.9	9.0	21.9	18.8	9.8	4.2	19.9	157.5
1965	15.3	0.7	10.6	7.1	14.0	12.0	23.6	7.0	14.7	11.1	20.9	27.5	164.5
1966	21.6	51.2	2.3	30.4	22.4	20.9	6.4	24.6	15.9	17.4	13.3	28.6	255.0
1967	15.9	14.6	10.0	6.2	30.1	7.3	6.7	13.6	17.7	14.0	10.8	6.4	153.3
1968	16.1	10.8	8.1	11.2	28.0	6.1	11.8	10.5	14.8	33.7	14.9	10.1	176.1
1969	28.1	11.6	15.3	19.1	24.9	13.8	9.5	4.2	16.3	5.8	15.5	18.3	182.4
1970	18.8	5.5	4.2	8.6	7.8	15.0	20.5	12.0	10.0	10.0	26.3	9.9	148.6
10 year mean	18.0	14.4	10.8	13.8	16.5	10.9	11.5	18.4	14.8	13.7	18.4	16.9	178.1
10 year mean expressed as percentage of total working time	6%	5%	3%	5%	5%	4%	4%	6%	5%	4%	6%	5%	5%

TABLE 10

Number of days with rain falling at a rate of 0.5 millimetres or more per hour at some time 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 1961 to 1970 at Leuchars

<u>Year</u>	<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 Total</u>
<u>Number of days</u>													
1961	10	10	5	10	8	8	7	10	12	16	8	12	116
1962	14	8	6	9	11	4	9	14	8	6	11	9	109
1963	11	12	12	13	16	6	12	17	8	6	17	8	138
1964	5	8	10	9	12	10	7	11	10	8	6	13	109
1965	14	4	8	12	11	9	11	8	12	8	12	18	127
1966	11	19	5	11	11	10	8	16	9	9	9	12	130
1967	11	9	9	8	17	5	5	8	10	14	8	7	111
1968	10	9	6	8	10	6	11	3	9	12	11	13	108
1969	13	12	8	11	13	12	6	8	7	4	6	10	110
1970	11	7	7	10	6	6	12	7	11	8	15	5	105
10 year mean	11.0	9.8	7.6	10.1	11.5	7.6	8.8	10.2	9.6	9.1	10.3	10.7	116.3

Number of hours with rain falling at a rate of 0.5 millimetres or more per hour at some time 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 1961 to 1970 at Leuchars

<u>Year</u>	<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 Total</u>
<u>Number of hours</u>													
1961	39	30	12	28	22	16	19	36	25	41	22	44	334
1962	43	12	10	19	18	9	17	57	27	13	35	25	285
1963	27	30	30	25	37	26	29	50	17	17	63	18	369
1964	14	16	34	23	17	19	19	40	30	21	9	34	276
1965	32	5	24	24	28	21	44	14	33	16	44	53	338
1966	38	75	8	42	34	35	17	42	34	25	26	40	416
1967	29	23	21	13	48	15	13	24	33	33	21	15	288
1968	24	26	19	20	37	16	23	13	28	45	32	29	312
1969	42	27	17	30	41	24	16	13	22	12	22	35	301
1970	31	10	13	21	15	29	33	22	22	15	35	16	262
10 year mean	31.9	25.4	18.6	24.5	29.7	21.0	23.0	31.1	27.1	23.8	30.9	30.9	318.1

10 year mean expressed as percentage of total working time

10%	9%	6%	8%	10%	7%	7%	10%	9%	8%	10%	10%	9%
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TABLE 1P

Table for converting amounts of rainfall in millimetres to inches

<u>mm</u>	<u>inch</u>	<u>mm</u>	<u>inch</u>	<u>mm</u>	<u>inch</u>
.1	.004	10	.394	100	3.937
.2	.008	15	.591	200	7.874
.3	.012	20	.787	300	11.811
.4	.016	25	.984	400	15.748
.5	.020	30	1.181	500	19.685
.6	.024	35	1.378	600	23.622
.7	.028	40	1.575	700	27.559
.8	.031	45	1.772	800	31.496
.9	.035	50	1.969	900	35.433
				1000	39.370
1	.039	55	2.165		
2	.079	60	2.362		
3	.118	65	2.559		
4	.157	70	2.756		
5	.197	75	2.953		
6	.236	80	3.150		
7	.276	85	3.346		
8	.315	90	3.543		
9	.354	95	3.740		
10	.394	100	3.937		

## 2. Temperature

Winter temperatures at the main centres of population in the Tayside region are broadly similar to winter temperatures at places on the eastern side of England, but because of the higher latitude, the very slow rise in sea temperature at the end of winter and an increased frequency of cold easterly winds in the spring, the rise of temperature at the end of winter is delayed. Consequently, the wintry period is longer in the Tayside region than in England and spring is later and cooler.

In summer and early autumn, the effect of latitude on the heat received from the sun is the dominant factor and temperatures in the Tayside region are several degrees lower than in the south of England.

Averages and extremes of maximum, minimum and mean temperature for temperature recording stations in the Tayside region are given in Tables 2, 2A and 2B.

Statistics of monthly and annual mean temperatures for Dundee are given in Table 2C. The cooperating weather station at the College Gardens, Mayfield, Dundee lies on the Arbroath Road about 1 mile northeast of the northern end of the Tay Road Bridge.

Statistics of monthly maximum and minimum temperatures for Dundee are given in Tables 2D and 2E.

Statistics of annual maximum and minimum temperatures for temperature recording stations in the Tayside region are given in Table 2F.

The reader will notice from the statistics that maximum temperatures are remarkably uniform from place to place within the region especially when the extent of the region and the complexity of the terrain are taken into account. Perth has rather higher maximum temperatures than other stations in the region but this could perhaps be expected in view of the fact that Perth lies further away from the moderating influence of the sea and is much less prone to the effect of cooling sea breezes on warm days during the summer than places on the coast. Indeed, it is interesting to compare the maximum temperatures at Perth with the much lower values at Buddon Ness which lies on a stretch of sand dunes at the tip of the Barry

promontory on the northern side of the Tay estuary.

In contrast to the broad uniformity of the maximum temperatures, it can be seen that there is a considerable variation from place to place in minimum temperatures. These differences in minimum temperatures are attributable much more to the downhill drainage and stagnation of cold air on frosty nights (i.e. the frost-hollow effect) than to the effect of increasing altitude. The distance of a temperature recording station from the sea and whether the local soil is sandy or not are also factors which normally have a greater influence on minimum temperatures during frosty weather than an increase in altitude. It should be borne in mind that in winter the mean sea surface temperature of the North Sea is much higher than the mean air temperature over the adjacent land areas. Thus, places on the coast near the moderating influence of the sea e.g. Montrose, Arbroath, Carnoustie and St Andrews normally have higher minimum temperatures during the winter months than inland stations like Perth and Cupar. An exception with unexpectedly low minimum temperatures is the station at Buddon Ness sited on very sandy soil amid sand dunes which probably form a local frost hollow.

Averages and extremes of dry and wet bulb temperature at 0000 hours, 0300 hours, 0600 hours, 0900 hours, 1200 hours, 1500 hours, 1800 hours, and 2100 hours GMT are given for Leuchars in Tables 2G and 2H. (Averages and extremes of relative humidity for the same hours are given in Section 3 of this memorandum).

The percentage frequency of occasions with dry and wet bulb temperatures within certain limits at Leuchars are given in Tables 2I and 2J. (Percentage frequencies of relative humidity are given in Section 3 of this memorandum).

The number of days with maximum air temperatures reaching or exceeding 60°F, 65°F, 70°F, 75°F and 80°F are given for Dundee in Table 2K.

The actual and average number of days with air frost for certain temperature recording stations in the Tayside region are given in Table 2L.

The average and extreme dates of the first and last air frosts are given in Table 2M.

### 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 air temperatures "below 36°F", "below 34°F" and "below 32°F" during the winter months. Tables 2N, 2O and 2P which provide this type of information have been prepared from records of hourly readings of air temperature made at Leuchars between 0700 and 1700 hours Greenwich Mean Time (0800 and 1800 hours British Standard Time) on each day during the 10 years from 1961 to 1970.

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 2N, 2O and 2P that there will be occasions when the ground is frozen for several hours with an air temperature higher than 33.9°F or 35.9°F.

The figures in Tables 2N, 2O and 2P relate to a 7-day working week and not to a 5-day working week.

Averages and extremes of soil temperature at depths of 10 cm (4 inch) and 20 cm (8 inch) calculated from readings made once-daily at 0900 hours GMT from thermometers exposed under a surface of bare, consolidated, sandy loam at Mylnefield near Invergowrie are given in Tables 2Q and 2R. Mylnefield is the only location in the region at which readings of soil temperature are made but readings of earth temperatures at depths of 30 cm (1 ft) and 122 cm (4 ft) under a surface of short turf are available from other locations in the region - see Tables 2S and 2T.

Except during the winter months, soil temperatures at 10 cm and 20 cm are subject to large diurnal fluctuations which make the once-daily readings difficult to interpret. However, on average, the mean of the once-daily readings at 10 cm is about 2 degrees Fahrenheit below the mean for the day at that depth

while the mean of the once-daily readings at 20 cm is about 1 to 2 degrees Fahrenheit below the mean for the day.

When soil is bare or sparsely covered with vegetation, temperatures in the uppermost layers tend to differ depending on the type of soil. The differences are most marked when soils are dry and become negligible when soils are waterlogged. For example, the 10 cm temperature in dry, sandy soil during spells of sunny weather could be of the order of 4 or 5 degrees Fahrenheit higher than in a heavy clay. At night, temperature differences between soil types are less marked but temperatures are lowest in a dry sandy soil.

On a monthly average basis, the daily mean soil temperature at 10 cm and 20 cm could differ by as much as 2 degrees Fahrenheit depending on the type of soil. Clay soils in winter would tend to be slightly warmer than a well drained sandy soil but the reverse would apply in summer.

The Mylnefield data in Tables 2Q and 2R indicate a definite tendency for the considerable penetration of frost into the soil during spells of hard winter weather, particularly during periods when a protective covering of snow is not present.

Averages and extremes of earth temperature at a depth of 30 cm (1 ft) for Dundee, Mylnefield, Cupar and St Andrews are given in Table 2S together with a brief description of the type of soil at each station.

Averages and extremes of earth temperature at a depth of 122 cm (4 ft) for Mylnefield and St Andrews are given in Table 2T. Readings of earth temperature at a depth of 122 cm (4 ft) are not available from Dundee and Cupar.

The standard period for averages of earth temperature in current use in the British Isles is the 30 years from 1931 to 1960. For the stations at Mylnefield and Cupar where the full 30-year period of records is not available, a 30 year (1931-60) estimated average has been given in Tables 2S and 2T in order that comparisons between one station and another can be made. Tables 2S and 2T also include averages for the actual periods of records available from Mylnefield and Cupar.

At the 30 cm (1 ft) depth, the range of the diurnal variation of temperature could amount to 5 degrees in summer but is quite small at the 122 cm (4 ft) depth. The minimum temperature at a depth of 30 cm (1 ft) usually occurs around 0900 hours and the maximum at about 2000 hours. It can be seen from Tables 2S and 2T that the annual variation is quite large at both the 30 cm (1 ft) and 122 cm (4 ft) depths. At 30 cm (1 ft), the highest and lowest temperatures in a year usually occur in the months with the highest and lowest air temperatures but at 122 cm (4 ft), the extremes usually lag about one month behind.

Estimated averages of earth temperature at a depth of 1 metre

From Tables 2S and 2T it is possible to estimate averages of earth temperature at 1 metre by calculating an average thermal diffusivity between 30 cm (1 ft) and 122 cm (4 ft) and then using two harmonic analyses to estimate the amplitude of the mean temperature variation at 1 metre. The estimated averages of earth temperature at a depth of 1 metre calculated in this way are shown in Table 2U.

A table for converting degrees Fahrenheit to degrees Centigrade is at Table 2V.

TABLE 2

Averages of daily maximum, minimum and mean  $\left[ \frac{1}{2}(\text{max} + \text{min}) \right]$  temperature  
in degrees Fahrenheit for temperature recording stations in the  
Tayside area  
30 years period from 1931 to 1960

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<u>MONTROSE</u> (altitude 186 feet)													
Maximum	41.1	43.1	46.8	52.6	56.7	62.5	65.2	64.2	61.2	54.2	47.3	43.0	53.2
Minimum	31.3	32.1	34.5	37.5	41.6	46.5	50.1	49.7	46.6	41.9	36.3	33.7	40.1
Mean	36.2	37.6	40.7	45.1	49.1	54.5	57.7	56.9	53.9	48.1	41.8	38.3	46.7
<u>ARBROATH</u> (altitude 95 feet)													
Maximum	42.4	43.9	47.1	52.0	56.1	61.5	64.8	64.0	60.6	54.5	48.4	44.4	53.2
Minimum	32.4	33.3	35.4	38.3	42.1	46.9	50.9	50.5	47.3	42.8	37.8	35.1	41.0
Mean	37.4	38.6	41.3	45.1	49.1	54.2	57.9	57.3	53.9	48.7	43.1	39.7	47.1
<u>CARNOUSTIE</u> (altitude 29 feet)													
Maximum	42.3	44.5	48.1	53.6	57.7	63.0	66.6	65.8	62.2	55.4	48.5	44.0	54.3
Minimum	31.8	32.9	35.5	38.5	42.5	47.4	51.3	50.7	47.4	42.6	37.2	34.4	41.0
Mean	37.1	38.7	41.8	46.1	50.1	55.2	58.9	58.3	54.8	49.0	42.9	39.2	47.7
<u>BUDDON NESS</u> (altitude 15 feet)													
Maximum	42.2	43.4	46.7	51.8	55.9	61.3	64.4	63.8	60.7	54.5	48.1	44.5	53.1
Minimum	31.4	31.7	34.1	36.5	40.2	45.6	49.9	49.7	46.5	42.4	37.0	34.0	39.9
Mean	36.8	37.5	40.4	44.1	48.1	53.5	57.1	56.7	53.6	48.5	42.5	39.3	46.5
<u>DUNDEE</u> (altitude 147 feet)													
Maximum	41.4	43.2	46.9	52.5	57.9	63.7	66.9	65.7	61.7	54.7	47.7	43.7	53.8
Minimum	32.0	32.9	35.2	38.3	42.3	47.7	51.4	50.7	46.9	42.1	36.9	34.2	40.8
Mean	36.7	38.1	41.1	45.4	50.1	55.7	59.1	58.2	54.3	48.4	42.3	38.9	47.3
<u>MYLNEFIELD</u> (altitude 100 feet)													
Maximum	41.5	42.9	46.7	52.3	57.2	62.7	66.1	65.3	61.2	54.5	47.7	43.8	53.5
Minimum	30.4	31.5	34.3	37.3	41.1	46.3	49.9	49.6	46.1	41.4	35.8	33.0	39.7
Mean	35.9	37.2	40.5	44.8	49.1	54.5	58.0	57.5	53.7	47.9	41.7	38.4	46.6

TABLE 2 (Contd)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<u>PERTH</u> (altitude 77 feet)													
Maximum	42.1	43.9	48.0	54.0	59.9	65.5	67.8	65.8	62.2	55.0	48.0	44.1	54.7
Minimum	30.6	31.5	34.5	37.8	42.1	47.7	51.5	50.4	46.6	41.7	35.8	33.3	40.3
Mean	36.3	37.7	41.3	45.9	51.0	56.6	59.5	58.1	54.4	48.3	41.9	38.7	47.5
<u>CUPAR</u> (altitude 82 feet)													
Maximum	42.5	44.1	48.0	53.4	57.9	63.6	67.0	65.7	62.1	55.5	48.5	44.7	54.4
Minimum	31.5	31.9	34.9	37.6	41.6	46.7	50.5	50.1	46.7	41.6	36.3	33.7	40.3
Mean	37.0	38.0	41.5	45.5	49.7	55.1	58.7	57.9	54.4	48.5	42.4	39.2	47.3
<u>LEUCHARS</u> (altitude 34 feet)													
Maximum	41.7	43.7	47.3	52.7	56.7	62.4	65.8	64.9	61.3	54.9	47.8	43.7	53.6
Minimum	33.3	33.8	35.8	38.7	42.6	47.8	51.6	51.1	47.8	43.3	38.3	35.8	41.7
Mean	37.5	38.7	41.5	45.7	49.7	55.1	58.7	58.0	54.5	49.1	43.1	39.7	47.7
<u>ST ANDREWS</u> (altitude 13 feet)													
Maximum	42.8	44.1	47.3	52.2	56.1	62.1	65.7	64.4	61.2	55.0	48.4	44.8	53.7
Minimum	32.2	32.9	35.2	38.3	42.4	47.5	51.3	50.7	47.5	43.0	37.4	34.9	41.1
Mean	37.5	38.5	41.5	45.3	49.3	54.8	58.5	57.5	54.3	49.0	42.9	39.9	47.4

Note:-

The standard period for averages of daily maximum, minimum and mean temperature in current use in the British Isles is the 30 years period from 1931 to 1960. The averages quoted above for Arbroath, Dundee, Perth, Leuchars and St Andrews are actual averages over this period of 30 years but the averages quoted for the other locations have been estimated from shorter period or broken periods of records.

TABLE 2A

Averages of the highest and lowest temperatures in each month in degrees Fahrenheit for temperature recording stations in the Tayside area

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<u>Montrose</u> (altitude 186 feet) 17 years from 1954 to 1970													
Average of the highest each month	49	49	55	63	66	72	73	72	68	62	55	52	75*
Average of the lowest each month	23	21	25	29	34	39	41	41	38	33	27	24	18**
<u>Arbroath</u> (altitude 95 feet) 49 years from 1922 to 1970													
Average of the highest each month	52	52	57	61	65	72	73	72	68	63	56	52	76*
Average of the lowest each month	22	24	26	29	33	38	43	41	37	31	27	24	19**
<u>Carnoustie</u> (altitude 29 feet) 20 years from 1951 to 1970													
Average of the highest each month	51	51	56	63	66	72	74	73	69	63	55	52	76*
Average of the lowest each month	23	23	26	31	34	39	43	41	39	33	27	24	20**
<u>Buddon Ness</u> (altitude 15 feet) 30 years from 1941 to 1970													
Average of the highest each month	50	51	55	62	65	72	72	72	68	62	55	52	74*
Average of the lowest each month	16	17	19	22	28	33	38	37	34	29	23	20	13**
<u>Dundee</u> (altitude 147 feet) 48 years from 1923 to 1970													
Average of the highest each month	51	52	57	63	68	75	77	74	70	63	56	52	79*
Average of the lowest each month	23	24	27	30	34	39	44	43	37	31	27	25	20**
<u>Mylnefield</u> (altitude 100 feet) 17 years from 1954 to 1970													
Average of the highest each month	51	51	55	63	68	74	74	74	69	63	55	52	77*
Average of the lowest each month	19	19	25	28	33	38	41	38	37	31	25	22	16**
<u>Perth</u> (altitude 77 feet) 57 years from 1914 to 1970													
Average of the highest each month	53	53	58	64	71	77	77	76	70	64	57	53	80*
Average of the lowest each month	17	20	23	27	31	37	42	39	34	28	22	19	13**

TABLE 2A (Contd)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<u>Cubar</u> (altitude 82 feet) 15 years from 1956 to 1970													
Average of the highest each month	51	52	56	64	68	75	74	74	70	63	56	53	77*
Average of the lowest each month	18	15	24	26	32	37	40	37	35	30	23	20	13**
<u>Leuchars</u> (altitude 34 feet) 49 years from 1922 to 1970													
Average of the highest each month	52	53	57	63	68	74	75	74	70	64	57	53	77*
Average of the lowest each month	21	23	26	28	32	38	43	41	37	30	26	23	18**
<u>St Andrews</u> (altitude 13 feet) 57 years from 1914 to 1970													
Average of the highest each month	52	52	57	63	68	74	75	73	70	63	56	53	78*
Average of the lowest each month	21	23	25	28	32	38	42	41	36	30	25	23	18**

\* = 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 in the Tayside area

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<u>Montrose</u> (altitude 186 feet) 17 years from 1954 to 1970													
Absolute highest in each month	55	56	67	72	70	77	81	79	77	69	58	56	81*
Absolute lowest in each month	14	11	12	23	29	36	38	36	32	28	22	19	11**
<u>Arbroath</u> (altitude 95 feet) 49 years from 1922 to 1970													
Absolute highest in each month	58	61	68	71	80	83	86	81	76	72	67	58	86*
Absolute lowest in each month	4	12	9	19	26	31	37	36	28	22	18	11	4**
<u>Carnoustie</u> (altitude 29 feet) 20 years from 1951 to 1970													
Absolute highest in each month	58	59	65	69	74	82	87	77	77	69	58	57	87*
Absolute lowest in each month	16	15	18	27	29	33	39	37	30	30	21	18	15**
<u>Buddon Ness</u> (altitude 15 feet) 30 years from 1941 to 1970													
Absolute highest in each month	56	57	62	72	71	80	79	79	75	69	61	58	80*
Absolute lowest in each month	8	5	9	11	22	24	32	32	25	21	18	13	5**
<u>Dundee</u> (altitude 147 feet) 48 years from 1923 to 1970													
Absolute highest in each month	57	58	68	70	78	85	86	84	79	74	62	59	86*
Absolute lowest in each month	11	11	14	23	26	34	40	38	28	27	21	19	11**
<u>Mylnefield</u> (altitude 100 feet) 17 years from 1954 to 1970													
Absolute highest in each month	56	55	65	70	72	82	83	83	77	69	59	57	83*
Absolute lowest in each month	10	4	14	24	28	33	37	35	28	25	20	17	4**
<u>Perth</u> (altitude 77 feet) 57 years from 1914 to 1970													
Absolute highest in each month	58	58	68	75	80	89	88	84	78	77	64	59	89*
Absolute lowest in each month	0	-2	4	19	25	31	35	32	25	20	-7	7	-7**

TABLE 2B (Contd)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<u>Cupar</u> (altitude 82 feet) 15 years from 1956 to 1970													
Absolute highest in each month	58	55	66	71	74	81	80	80	76	70	59	55	81*
Absolute lowest in each month	11	4	11	20	27	32	36	33	30	25	19	12	4**
<u>Leuchars</u> (altitude 34 feet) 49 years from 1922 to 1970													
Absolute highest in each month	57	58	67	71	78	84	84	83	77	72	68	58	84*
Absolute lowest in each month	10	10	13	22	26	32	36	36	31	25	21	12	10**
<u>St Andrews</u> (altitude 13 feet) 57 years from 1914 to 1970													
Absolute highest in each month	58	57	68	72	78	84	86	82	78	73	68	59	86*
Absolute lowest in each month	7	10	12	20	28	32	33	35	29	23	16	12	7**

\* = Absolute highest during whole period

\*\* = Absolute lowest during whole period

TABLE 2C

Statistics of monthly and annual mean  $\frac{1}{2}(\text{max} + \text{min})$  temperatures in degrees Fahrenheit for Dundee (48 years from 1923 to 1970)

Statistics of monthly mean temperatures

<u>Month</u>	<u>Highest monthly mean</u>	<u>Monthly mean seldom*</u>	<u>Median</u> <sup>+</sup>	<u>Monthly mean seldom*</u>	<u>Lowest monthly mean</u>
	<u>°F</u>	<u>above</u> <u>°F</u>		<u>below</u> <u>°F</u>	
January	43.0 in January 1932	39.6	37.4	34.3	30.1 in January 1940
February	43.1 in February 1934	40.7	38.5	35.4	30.5 in February 1947
March	48.3 in March 1938	43.9	41.2	38.1	34.5 in March 1947
April	49.7 in April 1943	47.1	44.9	43.1	41.7 in April 1941 and 1966
May	54.2 in May 1960	50.8	50.1	48.1	45.1 in May 1958
June	59.1 in June 1960	57.0	55.8	54.4	51.9 in June 1928
July	62.7 in July 1933 and 1955	60.3	58.9	57.5	54.1 in July 1965
August	62.3 in August 1947	59.1	57.9	56.4	53.9 in August 1956
September	57.7 in September 1949	56.0	54.5	52.4	49.9 in September 1952
October	54.1 in October 1969	50.0	48.4	47.2	44.2 in October 1926
November	45.5 in November 1953	43.6	42.1	40.3	37.7 in November 1925
December	43.9 in December 1924	40.4	38.5	37.0	33.7 in December 1950

Statistics of annual mean temperatures

<u>Period of record</u>	<u>Highest annual mean</u>	<u>Annual mean seldom*</u>	<u>Median</u> <sup>+</sup>	<u>Annual mean seldom*</u>	<u>Lowest annual mean</u>
	<u>°F</u>	<u>above</u> <u>°F</u>		<u>below</u> <u>°F</u>	
48 years	49.2 in 1959	48.1	47.1	46.6	45.9 in 1941

\*Seldom = 20 per cent of occasions or 1 year in 5; the figures given are the upper and lower quintiles.

<sup>+</sup>Median = the "middle" value, ie half the mean temperatures exceed it and half fall below it.

TABLE 2D

Statistics of monthly maximum temperatures in degrees Fahrenheit  
for Dundee  
(48 years from 1923 to 1970)

<u>Month</u>	<u>Highest monthly maximum temperature</u>	<u>Monthly maximum temperature seldom* above</u>	<u>Median<sup>+</sup></u>	<u>Monthly maximum temperature seldom* below</u>	<u>Lowest monthly maximum temperature</u>
January	57°F in January 1927	53°F	51°F	49°F	42°F in January 1940
February	58°F in February 1934	55°F	53°F	49°F	38°F in February 1947
March	68°F in March 1929	60°F	56°F	54°F	48°F in March 1937, 1947 and 1962
April	70°F in April 1937 and 1967	67°F	63°F	59°F	55°F in April 1932
May	78°F in May 1939 and 1948	72°F	68°F	65°F	61°F in May 1930
June	85°F in June 1950	79°F	75°F	72°F	66°F in June 1927
July	86°F in July 1933	79°F	77°F	73°F	65°F in July 1965
August	84°F in August 1955	71°F	74°F	77°F	67°F in August 1931
September	79°F in September 1941	72°F	69°F	67°F	65°F in September 1935 and 1967
October	74°F in October 1926	65°F	63°F	62°F	57°F in October 1952
November	62°F in November 1927	58°F	55°F	54°F	51°F in November 1950 and 1966
December	59°F in December 1942	55°F	52°F	50°F	46°F in December 1950

\*Seldom = 20 per cent of occasions or 1 year in 5; the figures given are the upper and lower quintiles.

<sup>+</sup>Median = the "middle" value, ie half the maximum temperatures exceed it and half fall below it.

TABLE 2E

Statistics of monthly minimum temperatures in degrees Fahrenheit  
for Dundee  
(48 years from 1923 to 1970)

<u>Month</u>	<u>Highest monthly minimum temperature</u>	<u>Monthly minimum temperature seldom* above</u>	<u>Median<sup>+</sup></u>	<u>Monthly minimum temperature seldom* below</u>	<u>Lowest monthly minimum temperature</u>
January	31°F in January 1925	27°F	23°F	19°F	11°F in January 1927 and 1942
February	30°F in February 1923 and 1962	28°F	25°F	20°F	11°F in February 1956
March	34°F in March 1957	30°F	27°F	24°F	14°F in March 1947
April	35°F in April 1937	32°F	30°F	28°F	23°F in April 1968
May	40°F in May 1914 and 1970	36°F	34°F	31°F	26°F in May 1946
June	47°F in June 1960	42°F	39°F	37°F	34°F in June 1941
July	50°F in July 1934	46°F	44°F	42°F	40°F in July 1939, 1941 and 1965
August	48°F in August 1936	45°F	43°F	40°F	38°F in August 1940 and 1944
September	43°F in September 1933, 1953, 1958 and 1961	40°F	38°F	35°F	28°F in September 1942
October	37°F in October 1947 and 1969	34°F	32°F	29°F	27°F in October 1926
November	33°F in November 1953	29°F	27°F	25°F	21°F in November 1947 and 1952
December	32°F in December 1924	29°F	25°F	21°F	19°F in December 1937, 1947 and 1961

\*Seldom = 20 per cent of occasions or 1 year in 5; the figures given are the upper and lower quintiles.

<sup>+</sup>Median = the "middle" value, ie half the minimum temperatures exceed it and half fall below it.

TABLE 2F

Statistics of annual maximum and minimum temperatures in degrees Fahrenheit for temperature recording stations in the Tayside area

	Period of record	Annual maximum temperature °F					Annual minimum temperature °F				
		Highest	Seldom* above	Median +	Seldom* below	Lowest	Lowest	Seldom* below	Median +	Highest	
<u>Montrose</u> (altitude 186 feet)	17 years	81	78	75	73	71	11	14	18	24	
<u>Arbroath</u> (altitude 95 feet)	49 years	86	79	76	72	67	4	15	20	27	
<u>Carnoustie</u> (altitude 29 feet)	20 years	87	78	76	73	68	15	18	19	25	
<u>Buddon Ness</u> (altitude 15 feet)	30 years	80	77	74	72	70	5	10	13	19	
<u>Dundee</u> (altitude 147 feet)	48 years	86	81	78	76	73	11	19	21	27	
<u>Wynnefield</u> (altitude 100 feet)	17 years	83	80	77	75	74	4	14	16	22	
<u>Porth</u> (altitude 77 feet)	57 years	89	83	80	78	74	-7	7	14	21	
<u>Cupar</u> (altitude 82 feet)	15 years	81	76	77	75	74	4	9	13	19	
<u>Leuchars</u> (altitude 34 feet)	49 years	84	80	77	75	70	10	13	19	26	
<u>St. Andrews</u> (altitude 13 feet)	57 years	86	81	78	75	70	7	14	19	25	

\*Seldom = 20 per cent of occasions or 1 year in 5; the figures given are the upper and lower quintiles.

+Median = the "middle" value, ie half the temperatures exceed it and half fall below it.

TABLE 2G

Averages and extremes of dry bulb temperature in degrees Centigrade  
at 0000 hours, 0300 hours, 0600 hours, 0900 hours, 1200 hours,  
1500 hours, 1800 hours and 2100 hours GMT at Leuchars  
 (14 years from 1957 to 1970)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	°C												
<u>Dry bulb temperature</u>													
<u>At 0000 hours GMT</u>													
Average	2.5	2.3	3.8	5.2	7.5	10.4	11.7	11.8	10.7	8.7	4.8	3.1	6.9
Absolute maximum	11.7	11.4	12.0	12.2	13.7	17.2	17.8	19.4	16.2	16.5	13.3	11.7	19.4
Absolute minimum	-8.0	-6.9	-5.7	-2.8	0.4	2.1	5.6	4.3	2.7	0.5	-4.0	-7.1	-8.0
<u>At 0300 hours GMT</u>													
Average	2.4	2.0	3.4	4.6	6.7	9.7	11.0	11.2	10.3	8.5	4.7	2.9	6.5
Absolute maximum	10.6	11.0	11.7	12.8	12.8	16.7	17.8	18.3	16.7	16.2	12.8	12.0	18.3
Absolute minimum	-6.1	-8.0	-7.5	-4.2	-1.6	1.0	3.4	4.0	2.8	-2.2	-4.9	-7.2	-8.0
<u>At 0600 hours GMT</u>													
Average	2.4	2.0	3.3	4.6	7.3	10.7	11.7	11.3	10.1	8.3	4.6	2.8	6.6
Absolute maximum	11.1	10.8	10.7	11.7	12.8	16.7	19.0	18.9	17.0	16.1	12.6	12.2	19.0
Absolute minimum	-6.0	-9.2	-7.6	-4.6	-0.6	5.0	5.4	2.7	2.4	-0.8	-4.1	-7.1	-9.2
<u>At 0900 hours GMT</u>													
Average	2.4	2.3	4.7	7.5	10.2	13.4	14.4	14.2	12.5	9.6	4.8	2.8	8.3
Absolute maximum	11.1	10.6	12.2	15.4	17.3	20.6	21.7	20.6	18.5	16.6	13.3	11.2	21.7
Absolute minimum	-6.6	-9.8	-5.1	-2.1	2.5	8.1	9.7	9.4	7.2	0.9	-3.8	-5.1	-9.8
<u>At 1200 hours GMT</u>													
Average	4.0	4.6	6.8	9.4	11.6	15.1	16.0	16.0	14.6	11.9	7.0	4.3	10.1
Absolute maximum	12.2	12.0	17.0	19.2	20.6	24.4	23.5	25.2	22.2	19.4	14.6	11.5	25.2
Absolute minimum	-5.0	-6.2	-0.6	0.0	3.9	8.9	9.7	10.6	9.4	4.9	-2.0	-3.5	-6.2
<u>At 1500 hours GMT</u>													
Average	4.4	5.2	7.3	9.7	12.0	15.5	16.5	16.4	14.9	12.1	7.1	4.4	10.5
Absolute maximum	12.8	12.3	18.8	20.0	22.1	26.7	24.1	24.7	24.4	20.2	15.3	11.8	26.7
Absolute minimum	-3.3	-2.3	0.1	0.5	4.2	8.2	8.6	10.3	9.2	3.3	-0.6	-3.9	-3.9
<u>At 1800 hours GMT</u>													
Average	3.2	3.5	5.9	8.6	10.9	14.4	15.5	15.2	13.4	10.1	5.5	3.3	9.2
Absolute maximum	11.7	11.1	15.9	17.8	21.0	25.0	24.4	22.9	21.7	16.5	14.5	12.1	25.0
Absolute minimum	-5.6	-7.0	-1.2	1.0	3.3	6.6	7.7	10.0	8.4	1.4	-2.5	-5.0	-7.0
<u>At 2100 hours GMT</u>													
Average	2.7	2.7	4.4	6.3	8.7	12.1	13.2	12.9	11.5	9.1	5.0	3.1	7.7
Absolute maximum	13.3	11.6	12.2	13.3	16.2	19.4	20.0	20.5	17.2	16.7	13.3	11.7	20.5
Absolute minimum	-6.5	-7.9	-5.6	-0.5	2.6	5.8	8.1	7.9	5.3	-0.5	-3.7	-6.0	-7.9

TABLE 2H

Averages and extremes of wet bulb temperature in degrees Centigrade  
 at 0000 hours, 0300 hours, 0600 hours, 0900 hours, 1200 hours,  
 1500 hours, 1800 hours and 2100 hours GMT at Leuchars  
 (14 years from 1957 to 1970)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	°C												
<u>Wet bulb temperature</u>													
<u>At 0000 hours GMT</u>													
Average	1.8	1.5	2.9	4.2	6.6	9.5	10.8	11.0	9.9	7.9	4.1	2.3	6.0
Absolute maximum	9.4	10.0	10.8	11.1	12.8	16.1	16.5	17.8	15.3	15.2	12.0	10.6	17.8
Absolute minimum	-8.0	-6.8	-5.9	-3.5	0.1	1.1	5.0	4.0	2.6	-0.3	-4.0	-7.4	-8.0
<u>At 0300 hours GMT</u>													
Average	1.7	1.3	2.7	3.8	5.9	8.9	10.2	10.5	9.6	7.7	3.9	2.1	5.7
Absolute maximum	10.0	9.6	10.2	11.1	12.1	16.7	16.2	16.7	15.6	15.3	12.2	10.9	16.7
Absolute minimum	-6.7	-8.1	-7.8	-4.3	-1.8	0.6	3.3	3.7	2.2	-2.3	-4.9	-7.3	-8.1
<u>At 0600 hours GMT</u>													
Average	1.6	1.2	2.5	3.8	6.5	9.8	10.7	10.6	9.3	7.5	3.8	2.1	5.8
Absolute maximum	10.0	10.0	10.0	10.6	12.0	16.1	17.6	17.8	15.9	15.2	11.8	10.6	17.8
Absolute minimum	-6.5	-9.2	-7.9	-5.1	-0.7	3.4	5.0	2.3	1.7	-1.3	-4.5	-7.3	-9.2
<u>At 0900 hours GMT</u>													
Average	1.6	1.5	3.5	5.8	8.2	11.3	12.2	12.4	11.1	8.6	4.0	2.1	6.9
Absolute maximum	9.7	10.0	11.7	12.3	14.5	17.8	19.0	17.8	16.1	15.2	11.2	10.0	19.0
Absolute minimum	-6.9	-9.9	-5.6	-4.0	1.9	4.8	8.1	7.9	4.4	0.4	-3.9	-5.6	-9.9
<u>At 1200 hours GMT</u>													
Average	2.9	3.2	4.9	6.9	9.1	12.2	13.0	13.3	12.1	10.0	5.7	3.3	8.1
Absolute maximum	10.6	10.4	11.9	15.0	16.1	17.8	18.5	18.9	17.3	16.4	13.5	10.6	18.9
Absolute minimum	-5.0	-6.2	-1.9	-1.3	2.8	6.3	9.1	8.3	5.6	2.5	-3.1	-4.4	-6.2
<u>At 1500 hours GMT</u>													
Average	3.3	3.7	5.2	7.1	9.4	12.4	13.4	13.6	12.3	10.1	5.8	3.4	8.3
Absolute maximum	10.6	10.6	12.2	14.5	16.7	18.3	19.4	19.4	18.0	17.6	14.2	10.8	19.4
Absolute minimum	-3.9	-4.3	-1.6	0.0	3.7	6.5	7.7	9.4	6.7	2.4	-2.4	-4.9	-4.9
<u>At 1800 hours GMT</u>													
Average	2.3	2.5	4.4	6.5	8.7	11.8	12.8	13.0	11.6	8.9	4.6	2.5	7.5
Absolute maximum	11.1	10.0	12.1	13.2	15.6	18.3	18.9	18.3	16.5	15.6	13.7	10.6	18.9
Absolute minimum	-5.6	-7.9	-2.8	-1.0	2.2	5.2	7.2	8.7	5.7	-0.3	-3.1	-5.9	-7.9
<u>At 2100 hours GMT</u>													
Average	2.0	1.8	3.4	5.1	7.5	10.6	11.7	11.8	10.4	8.2	4.2	2.3	6.6
Absolute maximum	12.2	9.8	11.1	11.4	14.4	17.2	18.0	18.3	15.5	15.4	12.0	11.0	18.3
Absolute minimum	-6.5	-8.4	-5.8	-1.8	1.4	4.8	7.1	6.8	4.4	-1.4	-3.9	-6.9	-8.4

TABLE 2I

Percentage number of occasions with dry bulb temperatures at or below certain limits at 0000, 0300, 0600, 0900, 1200, 1500, 1800 and 2100 hours GMT calculated from readings made at Leuchars, Fife, during the 14 years from 1957 to 1970

Month	Hour GMT	0°C (32.0°F) or below	4°C (39.2°F) or below	8°C (46.4°F) or below	12°C (53.6°F) or below	16°C (60.8°F) or below	20°C (68.0°F) or below
		%	%	%	%	%	%
January	0000	22	68	95	100	100	100
	0300	22	69	97	100	100	100
	0600	22	71	97	100	100	100
	0900	22	69	97	100	100	100
	1200	9	51	91	100	100	100
	1500	5	47	90	100	100	100
	1800	15	64	93	100	100	100
	2100	20	67	93	100	100	100
February	0000	25	71	94	100	100	100
	0300	28	72	96	100	100	100
	0600	29	72	95	100	100	100
	0900	25	71	95	100	100	100
	1200	5	46	84	100	100	100
	1500	3	39	80	100	100	100
	1800	14	59	91	100	100	100
	2100	22	68	94	100	100	100
March	0000	12	54	91	100	100	100
	0300	15	58	92	100	100	100
	0600	15	60	91	100	100	100
	0900	7	41	86	99	100	100
	1200	1	19	65	96	100	100
	1500	0	18	61	92	100	100
	1800	3	28	75	98	100	100
	2100	9	46	87	100	100	100
April	0000	5	37	82	99	100	100
	0300	9	42	86	99	100	100
	0600	9	42	85	100	100	100
	0900	1	12	59	95	100	100
	1200	0	5	34	79	99	100
	1500	0	4	36	73	97	100
	1800	0	7	47	85	99	100
	2100	1	23	73	99	100	100

TABLE 2I (Contd)

Month	Hour GMT	0°C (32.0°F) or below	4°C (39.2°F) or below	8°C (46.4°F) or below	12°C (53.6°F) or below	16°C (60.8°F) or below	20°C (68.0°F) or below
		%	%	%	%	%	%
May	0000	0	7	60	97	100	100
	0300	1	14	70	99	100	100
	0600	1	7	62	98	100	100
	0900	0	0	20	78	99	100
	1200	0	0	9	55	92	100
	1500	0	0	10	52	90	99
	1800	0	1	15	65	95	99
	2100	0	1	38	93	100	100
June	0000	0	1	13	79	99	100
	0300	0	2	23	87	100	100
	0600	0	0	9	76	99	100
	0900	0	0	0	26	87	99
	1200	0	0	0	12	65	95
	1500	0	0	0	11	58	93
	1800	0	0	1	18	72	96
	2100	0	0	2	52	95	100
July	0000	0	0	4	55	98	100
	0300	0	0	11	65	99	100
	0600	0	0	3	58	98	100
	0900	0	0	0	13	79	99
	1200	0	0	0	6	50	95
	1500	0	0	0	4	46	91
	1800	0	0	0	9	62	96
	2100	0	0	0	28	91	100
August	0000	0	0	7	53	97	100
	0300	0	0	12	61	98	100
	0600	0	1	11	59	98	100
	0900	0	0	0	11	83	99
	1200	0	0	0	3	52	95
	1500	0	0	0	3	47	93
	1800	0	0	0	5	66	97
	2100	0	0	0	33	94	100

TABLE 2I (Contd)

Month	Hour GMT	0°C (32.0°F) or below	4°C (39.2°F) or below	8°C (46.4°F) or below	12°C (53.6°F) or below	16°C (60.8°F) or below	20°C (68.0°F) or below
		%	%	%	%	%	%
September	0000	0	1	17	68	99	100
	0300	0	1	19	73	100	100
	0600	0	2	23	75	99	100
	0900	0	0	1	40	96	100
	1200	0	0	0	11	75	99
	1500	0	0	0	8	71	98
	1800	0	0	0	25	89	99
	2100	0	0	8	57	99	100
October	0000	0	7	39	88	100	100
	0300	1	10	42	89	100	100
	0600	1	11	43	90	100	100
	0900	0	3	26	82	99	100
	1200	0	0	6	49	97	100
	1500	0	0	7	47	96	100
	1800	0	2	22	78	99	100
	2100	1	5	36	85	100	100
November	0000	11	40	80	99	100	100
	0300	11	42	81	99	100	100
	0600	11	45	81	99	100	100
	0900	11	42	81	99	100	100
	1200	1	16	60	97	100	100
	1500	0	16	62	97	100	100
	1800	5	35	77	99	100	100
	2100	9	40	80	99	100	100
December	0000	21	62	92	100	100	100
	0300	20	65	93	100	100	100
	0600	23	64	94	100	100	100
	0900	22	64	95	100	100	100
	1200	8	47	89	100	100	100
	1500	7	46	90	100	100	100
	1800	15	60	92	100	100	100
	2100	17	62	93	100	100	100

Example:- At 0600 hours GMT in December during the 14 years from 1957 to 1970, air temperatures were at or below 4 degrees Centigrade (39.2°F) on 64 per cent of occasions.

TABLE 2J

Percentage number of occasions with wet bulb temperatures at or below certain limits at 0000, 0300, 0600, 0900, 1200, 1500, 1800 and 2100 hours GMT calculated from readings made at Leuchars, Fife, during the 14 years from 1957 to 1970

Month	Hour GMT	0°C (32.0°F) or below	4°C (39.2°F) or below	8°C (46.4°F) or below	12°C (53.6°F) or below	16°C (60.8°F) or below	20°C (68.0°F) or below
		%	%	%	%	%	%
January	0000	29	75	97	100	100	100
	0300	29	77	99	100	100	100
	0600	30	76	99	100	100	100
	0900	29	75	99	100	100	100
	1200	20	61	97	100	100	100
	1500	13	61	95	100	100	100
	1800	22	72	96	100	100	100
	2100	27	76	97	100	100	100
February	0000	32	80	98	100	100	100
	0300	35	80	98	100	100	100
	0600	35	81	97	100	100	100
	0900	33	78	98	100	100	100
	1200	15	61	93	100	100	100
	1500	12	56	92	100	100	100
	1800	23	71	96	100	100	100
	2100	29	77	97	100	100	100
March	0000	16	65	95	100	100	100
	0300	18	68	96	100	100	100
	0600	21	70	96	100	100	100
	0900	12	58	95	100	100	100
	1200	4	39	86	100	100	100
	1500	2	36	83	100	100	100
	1800	7	46	90	100	100	100
	2100	14	60	94	100	100	100
April	0000	9	48	91	100	100	100
	0300	13	53	91	100	100	100
	0600	15	51	91	100	100	100
	0900	1	28	77	100	100	100
	1200	1	17	63	99	100	100
	1500	0	15	60	97	100	100
	1800	1	20	70	99	100	100
	2100	4	36	85	100	100	100

TABLE 2J (contd)

Month	Hour GMT	0°C (32.0°F) or below	4°C (39.2°F) or below	8°C (46.4°F) or below	12°C (53.6°F) or below	16°C (60.8°F) or below	20°C (68.0°F) or below
		%	%	%	%	%	%
May	0000	0	14	75	99	100	100
	0300	1	22	79	100	100	100
	0600	1	15	75	100	100	100
	0900	0	4	45	96	100	100
	1200	0	1	33	89	100	100
	1500	0	1	28	86	100	100
	1800	0	2	39	91	100	100
	2100	0	6	61	99	100	100
June	0000	0	1	24	91	99	100
	0300	0	3	34	93	99	100
	0600	0	1	17	89	100	100
	0900	0	0	5	69	98	100
	1200	0	0	2	49	96	100
	1500	0	0	1	45	96	100
	1800	0	0	2	58	97	100
	2100	0	0	5	80	99	100
July	0000	0	0	11	72	99	100
	0300	0	0	17	79	99	100
	0600	0	0	9	76	99	100
	0900	0	0	0	49	97	100
	1200	0	0	0	33	91	100
	1500	0	0	0	26	88	100
	1800	0	0	0	35	95	100
	2100	0	0	1	56	98	100
August	0000	0	0	12	67	99	100
	0300	0	0	17	71	99	100
	0600	0	1	15	71	99	100
	0900	0	0	0	45	97	100
	1200	0	0	0	29	90	100
	1500	0	0	0	23	87	100
	1800	0	0	0	32	93	100
	2100	0	0	3	56	99	100

TABLE 2J (contd)

Month	Hour GMT	0°C (32.0°F) or below	4°C (39.2°F) or below	8°C (46.4°F) or below	12°C (53.6°F) or below	16°C (60.8°F) or below	20°C (68.0°F) or below
		%	%	%	%	%	%
September	0000	0	1	22	77	100	100
	0300	0	1	28	83	100	100
	0600	0	3	31	83	100	100
	0900	0	0	7	67	100	100
	1200	0	0	2	53	98	100
	1500	0	0	2	46	96	100
	1800	0	0	6	59	99	100
	2100	0	0	15	73	100	100
October	0000	0	10	49	93	100	100
	0300	1	14	52	92	100	100
	0600	2	15	53	95	100	100
	0900	0	6	42	93	100	100
	1200	0	1	20	79	99	100
	1500	0	1	20	77	99	100
	1800	0	4	36	89	100	100
	2100	1	8	46	92	100	100
November	0000	15	48	86	100	100	100
	0300	15	50	87	100	100	100
	0600	15	52	89	100	100	100
	0900	15	49	87	100	100	100
	1200	3	31	78	99	100	100
	1500	1	28	78	100	100	100
	1800	8	45	87	100	100	100
	2100	11	47	86	100	100	100
December	0000	27	73	95	100	100	100
	0300	27	73	97	100	100	100
	0600	28	74	97	100	100	100
	0900	29	75	97	100	100	100
	1200	15	61	95	100	100	100
	1500	13	60	94	100	100	100
	1800	22	71	95	100	100	100
	2100	24	73	95	100	100	100

Example:- At 0600 hours GMT in December during the 14 years from 1957 to 1970, wet bulb temperatures were at or below 4 degrees Centigrade (39.2°F) on 74 per cent of occasions.

TABLE 2K

Number of days with maximum air temperatures reaching or exceeding  
60°F, 65°F, 70°F, 75°F and 80°F at Dundee  
(10 years from 1961 to 1970)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
<u>Number of days with maximum air temperatures reaching or exceeding 60°F</u>													
1961			1	6	12	24	28	28	20	9			128
1962				1	12	30	22	25	13	10			113
1963				4	10	24	26	26	21	6			117
1964				6	14	25	31	24	21	1	1		123
1965			2	1	8	22	19	27	12	1			92
1966				2	15	23	31	25	20				116
1967				6	4	24	29	29	20	2			114
1968				5	2	27	24	30	16	8			112
1969					5	24	31	31	18	17			126
1970					14	24	26	25	25	3			117
10 year average	0	0	< 1	3	10	25	27	27	18	6	< 1	0	116
<u>Number of days with maximum air temperatures reaching or exceeding 65°F</u>													
1961					3	18	14	17	7				59
1962				1	4	18	11	16	4				54
1963					2	7	12	7	5				33
1964					4	15	24	12	5				60
1965			1		3	12	3	8	3				30
1966				1	5	8	18	7	9				48
1967				3		11	20	16	3				53
1968				1		11	11	18	5				46
1969					1	13	25	25	10	3			77
1970					5	12	10	16	6				49
10 year average	0	0	< 1	1	3	12	15	14	6	< 1	0	0	51

TABLE 2K (Contd)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
<u>Number of days with maximum air temperatures reaching or exceeding 70°F</u>													
1961						2	2	4	2				10
1962						5	3	1					9
1963						2	4	2					8
1964						4	8	4					16
1965						4							4
1966						1	7	2					10
1967				2		2	6	7					17
1968						2	1	4	1				8
1969						5	13	9	5	1			33
1970					2	4	1	4					11
10 year average	0	0	0	< 1	< 1	3	5	4	1	< 1	0	0	13
<u>Number of days with maximum air temperatures reaching or exceeding 75°F</u>													
1961							1	1					2
1962						2							2
1963							1						1
1964							1	2					3
1965						1							1
1966							3						3
1967								1					1
1968													0
1969						1	4	1	2				8
1970						1		1					2
10 year average	0	0	0	0	0	< 1	1	1	< 1				2

Note: During the 10 years from 1961 to 1970 there were only 2 days at Dundee with maximum temperatures reaching or exceeding 80°F viz

80°F on 4 August 1964  
80°F on 14 July 1969

TABLE 2L

Actual and average number of days of air frost (minimum air temperature less than 32°F) at temperature recording stations in the Tayside area

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
<u>Montrose (altitude 186 feet) - 15 years from 1956 to 1970</u>													
1956	21	22	5	9	0	0	0	0	0	1	6	3	67
1957	12	15	0	2	1	0	0	0	0	0	5	13	48
1958	17	13	15	5	0	0	0	0	0	0	8	13	71
1959	26	12	2	1	1	0	0	0	0	0	5	9	56
1960	13	20	2	1	1	0	0	0	0	0	7	15	59
1961	16	5	3	4	0	0	0	0	0	1	9	20	58
1962	10	9	17	8	0	0	0	0	0	1	11	19	75
1963	21	21	8	1	0	0	0	0	0	0	6	10	67
1964	6	10	2	1	0	0	0	0	0	1	9	18	47
1965	18	9	15	4	0	0	0	0	0	0	10	15	71
1966	11	12	7	8	0	0	0	0	0	2	8	10	58
1967	7	5	2	4	1	0	0	0	0	0	6	12	37
1968	14	20	3	8	2	0	0	0	0	0	5	10	62
1969	6	18	10	3	0	0	0	0	0	0	19	12	68
1970	9	16	12	11	0	0	0	0	0	1	4	6	59
15-year average	14	14	7	5	< 1	0	0	0	0	< 1	8	12	60
<u>Arbroath (altitude 95 feet) - 15 years from 1956 to 1970</u>													
1956	17	21	2	5	0	0	0	0	0	1	5	5	56
1957	11	11	0	1	1	0	0	0	0	0	0	9	33
1958	13	13	14	4	0	0	0	0	0	0	4	11	59
1959	24	10	0	0	0	0	0	0	0	0	3	2	39
1960	12	18	3	0	0	0	0	0	0	0	4	14	51
1961	13	3	1	2	0	0	0	0	0	0	4	18	41
1962	12	5	13	4	0	0	0	0	0	0	11	14	59
1963	18	20	3	0	0	0	0	0	0	0	5	9	55
1964	5	5	2	0	0	0	0	0	0	0	4	11	27
1965	11	4	11	0	0	0	0	0	0	0	12	10	48
1966	9	10	1	8	0	0	0	0	0	0	4	8	40
1967	3	1	1	3	1	0	0	0	0	0	6	12	27
1968	12	16	2	5	0	0	0	0	0	0	3	11	49
1969	5	17	8	1	0	0	0	0	0	0	11	6	48
1970	8	15	10	7	0	0	0	0	0	0	4	1	45
15-year average	12	11	5	3	< 1	0	0	0	0	< 1	5	9	45

TABLE 2L (Contd)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
<u>Carnoustie</u> (altitude 29 feet) - 12 years from 1959 to 1970													
1959	22	10	1	0	0	0	0	0	0	0	4	4	41
1960	11	21	2	1	0	0	0	0	0	0	7	15	57
1961	12	4	0	2	0	0	0	0	0	0	6	17	41
1962	13	7	12	5	0	0	0	0	0	1	11	19	68
1963	21	20	6	1	0	0	0	0	0	0	7	10	65
1964	9	9	1	1	0	0	0	0	0	0	9	18	47
1965	16	8	11	4	0	0	0	0	0	0	13	16	68
1966	14	13	5	11	0	0	0	0	0	1	14	19	77
1967	14	6	8	3	3	0	0	0	0	1	7	12	54
1968	13	18	6	7	0	0	0	0	0	0	2	9	55
1969	6	20	16	9	0	0	0	0	0	0	13	13	77
1970	9	15	11	8	0	0	0	0	0	0	6	10	59
12-year average	13	13	7	4	< 1	0	0	0	0	< 1	8	14	59
<u>Buddon Ness</u> (altitude 15 feet) - 14 years from 1956 to 1969													
1956	15	22	7	16	4	1	0	0	0	1	4	5	75
1957	8	16	3	7	7	4	0	0	0	0	7	11	63
1958	14	17	16	8	2	0	0	0	0	1	11	12	81
1959	26	13	8	5	1	0	0	0	0	0	3	9	65
1960	14	21	2	4	4	0	0	0	0	0	9	16	70
1961	13	7	5	5	2	1	1	0	0	2	9	20	65
1962	10	10	17	10	3	2	0	0	0	2	15	17	86
1963	21	21	9	2	2	0	0	0	0	0	8	11	74
1964	7	8	6	4	0	1	0	0	1	3	9	13	52
1965	12	11	14	9	2	1	0	0	0	1	14	16	80
1966	11	11	4	7	6	0	0	0	0	3	7	12	61
1967	9	4	4	8	4	1	0	0	0	2	5	13	50
1968	13	17	9	11	8	0	0	0	0	1	3	12	74
1969	9	17	12	9	0	0	0	0	0	0	16	14	77
14-year average	13	14	8	7	3	1	< 1	0	< 1	1	9	13	69

TABLE 2L (Contd)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
<u>Dundee</u> (altitude 147 feet) - 15 years from 1956 to 1970													
1956	18	21	8	4	0	0	0	0	0	1	6	6	64
1957	10	13	0	1	0	0	0	0	0	0	2	10	36
1958	15	15	15	4	0	0	0	0	0	0	7	9	65
1959	26	10	1	0	0	0	0	0	0	0	3	4	44
1960	11	21	2	1	0	0	0	0	0	0	6	15	56
1961	12	4	0	3	0	0	0	0	0	0	7	19	45
1962	10	6	14	3	0	0	0	0	0	1	10	17	61
1963	20	20	6	0	0	0	0	0	0	0	6	9	61
1964	7	7	2	0	0	0	0	0	0	0	6	14	36
1965	15	8	12	1	0	0	0	0	0	0	13	13	62
1966	11	12	3	6	0	0	0	0	0	1	8	9	50
1967	7	3	2	2	1	0	0	0	0	0	4	13	32
1968	13	19	3	7	0	0	0	0	0	0	4	12	58
1969	10	18	15	4	0	0	0	0	0	0	16	14	77
1970	9	14	12	4	0	0	0	0	0	0	3	4	46
15-year average	13	13	6	3	< 1	0	0	0	0	< 1	7	11	53
<u>Mylnefield</u> (altitude 100 feet) - 15 years from 1956 to 1970													
1956	22	22	9	8	1	0	0	0	0	2	10	9	83
1957	13	15	0	4	3	0	0	0	0	0	5	12	52
1958	17	19	18	5	0	0	0	0	0	1	11	15	86
1959	27	12	1	2	1	0	0	0	0	0	5	10	58
1960	16	21	4	2	1	0	0	0	0	0	9	18	71
1961	16	5	3	4	1	0	0	0	0	1	10	21	61
1962	13	8	17	8	0	0	0	0	0	3	11	22	82
1963	20	21	7	1	0	0	0	0	0	0	8	12	69
1964	9	8	3	0	0	0	0	0	1	2	10	17	50
1965	18	13	13	5	1	0	0	0	0	2	13	18	83
1966	15	13	6	8	0	0	0	0	0	3	10	10	65
1967	8	5	3	6	2	0	0	0	0	2	7	13	46
1968	15	21	9	10	1	0	0	0	0	1	5	14	76
1969	14	19	16	5	0	0	0	0	0	0	20	17	91
1970	10	17	13	8	0	0	0	0	0	1	4	7	60
15-year average	16	15	8	5	1	0	0	0	< 1	1	9	14	69

TABLE 2L (Contd)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
<u>Perth</u> (altitude 77 feet) - 15 years from 1956 to 1970													
1956	21	24	11	15	1	0	0	0	0	3	10	7	92
1957	13	21	1	5	0	0	0	0	2	1	6	13	62
1958	17	16	17	7	3	0	0	0	0	1	12	16	89
1959	26	13	2	2	1	0	0	0	0	0	5	12	61
1960	16	23	6	2	1	0	0	0	0	0	13	18	79
1961	22	6	1	3	1	0	0	0	0	1	11	21	66
1962	13	9	19	5	0	0	0	0	0	3	15	20	84
1963	25	22	8	2	0	0	0	0	0	0	9	14	80
1964	10	9	3	2	0	0	0	0	1	2	8	15	50
1965	14	11	15	7	1	0	0	0	0	3	15	17	83
1966	15	12	4	8	0	0	0	0	0	6	8	9	62
1967	14	8	4	9	2	0	0	0	0	2	10	13	62
1968	15	23	14	9	1	0	0	0	0	1	8	15	86
1969	11	20	13	9	0	0	0	0	0	0	20	20	93
1970	12	17	16	11	0	0	0	0	0	1	5	12	74
15-year average	16	16	9	6	1	0	0	0	< 1	2	10	15	75
<u>Cupar</u> (altitude 82 feet) - 13 years from 1956-58, 1960-61, 1963-70													
1956	21	24	8	13	1	0	0	0	0	4	10	6	87
1957	12	19	3	5	0	0	0	0	1	1	7	12	60
1958	18	17	17	8	2	0	0	0	0	1	12	14	89
1960	20	22	4	3	1	0	0	0	0	0	10	19	79
1961	16	6	1	4	4	0	0	0	0	2	13	22	68
1963	20	21	7	1	0	0	0	0	0	1	8	11	69
1964	7	6	3	1	0	0	0	0	1	3	11	16	48
1965	15	7	14	10	1	0	0	0	0	3	15	25	90
1966	19	15	10	8	0	0	0	0	0	4	10	12	78
1967	12	8	5	7	4	0	0	0	0	2	8	14	60
1968	19	21	13	11	2	0	0	0	0	1	6	16	89
1969	14	18	14	9	0	0	0	0	0	0	21	17	93
1970	9	18	16	11	0	0	0	0	0	1	6	10	71
13-year average	16	16	9	6	1	0	0	0	< 1	2	10	15	75

TABLE 2L (Contd)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
<u>Leuchars (altitude 34 feet) - 15 years from 1956 to 1970</u>													
1956	18	22	6	4	0	0	0	0	0	1	6	5	62
1957	9	13	1	2	0	0	0	0	0	0	5	12	42
1958	17	13	15	5	0	0	0	0	0	0	6	11	67
1959	26	11	2	0	0	0	0	0	0	0	5	7	51
1960	15	18	3	2	1	0	0	0	0	0	10	17	66
1961	15	7	3	4	1	0	0	0	0	0	14	22	66
1962	12	9	16	10	0	1	0	0	0	4	14	22	88
1963	21	23	9	3	0	0	0	0	0	0	9	15	80
1964	8	10	4	2	0	0	0	0	0	3	10	15	52
1965	17	10	13	3	1	0	0	0	0	2	14	20	80
1966	10	12	6	9	0	0	0	0	0	2	9	14	62
1967	13	7	4	5	2	0	0	0	0	0	4	12	47
1968	16	21	10	11	2	0	0	0	0	1	5	11	77
1969	11	16	13	9	0	0	0	0	0	0	20	15	84
1970	11	18	17	13	0	0	0	0	0	1	7	10	77
15-year average	15	14	8	5	1	< 1	0	0	0	1	9	14	67
<u>St Andrews (altitude 13 feet) - 9 years from 1956-58, 1962-1967</u>													
1956	12	18	4	1	0	0	0	0	0	2	9	6	52
1957	6	14	3	4	3	0	0	0	0	0	6	11	47
1958	16	12	16	5	0	0	0	0	0	0	10	15	74
1962	9	8	15	5	0	1	0	0	0	1	14	18	71
1963	18	20	6	0	0	0	0	0	0	0	6	11	61
1964	6	8	3	0	0	0	0	0	0	0	11	16	44
1965	13	9	11	4	0	0	0	0	0	1	14	15	67
1966	12	12	5	7	0	0	0	0	0	2	9	11	58
1967	10	3	2	6	3	0	0	0	0	0	2	11	37
9-year average	11	12	7	3	1	< 1	0	0	0	1	9	13	57

TABLE 2M

Average and extreme dates of first and last frosts at temperature recording stations in the Tayside area during the 15 year period from 1956 to 1970

	<u>Average date of first air frost</u>	<u>Average date of last air frost</u>
Montrose	2 November	23 April
Arbroath	9 November	8 April
Carnoustie	3 November	17 April
Buddon Ness	28 October	1 June
Dundee	5 November	11 April
Mylnefield	27 October	1 May
Perth	22 October	30 April
Cupar	14 October	6 May
Leuchars	29 October	27 April
St Andrews	2 November	27 April

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	<u>Earliest date of first air frost</u>	<u>Latest date of last air frost</u>
Montrose	5 October	9 May
Arbroath	27 October	7 May
Carnoustie	12 October	18 May
Buddon Ness	21 September	14 July
Dundee	5 October	3 May
Mylnefield	21 September	27 May
Perth	21 September	27 May
Cupar	18 September	1 June
Leuchars	5 October	1 June
St Andrews	5 October	1 June

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TABLE 2N

Total number of days in each month with an hourly air temperature reading of 35.9 degrees Fahrenheit or below (2.2 degrees Centigrade or below) between 0700 and 1700 hours Greenwich Mean Time at Leuchars, Fife (10 years 1961 to 1970)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
<u>Number of days</u>													
1961	16	6	4	4	0	0	0	0	0	0	14	22	66
1962	13	13	21	7	0	0	0	0	0	3	12	22	91
1963	26	28	8	2	0	0	0	0	0	0	7	14	85
1964	10	11	7	1	0	0	0	0	0	4	10	19	62
1965	23	15	17	6	0	0	0	0	0	2	14	21	98
1966	16	16	10	11	0	0	0	0	0	4	11	15	83
1967	12	11	7	5	2	0	0	0	0	2	9	15	63
1968	15	24	15	11	0	0	0	0	0	1	6	13	85
1969	14	24	21	6	0	0	0	0	0	0	17	16	98
1970	15	21	20	9	0	0	0	0	0	1	8	15	89
10 year mean	16.0	16.9	13.0	6.2	0.2	0.0	0.0	0.0	0.0	1.7	10.8	17.2	82.0

Total number of hours between 0700 and 1700 hours GMT in each month with air temperatures of 35.9 degrees Fahrenheit or below (2.2°C or below) at Leuchars, Fife (10 years 1961 to 1970)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
<u>Number of hours</u>													
1961	86	28	8	8	0	0	0	0	0	0	49	198	377
1962	79	42	76	11	0	0	0	0	0	6	72	150	436
1963	200	216	29	5	0	0	0	0	0	0	35	81	566
1964	58	49	21	1	0	0	0	0	0	6	45	115	295
1965	139	63	90	7	0	0	0	0	0	4	77	119	499
1966	118	120	18	32	0	0	0	0	0	7	42	76	413
1967	64	35	9	6	2	0	0	0	0	4	27	104	251
1968	110	113	32	32	0	0	0	0	0	2	17	90	396
1969	67	152	102	8	0	0	0	0	0	0	90	99	518
1970	96	109	55	17	0	0	0	0	0	4	25	68	374
10 year mean	101.7	92.7	44.0	12.7	0.2	0.0	0.0	0.0	0.0	3.3	47.9	110.0	412.5
10 year mean expressed as percentage of total working time	33%	33%	14%	4%	< 1%	0%	0%	0%	0%	1%	16%	35%	11%

TABLE 20

Total number of days in each month with an hourly air temperature reading of 33.9 degrees Fahrenheit or below (1.1 degrees Centigrade or below) between 0700 and 1700 hours Greenwich Mean Time at Leuchars (10 years 1961 to 1970)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
<u>Number of Days</u>													
1961	12	4	3	4	0	0	0	0	0	0	12	21	56
1962	12	5	17	6	0	0	0	0	0	1	10	16	67
1963	19	24	5	1	0	0	0	0	0	0	6	10	65
1964	6	10	2	0	0	0	0	0	0	1	8	14	41
1965	16	10	16	2	0	0	0	0	0	2	12	16	74
1966	10	13	6	7	0	0	0	0	0	2	9	10	57
1967	8	7	4	3	1	0	0	0	0	0	4	11	38
1968	15	18	8	8	0	0	0	0	0	1	3	11	64
1969	8	16	13	4	0	0	0	0	0	0	14	13	68
1970	10	16	11	7	0	0	0	0	0	1	4	8	57
10 year mean	11.6	12.3	8.5	4.2	0.1	0.0	0.0	0.0	0.0	0.8	8.2	13.0	58.7

Total number of hours between 0700 and 1700 hours GMT in each month with air temperatures of 33.9 degrees Fahrenheit or below (1.1°C or below) at Leuchars, Fife (10 years 1961 to 1970)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
<u>Number of Hours</u>													
1961	60	13	4	6	0	0	0	0	0	0	31	167	281
1962	53	12	45	6	0	0	0	0	0	2	40	91	249
1963	124	124	23	3	0	0	0	0	0	0	24	51	349
1964	35	35	5	0	0	0	0	0	0	1	30	68	174
1965	88	35	65	2	0	0	0	0	0	3	60	76	329
1966	58	85	9	19	0	0	0	0	0	3	26	49	249
1967	33	20	5	3	1	0	0	0	0	0	11	63	136
1968	87	71	13	19	0	0	0	0	0	1	11	64	266
1969	32	93	37	4	0	0	0	0	0	0	64	67	297
1970	59	61	25	10	0	0	0	0	0	3	13	30	201
10 year mean	62.9	54.9	23.1	7.2	0.1	0.0	0.0	0.0	0.0	1.3	31.0	72.6	253.1
10 year mean expressed as percentage of total working time	20%	19%	7%	2%	< 1%	0%	0%	0%	0%	< 1%	10%	23%	7%

TABLE 2P

Total number of days in each month with an hourly air temperature reading of 31.9 degrees Fahrenheit or below (minus 0.1 degrees Centigrade or below) between 0700 and 1700 hours Greenwich Mean Time at Leuchars (10 years 1961 to 1970)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
<u>Number of days</u>													
1961	7	2	0	2	0	0	0	0	0	0	6	19	36
1962	6	1	12	2	0	0	0	0	0	0	6	11	38
1963	15	15	4	1	0	0	0	0	0	0	3	7	45
1964	5	6	1	0	0	0	0	0	0	0	6	8	26
1965	10	6	8	0	0	0	0	0	0	0	9	9	42
1966	5	7	1	3	0	0	0	0	0	1	4	6	27
1967	3	3	1	1	0	0	0	0	0	0	1	7	16
1968	9	14	2	4	0	0	0	0	0	0	3	8	40
1969	4	12	7	1	0	0	0	0	0	0	9	8	41
1970	7	12	7	3	0	0	0	0	0	0	3	3	35
10 year mean	7.1	7.8	4.3	1.7	0.0	0.0	0.0	0.0	0.0	0.1	5.0	8.6	34.6

Total number of hours between 0700 and 1700 hours GMT in each month with air temperatures of 31.9 degrees Fahrenheit or below (minus 0.1°C or below) at Leuchars, Fife (10 years 1961 to 1970)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
<u>Number of hours</u>													
1961	23	5	0	2	0	0	0	0	0	0	9	109	148
1962	32	3	30	2	0	0	0	0	0	0	17	47	131
1963	83	75	19	1	0	0	0	0	0	0	11	31	220
1964	23	19	3	0	0	0	0	0	0	0	19	36	100
1965	51	21	31	0	0	0	0	0	0	0	33	38	174
1966	33	38	1	6	0	0	0	0	0	1	9	28	116
1967	13	9	1	1	0	0	0	0	0	0	2	32	58
1968	49	41	3	8	0	0	0	0	0	0	8	37	146
1969	15	60	17	1	0	0	0	0	0	0	36	35	164
1970	40	35	13	3	0	0	0	0	0	0	8	4	103
10 year mean	36.2	30.6	11.8	2.4	0.0	0.0	0.0	0.0	0.0	0.1	15.2	39.7	136.0
10 year mean expressed as percentage of total working time	12%	11%	4%	1%	0%	0%	0%	0%	0%	< 1%	5%	13%	4%

TABLE 2Q

Averages and extremes of soil temperature in degrees Fahrenheit from readings made once-daily at 0900 hours Greenwich Mean Time from a thermometer exposed at a depth of 10 cm (4-inches) below a surface of bare soil at Mylnefield - altitude 100 feet

(Type of soil: sandy loam above sandy gravel)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<u>Actual means of 0900 hours GMT readings of 10 cm (4-inch) soil temperature recorded in each month during the 10 years from 1961 to 1970</u>													
1961	33.3	38.2	42.2	44.4	50.5	55.0	57.5	55.3	53.2	46.5	38.2	33.3	45.6
1962	33.5	36.1	34.5	41.2	49.7	56.3	57.0	53.9	(52.6)	48.4	38.9	34.6	44.7
1963	30.6	30.9	35.5	42.3	48.7	57.5	57.2	56.2	51.8	46.5	41.3	35.0	44.4
1964	35.9	36.4	37.6	44.6	52.3	56.5	59.7	56.8	51.9	44.7	39.5	34.1	45.8
1965	33.0	34.0	36.2	42.7	49.8	55.8	55.8	55.3	51.8	47.4	37.1	32.1	44.3
1966	33.1	35.0	39.0	39.5	50.2	57.5	59.9	55.6	54.0	45.7	37.1	34.7	45.1
1967	35.1	37.3	39.1	43.7	48.2	57.4	59.3	58.7	53.7	45.2	38.4	35.2	45.9
1968	33.7	33.2	37.6	43.0	48.1	57.6	58.4	59.1	53.9	49.1	40.1	36.3	45.8
1969	36.5	31.7	34.7	41.0	48.1	56.5	59.9	59.3	54.1	50.4	36.1	34.1	45.2
1970	35.0	32.5	35.7	40.8	51.0	59.3	57.1	57.9	53.3	46.4	39.6	36.5	45.4
10 year means	34.0	34.5	37.2	42.3	49.7	56.9	58.2	56.8	53.0	47.0	38.6	34.6	45.2
<u>Absolute highest 0900 hours GMT readings of 10 cm (4-inch) soil temperature recorded in each month during the 10 years from 1961 to 1970</u>													
1961	37	44	47	49	55	61	62	58	59	54	45	41	62
1962	41	43	38	50	53	61	61	58	(58)	52	49	42	61
1963	33	33	41	50	55	61	62	65	56	49	49	41	65
1964	41	41	40	51	60	62	64	64	57	52	45	41	64
1965	39	40	43	46	56	60	60	59	56	56	45	36	60
1966	40	40	44	48	57	62	64	60	57	53	41	40	64
1967	40	44	44	53	54	64	62	63	57	53	45	42	64
1968	42	35	46	50	55	63	65	64	57	53	45	42	65
1969	42	35	41	46	53	64	66	63	61	56	48	38	66
1970	40	36	42	48	59	65	61	63	57	53	46	46	65
10 year means	39	39	43	49	56	62	63	62	57	53	46	41	64
10 year extremes	42	44	47	53	60	65	66	65	61	56	49	46	66

TABLE 2Q (Contd)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<u>Absolute lowest 0900 hours GMT readings of 10 cm (4-inch) soil temperature recorded in each month during the 10 years from 1961 to 1970</u>													
1961	31	32	36	35	45	50	52	50	48	39	32	28	28
1962	30	33	32	35	46	48	53	50	(48)	39	32	30	30
1963	24	25	27	36	44	53	54	50	45	42	35	31	24
1964	32	33	34	36	47	52	52	51	43	36	33	31	31
1965	31	30	31	39	45	53	51	52	49	40	31	30	30
1966	31	32	35	34	46	54	54	52	50	35	34	32	31
1967	31	35	35	35	43	53	54	54	49	38	34	30	30
1968	29	32	32	34	44	53	53	54	49	41	36	31	29
1969	32	29	33	35	42	50	55	52	44	42	32	32	29
1970	30	29	32	34	46	51	53	53	47	39	34	33	29
10 year means	30	31	33	35	45	52	53	52	47	39	33	31	29
10 year extremes	24	25	27	34	42	48	51	50	43	35	31	28	24

Note: The soil temperatures enclosed in brackets have been estimated from incomplete records.

TABLE 2R

Averages and extremes of soil temperature in degrees Fahrenheit from readings made once-daily at 0900 hours Greenwich Mean Time from a thermometer exposed at a depth of 20 cm (8 inches) below a surface of bare soil at Mylnefield - altitude 100 feet

(Type of soil: sandy loam above sandy gravel)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<u>Actual means of 0900 hours GMT readings of 20 cm (8 inch) soil temperature recorded in each month during the 10 years from 1961 to 1970</u>													
1961	34.6	39.0	43.2	45.3	51.2	55.0	58.1	56.5	54.9	48.7	40.8	35.2	46.9
1962	34.7	37.5	-	-	-	-	-	-	-	-	-	-	-
1963	-	-	-	42.7	48.5	57.2	57.1	56.8	52.9	47.8	42.6	36.2	-
1964	36.8	37.3	38.7	45.0	52.0	56.0	59.5	57.2	52.7	46.5	41.1	35.4	46.5
1965	34.0	35.0	37.3	43.6	49.6	55.5	56.0	55.4	52.3	48.8	39.0	33.5	45.0
1966	33.7	35.6	40.3	40.2	49.4	56.7	59.0	55.5	54.6	47.3	38.6	35.9	45.6
1967	35.8	38.5	40.4	44.3	48.2	57.0	58.9	59.1	54.6	46.8	39.9	36.8	46.7
1968	34.6	34.4	38.4	44.0	47.7	57.3	58.0	59.6	54.7	50.0	41.4	37.3	46.5
1969	37.3	32.8	35.5	41.6	48.1	56.4	60.0	59.7	54.9	50.9	37.4	34.7	45.8
1970	35.9	33.8	36.7	40.7	50.8	59.1	56.6	57.8	53.5	47.0	40.3	37.2	45.8
Means	35.3	36.0	38.8	43.0	49.5	56.7	58.1	57.5	53.9	48.2	40.1	35.8	46.1
<u>Absolute highest 0900 hours GMT readings of 20 cm (8 inch) soil temperature recorded in each month during the 10 years from 1961 to 1970</u>													
1961	37	43	47	49	55	59	61	59	60	54	46	41	61
1962	39	42	-	-	-	-	-	-	-	-	-	-	-
1963	-	-	-	49	55	60	63	63	55	50	49	41	-
1964	41	41	40	50	59	61	63	64	57	53	45	41	64
1965	39	39	44	45	55	60	60	59	55	55	45	36	60
1966	39	40	44	47	55	60	64	59	57	54	43	41	64
1967	40	44	44	53	53	62	62	63	58	54	43	44	63
1968	41	38	45	50	54	61	62	63	58	53	45	43	63
1969	42	36	41	45	53	64	66	64	63	55	48	38	66
1970	40	38	41	47	58	64	61	63	57	53	45	45	64
Means	40	40	43	48	55	61	62	62	58	53	45	41	63
Extremes	42	44	47	53	59	64	66	64	63	55	49	45	66
<u>Absolute lowest 0900 hours GMT readings of 20 cm (8 inch) soil temperature recorded in each month during the 10 years from 1961 to 1970</u>													
1961	32	34	40	39	48	51	54	54	51	40	35	33	32
1962	33	35	-	-	-	-	-	-	-	-	-	-	-
1963	-	-	-	38	44	54	54	52	47	46	37	33	-
1964	34	34	35	39	47	53	56	51	46	40	36	33	33
1965	33	32	33	41	46	50	51	51	48	40	33	32	32
1966	31	32	37	35	47	54	55	53	51	39	35	34	31
1967	33	36	38	37	45	53	55	54	51	41	34	33	33
1968	32	33	33	37	44	53	54	55	51	44	38	33	32
1969	33	32	33	37	43	50	56	53	46	45	33	31	31
1970	32	32	33	35	46	53	54	53	49	40	35	35	32
Means	33	33	35	37	45	52	54	53	49	42	35	33	32
Extremes	31	32	33	35	43	50	51	51	46	39	33	31	31

Note: Records are not available for the period from March 1962 to March 1963

TABLE 2S

Averages and extremes of earth temperature in degrees Centigrade from readings made once daily at 0900 hours Greenwich Mean Time from a thermometer exposed at a depth of 30 cm (1 ft) under a surface of short grass at Dundee - altitude 147 feet

Type of soil: loam and clay  
 Period of record: 38 years from 1923 to 1960

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<u>At 30 cm (1 ft)</u>													
Monthly mean of daily readings (1931 to 1960)	2.0	2.2	4.2	7.4	11.0	14.4	16.2	15.7	13.2	9.5	5.6	3.3	8.7
Highest monthly mean of daily readings (1931 to 1960)	4.3	4.4	7.2	9.2	13.1	16.7	17.6	17.2	14.7	11.2	7.6	5.3	17.6
Lowest monthly mean of daily readings (1931 to 1960)	-0.3	0.1	-0.2	5.2	9.2	13.1	15.2	14.1	11.3	7.8	3.4	0.7	-0.3
Absolute highest daily reading (1923 to 1960)	6.1	7.3	9.4	11.0	15.6	18.9	19.6	18.9	16.9	14.5	10.4	8.7	19.6
Absolute lowest daily reading (1923 to 1960)	-3.3	-1.2	-2.2	2.7	5.7	9.4	12.8	12.2	7.3	3.2	0.8	0.2	-3.3

Notes:

The means quoted above have been obtained by averaging readings made during the 30 years from 1931 to 1960.

The "highest and lowest monthly means of daily readings" relate to the single January, February, March etc during the period from 1931 to 1960 which had the highest or lowest monthly mean of daily readings.

The "absolute highest and lowest daily readings" are the absolute highest and lowest readings recorded during the period from 1923 to 1960.

TABLE 2S (Contd)

Averages and extremes of earth temperature in degrees Centigrade from readings made once daily at 0900 hours Greenwich Mean Time from a thermometer exposed at a depth of 30 cm (1 ft) under a surface of short grass at Mylnefield - altitude 100 feet

Type of soil:           sandy loam above sandy gravel  
 Period of record: 12 years from 1954 to 1965

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	<u>At 30 cm (1 ft)</u>												
Estimated long term monthly mean of daily readings (1931 to 1960)	2.1	2.4	4.1	6.9	10.1	13.8	15.8	15.1	12.7	9.2	5.4	3.3	8.4
Actual monthly mean of daily readings (1954 to 1965)	1.8	2.1	3.9	7.1	10.3	13.5	14.9	14.4	12.6	9.6	5.8	3.2	8.3
Actual highest monthly mean of daily readings (1954 to 1965)	3.3	3.9	6.4	7.9	11.3	14.7	17.3	17.6	13.9	11.0	6.6	4.8	17.6
Actual lowest monthly mean of daily readings (1954 to 1965)	0.3	0.0	2.2	5.7	9.3	12.2	13.6	13.2	11.5	8.7	4.6	1.3	0.0
Absolute highest daily reading (1954 to 1965)	5.7	5.8	8.3	10.3	14.7	16.8	19.2	19.8	15.8	12.9	9.6	8.2	19.8
Absolute lowest daily reading (1954 to 1965)	-0.2	-0.3	-0.4	3.0	7.2	9.4	11.6	11.7	8.3	4.2	1.2	0.7	-0.4

Notes:

The long term (1931 to 1960) monthly means of daily readings quoted above have been estimated from recordings made during the years from 1954 to 1965. The remaining actual monthly means quoted above have been obtained by averaging readings made during the years from 1954 to 1965.

The "highest and lowest monthly means of daily readings" relate to the single January, February, March etc during the years from 1954 to 1965 which had the highest or lowest monthly mean of daily readings.

The "absolute highest and lowest daily readings" are the absolute highest and lowest readings recorded during the period from 1954 to 1965.

TABLE 2S (Contd)

Averages and extremes of earth temperature in degrees Centigrade from readings made once daily at 0900 hours Greenwich Mean Time from a thermometer exposed at a depth of 30 cm (1 ft) under a surface of short grass at Cupar - altitude 82 feet

Type of soil: clay loam to a considerable depth  
 Period of record: 11 years from 1955 to 1965

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	<u>At 30 cm (1 ft)</u>												
Estimated long term monthly mean of daily readings (1931 to 1960)	2.8	3.0	4.6	6.8	10.0	13.3	15.0	14.7	12.5	9.3	5.7	4.1	8.5
Actual monthly mean of daily readings (1955 to 1965)	2.3	2.7	4.4	7.3	10.7	13.7	14.9	14.6	12.7	9.7	5.9	3.4	8.5
Actual highest monthly mean of daily readings (1955 to 1965)	3.7	4.5	6.9	8.2	12.1	15.4	16.9	16.9	13.7	11.1	6.7	4.9	16.9
Actual lowest monthly mean of daily readings (1955 to 1965)	0.6	1.0	2.7	5.9	9.5	12.7	13.8	12.8	11.3	8.8	4.8	1.6	0.6
Absolute highest daily reading (1955 to 1965)	6.6	6.7	8.6	10.3	14.6	18.2	19.0	18.9	15.7	14.7	10.0	8.1	19.0
Absolute lowest daily reading (1955 to 1965)	-0.1	-1.1	0.1	2.9	7.2	10.0	12.2	11.0	8.1	4.4	1.7	0.8	-1.1

Notes:

The long term (1931 to 1960) monthly means of daily readings quoted above have been estimated from recordings made during the years from 1955 to 1965. The remaining actual monthly means quoted above have been obtained by averaging readings made during the years from 1955 to 1965.

The "highest and lowest monthly means of daily readings" relate to the single January, February, March etc during the years from 1955 to 1965 which had the highest or lowest monthly mean of daily readings.

The "absolute highest and lowest daily readings" are the absolute highest and lowest readings recorded during the period from 1955 to 1965.

TABLE 2S (Contd)

Averages and extremes of earth temperature in degrees Centigrade from readings made once daily at 0900 hours Greenwich Mean Time from a thermometer exposed at a depth of 30 cm (1 ft) under a surface of short grass at St Andrews - altitude 13 feet

Type of soil: sand over rock  
 Period of record: 30 years from 1931 to 1960

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	<u>At 30 cm (1 ft)</u>												
Monthly mean of daily readings (1931 to 1960)	3.2	3.3	4.7	7.5	10.6	13.6	15.5	15.1	13.2	10.1	6.5	4.4	8.9
Highest monthly mean of daily readings (1931 to 1960)	5.0	4.8	7.2	9.1	12.1	15.3	17.3	17.1	14.6	11.7	7.7	6.3	17.3
Lowest monthly mean of daily readings (1931 to 1960)	0.9	1.6	1.7	5.7	8.9	12.3	14.3	12.8	11.8	8.7	5.1	2.1	0.9
Absolute highest daily reading (1931 to 1960)	7.4	6.7	8.3	10.1	15.0	17.8	18.3	18.3	16.4	14.2	12.2	8.9	18.3
Absolute lowest daily reading (1931 to 1960)	-0.4	-0.6	0.6	3.9	6.1	10.0	12.2	11.1	8.9	5.0	2.2	0.1	-0.6

Notes:

The means quoted above have been obtained by averaging readings made during the 30 years from 1931 to 1960.

The "highest and lowest monthly means of daily readings" relate to the single January, February, March etc during the period from 1931 to 1960 which had the highest or lowest monthly mean of daily readings.

The "absolute highest and lowest daily readings" are the absolute highest and lowest readings recorded during the period from 1931 to 1960.

TABLE 2T

Averages and extremes of earth temperature in degrees Centigrade from readings made once daily at 0900 hours Greenwich Mean Time from a thermometer exposed at a depth of 122 cm (4 ft) under a surface of short grass at Mylnefield - altitude 100 feet

Type of soil:           sandy loam above sandy gravel  
 Period of record:   12 years from 1954 to 1965

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	<u>At 122 cm (4 ft)</u>												
Estimated long term monthly mean of daily readings (1931 to 1960)	5.1	4.4	5.0	6.3	8.3	10.6	12.4	13.2	12.6	10.8	8.6	6.5	8.6
Actual monthly mean of daily readings (1954 to 1965)	4.9	4.3	4.7	6.2	8.3	10.4	12.0	12.7	12.2	10.8	8.6	6.3	8.4
Actual highest monthly mean of daily readings (1954 to 1965)	5.7	4.9	6.3	7.2	9.1	11.4	12.7	14.3	13.2	12.1	9.4	7.4	14.3
Actual lowest monthly mean of daily readings (1954 to 1965)	4.0	3.2	3.3	5.1	7.5	9.5	11.3	11.7	11.3	10.1	7.9	5.0	3.2
Absolute highest daily reading (1954 to 1965)	6.5	5.6	6.8	8.1	10.1	12.4	14.1	14.4	14.3	12.5	10.8	8.6	14.4
Absolute lowest daily reading (1954 to 1965)	3.4	2.9	2.7	4.1	6.4	8.4	10.4	11.4	10.7	9.3	6.1	4.3	2.7

Notes:

The long term (1931 to 1960) monthly means of daily readings quoted above have been estimated from recordings made during the years from 1954 to 1965. The remaining actual monthly means quoted above have been obtained by averaging readings made during the years from 1954 to 1965.

The "highest and lowest monthly means of daily readings" relate to the single January, February, March etc during the years from 1954 to 1965 which had the highest or lowest monthly mean of daily readings.

The "absolute highest and lowest daily readings" are the absolute highest and lowest readings recorded during the period from 1954 to 1965.

TABLE 2T (Contd)

Averages and extremes of earth temperature in degrees Centigrade from readings made once daily at 0900 hours Greenwich Mean Time from a thermometer exposed at a depth of 122 cm (4 ft) under a surface of short grass at St Andrews - altitude 13 feet

Type of soil: sand over rock  
 Period of record: 30 years from 1931 to 1960

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	<u>At 122 cm (4 ft)</u>												
Monthly mean of daily readings (1931 to 1960)	5.4	4.9	5.2	6.9	8.8	11.3	13.0	13.8	13.1	11.3	8.6	6.7	9.1
Highest monthly mean of daily readings (1931 to 1960)	6.7	6.0	6.7	8.3	10.1	13.4	14.1	14.8	14.4	12.8	9.8	7.9	14.8
Lowest monthly mean of daily readings (1931 to 1960)	4.0	3.8	2.4	5.4	6.6	9.9	12.0	12.4	12.2	10.4	7.8	4.6	2.4
Absolute highest daily reading (1931 to 1960)	7.4	6.7	8.3	8.9	12.8	14.2	15.0	15.6	15.6	13.9	12.2	9.2	15.6
Absolute lowest daily reading (1931 to 1960)	3.3	3.2	1.1	4.1	6.7	8.3	10.1	11.7	10.6	8.9	6.1	4.4	1.1

Notes:

The means quoted above have been obtained by averaging readings made during the 30 years from 1931 to 1960.

The "highest and lowest monthly means of daily readings" relate to the single January, February, March etc during the period from 1931 to 1960 which had the highest or lowest monthly mean of daily readings.

The "absolute highest and lowest daily readings" are the absolute highest and lowest readings recorded during the period from 1931 to 1960.

TABLE 2U

Estimated averages of earth temperature in degrees Centigrade  
at a depth of 1 metre for Mylnefield and St Andrews

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<u>At 1 metre (100 cm)</u>													
Mylnefield	4.4	4.0	4.6	6.1	8.4	11.0	13.0	13.7	12.7	10.6	8.0	5.8	8.5
St Andrews	4.8	4.4	5.1	6.8	9.1	11.7	13.6	14.2	13.2	11.0	8.3	6.1	9.0

Note: The method of calculating the estimated averages quoted above is explained on page 36.

TABLE 2V

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 the Tayside region as elsewhere in the British Isles, the relative humidity reaches 90 per cent or thereabouts on most nights of the year. As a 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 in the region under consideration, the mean relative humidity is highest during the winter months and lowest during the months of April, May and June.

It should be noted that it is normal practice at climatological stations to obtain values of relative humidity from simultaneous readings of dry and wet bulb thermometers exposed outdoors inside a ventilated thermometer screen at a height of 4 feet above ground level. Values so obtained may be very different from those prevailing indoors which are influenced by heating, ventilation and other factors.

The meteorological office at Leuchars is the only weather station in the region for which detailed records of dry and wet bulb temperatures are available and all the statistics of relative humidity and wet bulb temperature included in this memorandum have been calculated from the records for Leuchars. From the planning or design point of view, the Leuchars figures should give a reasonably good guide to the region as a whole although significant differences in temperature and relative humidity could exist from place to place within the region at a particular time of day depending on the local weather conditions prevailing at the time. For example, the onset of a sea breeze on the coast could lead to a sharp fall in temperature coinciding with a marked rise in relative humidity particularly on a warm day in the summer.

Monthly averages and extremes of relative humidity at 0000 hours, 0300 hours, 0600 hours, 0900 hours, 1200 hours, 1500 hours, 1800 hours and 2100 hours GMT are given in Table 3.

The percentage frequency of occurrence of relative humidities within stated limits are given in Table 3A.

Note: Averages and extremes of dry and wet bulb temperature are given in the previous section of this memorandum in Tables 2G and 2H. Percentage frequencies of occurrence of dry and wet bulb temperatures within certain limits are also given in the previous section of this memorandum in Tables 2I and 2J.

TABLE 3

Averages and extremes of relative humidity per cent at 0000 hours,  
0300 hours, 0600 hours, 0900 hours, 1200 hours, 1500 hours,  
1800 hours and 2100 hours GMT at Leuchars  
(14 years from 1957 to 1970)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	%	%	%	%	%	%	%	%	%	%	%	%	%
<u>Relative Humidity</u>													
<u>At 0000 hours GMT</u>													
Average	87	86	86	85	87	88	88	90	89	89	88	86	87
Absolute maximum	100	100	100	100	100	100	100	100	100	100	100	100	100
Absolute minimum	56	53	59	55	60	55	55	62	64	52	59	59	52
<u>At 0300 hours GMT</u>													
Average	87	86	86	87	89	90	90	91	90	89	88	86	88
Absolute maximum	100	100	100	100	100	100	100	100	100	100	100	100	100
Absolute minimum	60	57	56	51	62	59	56	65	62	56	55	51	51
<u>At 0600 hours GMT</u>													
Average	87	86	86	87	88	88	88	91	91	89	88	86	88
Absolute maximum	100	100	100	100	100	100	100	100	100	100	100	100	100
Absolute minimum	61	56	54	50	61	61	57	60	66	58	57	55	50
<u>At 0900 hours GMT</u>													
Average	86	85	82	76	76	77	77	80	83	86	87	87	82
Absolute maximum	100	100	100	100	100	100	100	100	100	100	100	100	100
Absolute minimum	59	56	49	46	45	38	50	52	56	54	56	49	38
<u>At 1200 hours GMT</u>													
Average	82	78	73	68	71	70	71	73	74	78	81	83	75
Absolute maximum	100	100	100	100	100	100	100	100	100	100	100	100	100
Absolute minimum	52	47	37	37	36	31	37	45	36	48	53	39	31
<u>At 1500 hours GMT</u>													
Average	81	76	72	68	71	69	69	72	73	77	81	83	74
Absolute maximum	100	100	100	100	99	100	100	100	100	100	100	100	100
Absolute minimum	52	38	29	34	31	31	36	41	34	51	50	55	29
<u>At 1800 hours GMT</u>													
Average	85	82	78	73	74	73	74	77	79	85	86	86	79
Absolute maximum	100	100	100	100	100	100	100	99	100	100	100	100	100
Absolute minimum	58	53	45	37	35	34	40	43	45	57	59	58	34
<u>At 2100 hours GMT</u>													
Average	86	84	83	82	83	82	83	86	87	88	87	86	85
Absolute maximum	100	100	100	100	100	100	100	100	100	100	100	100	100
Absolute minimum	58	52	57	45	54	37	50	58	62	57	51	60	37

TABLE 3A

Percentage frequency of occurrence of relative humidities at or within stated limits at 0000 hours, 0300 hours, 0600 hours, 0900 hours, 1200 hours, 1500 hours, 1800 hours and 2100 hours at Leuchars, Fife (14 years 1957 to 1970)

Month	Hour	Relative humidity											
		Less than 20%	20-29%	30-39%	40-49%	50-59%	60-69%	70-79%	80-89%	90-94%	95-98%	99%	100%
Jan	0000	0.0	0.0	0.0	0.0	0.2	3.5	17.3	35.0	24.9	13.8	1.8	3.5
	0300	0.0	0.0	0.0	0.0	0.0	2.8	16.4	39.6	22.8	14.0	2.3	2.1
	0600	0.0	0.0	0.0	0.0	0.0	3.9	16.3	38.8	22.1	14.3	2.8	1.8
	0900	0.0	0.0	0.0	0.0	0.2	5.5	12.7	39.2	25.1	14.3	1.4	1.6
	1200	0.0	0.0	0.0	0.0	1.8	10.1	26.1	32.5	18.4	8.5	2.1	0.5
	1500	0.0	0.0	0.0	0.0	1.6	11.9	28.6	31.8	19.4	4.6	0.9	1.2
	1800	0.0	0.0	0.0	0.0	0.5	5.1	20.7	35.7	22.1	11.3	2.1	2.5
	2100	0.0	0.0	0.0	0.0	0.5	2.8	20.7	35.2	23.7	12.0	2.1	3.0
Feb	0000	0.0	0.0	0.0	0.0	0.3	5.1	18.2	35.4	24.0	13.4	0.8	2.8
	0300	0.0	0.0	0.0	0.0	0.5	5.6	17.5	36.5	24.0	12.9	1.5	1.5
	0600	0.0	0.0	0.0	0.0	1.0	6.1	13.9	39.8	21.2	14.2	2.8	1.0
	0900	0.0	0.0	0.0	0.0	1.3	6.3	20.5	33.6	23.8	10.4	1.3	2.8
	1200	0.0	0.0	0.0	0.5	6.3	18.5	31.2	23.3	10.1	6.6	1.5	2.0
	1500	0.0	0.0	0.3	1.3	8.9	23.0	26.3	23.3	8.6	6.8	0.5	1.0
	1800	0.0	0.0	0.0	0.0	2.0	9.9	23.0	40.2	14.4	7.9	1.8	0.8
	2100	0.0	0.0	0.0	0.0	0.8	5.8	19.7	39.5	22.0	9.1	1.3	1.8
Mar	0000	0.0	0.0	0.0	0.0	0.2	4.4	18.7	36.2	25.1	13.1	0.9	1.4
	0300	0.0	0.0	0.0	0.0	0.5	4.6	14.7	40.5	24.2	11.8	2.1	1.6
	0600	0.0	0.0	0.0	0.0	0.9	5.5	13.9	37.3	23.7	14.1	2.8	1.8
	0900	0.0	0.0	0.0	0.5	2.5	12.7	22.6	32.9	16.1	9.7	1.4	1.6
	1200	0.0	0.0	0.5	5.5	15.7	20.7	20.7	19.9	11.5	3.9	0.7	0.9
	1500	0.0	0.2	0.9	5.5	15.0	21.5	23.3	20.3	8.3	4.6	0.2	0.2
	1800	0.0	0.0	0.0	0.9	6.2	18.9	26.3	27.9	13.4	5.3	0.9	0.2
	2100	0.0	0.0	0.0	0.0	0.7	7.8	23.5	36.8	19.8	9.7	1.2	0.5
Apr	0000	0.0	0.0	0.0	0.0	0.7	6.2	21.2	36.9	18.6	11.9	2.6	1.9
	0300	0.0	0.0	0.0	0.0	0.5	6.9	11.0	37.4	23.6	14.0	4.5	2.1
	0600	0.0	0.0	0.0	0.0	0.5	4.3	13.8	39.8	20.4	15.2	3.6	2.4
	0900	0.0	0.0	0.0	1.0	7.8	24.8	28.3	19.5	9.5	6.2	2.4	0.5
	1200	0.0	0.0	0.7	9.1	20.7	25.7	17.4	14.8	5.7	4.8	0.2	0.9
	1500	0.0	0.0	2.6	9.8	23.1	18.3	18.8	16.2	7.4	2.4	0.9	0.5
	1800	0.0	0.0	0.5	5.2	15.7	21.9	20.0	21.0	7.8	6.2	1.2	0.5
	2100	0.0	0.0	0.0	0.2	2.4	11.2	25.0	33.8	15.0	9.1	1.4	1.9

TABLE 3A (contd)

Month	Hour	Relative humidity											
		Less than 20%	20-29%	30-39%	40-49%	50-59%	60-69%	70-79%	80-89%	90-94%	95-98%	99%	100%
May	0000	0.0	0.0	0.0	0.0	0.0	3.5	16.1	36.9	19.8	14.3	5.5	3.9
	0300	0.0	0.0	0.0	0.0	0.0	1.8	11.1	34.3	23.5	18.0	5.1	6.2
	0600	0.0	0.0	0.0	0.0	0.0	1.8	17.1	35.9	19.4	14.5	6.2	5.1
	0900	0.0	0.0	0.0	1.2	7.6	25.1	28.5	18.7	10.1	4.6	3.0	1.2
	1200	0.0	0.0	0.2	8.1	15.2	26.9	20.7	12.9	9.9	4.2	1.2	0.7
	1500	0.0	0.0	1.4	6.9	15.5	24.4	20.5	17.9	8.5	3.7	1.2	0.0
	1800	0.0	0.0	0.2	4.8	12.2	21.0	23.0	19.4	9.0	8.1	1.8	0.5
	2100	0.0	0.0	0.0	0.0	1.4	8.5	27.0	31.6	13.8	12.4	4.4	0.9
Jun	0000	0.0	0.0	0.0	0.0	0.5	1.7	13.3	36.9	21.9	17.4	4.3	4.0
	0300	0.0	0.0	0.0	0.0	0.2	1.0	7.6	31.4	24.8	23.8	5.0	6.2
	0600	0.0	0.0	0.0	0.0	0.0	2.6	12.4	37.1	20.0	17.9	4.5	5.5
	0900	0.0	0.0	0.2	1.0	9.8	23.3	21.6	25.0	9.3	6.0	2.1	1.7
	1200	0.0	0.0	1.0	7.6	16.7	21.9	22.6	19.1	6.9	3.3	0.7	0.2
	1500	0.0	0.0	1.9	9.3	20.7	18.4	21.4	19.5	5.7	1.9	1.0	0.2
	1800	0.0	0.0	0.5	4.5	17.6	19.3	19.0	24.3	9.3	4.3	0.7	0.5
	2100	0.0	0.0	0.2	0.0	1.9	13.3	21.7	30.5	18.1	10.7	2.6	1.0
Jul	0000	0.0	0.0	0.0	0.0	0.5	1.6	10.6	38.7	26.5	16.4	3.4	2.3
	0300	0.0	0.0	0.0	0.0	0.2	1.2	7.6	33.6	28.8	21.7	3.2	3.7
	0600	0.0	0.0	0.0	0.0	0.2	3.0	9.9	41.0	24.0	14.8	4.6	2.5
	0900	0.0	0.0	0.0	0.0	6.7	25.3	29.2	19.4	9.9	7.8	1.2	0.5
	1200	0.0	0.0	0.2	4.4	21.0	21.4	23.5	19.1	4.8	4.2	0.9	0.5
	1500	0.0	0.0	0.5	7.2	20.5	21.4	25.8	15.4	5.8	2.5	0.2	0.7
	1800	0.0	0.0	0.0	3.0	14.8	21.9	23.7	21.6	10.4	3.9	0.5	0.2
	2100	0.0	0.0	0.0	0.0	0.7	8.7	23.7	35.7	18.2	9.7	2.1	1.2
Aug	0000	0.0	0.0	0.0	0.0	0.0	1.2	7.6	35.2	25.4	23.3	3.4	3.9
	0300	0.0	0.0	0.0	0.0	0.0	1.2	4.8	25.8	33.4	23.7	7.4	3.7
	0600	0.0	0.0	0.0	0.0	0.0	0.9	4.8	27.6	32.0	23.8	6.7	4.2
	0900	0.0	0.0	0.0	0.0	2.1	16.1	30.0	28.8	11.2	8.8	1.2	1.8
	1200	0.0	0.0	0.0	2.5	18.2	24.0	21.7	18.0	9.2	4.8	0.9	0.7
	1500	0.0	0.0	0.0	4.6	20.0	18.0	22.1	21.9	9.0	3.2	0.5	0.7
	1800	0.0	0.0	0.0	1.2	9.2	20.5	23.7	24.2	12.2	7.8	1.2	0.0
	2100	0.0	0.0	0.0	0.0	0.2	2.5	19.3	39.9	18.0	15.7	2.3	2.1

TABLE 3A (contd)

Month	Hour	Relative humidity											
		Less than 20%	20-29%	30-39%	40-49%	50-59%	60-69%	70-79%	80-89%	90-94%	95-98%	99%	100%
Sep	0000	0.0	0.0	0.0	0.0	0.0	1.4	7.6	38.4	25.7	19.3	3.8	3.8
	0300	0.0	0.0	0.0	0.0	0.0	1.4	7.6	28.6	32.9	20.0	4.0	5.5
	0600	0.0	0.0	0.0	0.0	0.0	0.7	7.6	26.4	30.7	23.4	5.7	5.5
	0900	0.0	0.0	0.0	0.0	0.5	7.1	28.8	36.4	14.8	7.6	2.4	2.4
	1200	0.0	0.0	0.2	1.0	14.3	26.0	23.5	21.9	7.6	4.3	0.5	0.7
	1500	0.0	0.0	0.5	1.9	17.1	21.2	23.1	24.3	7.8	2.9	0.5	0.7
	1800	0.0	0.0	0.0	0.2	3.1	18.1	27.8	30.8	12.6	5.5	1.2	0.7
	2100	0.0	0.0	0.0	0.0	0.0	4.1	16.4	37.2	24.5	14.5	1.2	2.1
Oct	0000	0.0	0.0	0.0	0.0	0.2	4.8	7.8	37.4	24.2	14.3	5.1	6.2
	0300	0.0	0.0	0.0	0.0	0.2	2.8	9.2	32.5	25.1	19.6	3.9	6.7
	0600	0.0	0.0	0.0	0.0	0.2	2.1	9.9	30.2	27.2	19.6	5.1	5.7
	0900	0.0	0.0	0.0	0.0	0.7	4.6	15.7	37.8	18.4	16.1	3.2	3.5
	1200	0.0	0.0	0.0	0.2	6.9	17.0	32.7	25.6	9.7	5.3	1.2	1.4
	1500	0.0	0.0	0.0	0.0	9.7	18.7	28.6	26.3	10.8	4.1	1.1	0.7
	1800	0.0	0.0	0.0	0.0	0.2	6.2	23.3	37.4	17.5	10.8	3.0	1.6
	2100	0.0	0.0	0.0	0.0	0.2	3.2	12.5	40.4	21.5	13.6	5.8	2.8
Nov	0000	0.0	0.0	0.0	0.0	0.2	3.3	13.1	35.5	25.3	17.4	2.4	2.8
	0300	0.0	0.0	0.0	0.0	0.5	3.6	12.8	30.9	29.5	18.1	2.9	1.7
	0600	0.0	0.0	0.0	0.0	0.5	3.6	11.4	34.0	29.3	16.4	2.4	2.4
	0900	0.0	0.0	0.0	0.0	0.7	5.0	10.7	34.5	28.3	15.0	2.9	2.9
	1200	0.0	0.0	0.0	0.0	3.8	10.0	24.8	36.6	14.8	8.1	0.7	1.2
	1500	0.0	0.0	0.0	0.0	4.5	14.1	20.5	36.2	17.6	5.2	1.4	0.5
	1800	0.0	0.0	0.0	0.0	0.2	5.3	16.4	35.3	23.6	15.7	1.9	1.6
	2100	0.0	0.0	0.0	0.0	1.7	2.6	14.3	32.8	27.9	15.5	3.1	2.1
Dec	0000	0.0	0.0	0.0	0.0	0.2	4.4	15.0	37.6	26.0	13.4	2.3	1.1
	0300	0.0	0.0	0.0	0.0	0.9	3.9	15.2	36.0	26.3	14.3	2.3	1.1
	0600	0.0	0.0	0.0	0.0	0.7	4.4	13.6	40.3	23.5	14.7	1.4	1.4
	0900	0.0	0.0	0.0	0.2	0.2	4.8	13.4	35.6	25.8	16.1	2.3	1.6
	1200	0.0	0.0	0.2	0.0	0.2	10.8	23.3	37.8	15.2	10.4	1.2	0.9
	1500	0.0	0.0	0.0	0.0	0.5	10.6	21.0	38.4	17.5	9.9	1.4	0.7
	1800	0.0	0.0	0.0	0.0	0.2	4.8	17.8	38.3	21.2	15.4	1.8	0.5
	2100	0.0	0.0	0.0	0.0	0.0	3.9	18.2	36.6	24.0	13.3	2.8	1.2

Example: At 0600 hours GMT in January, relative humidities of between 80 and 89 per cent occurred on 38.8 per cent of occasions.

#### 4. Sunshine

A study of sunshine records suggests that Tayside experiences more sunshine than most other areas of Scotland and Arbroath is one of the sunniest places in the country. Indeed, the average annual duration of sunshine recorded over the region as a whole is similar to that of central London.

Monthly average and daily mean durations of sunshine for sunshine recording stations in the region are given in Table 4. The sunshine recording instruments at all the stations in the Tayside region have relatively free horizons with no obstructing hills, buildings or trees to cut off the sunshine. The lower durations of sunshine at Perth and Dundee are probably due to the general tendency for cloud to form inland during the day and a contributory cause may be a higher output of domestic and industrial smoke from these main centres of population.

Statistics of monthly and annual sunshine durations for Leuchars based on recordings made during the 49 years from 1922 to 1970 are given in Table 4A. Leuchars is the oldest established sunshine recording station in the region.

The path of the sun across the sky depends on the latitude and the time of year. Figure 2 is a solar chart for the Tayside region (latitude 56 degrees North) which shows the altitude 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 can then be evaluated. For example, it can be seen from Figure 2 that at 8.30 am 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 22 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, there would be no direct sunshine at any place in the region with a hill to the south whose top subtended an angle of  $10\frac{1}{2}$  degrees or more.

TABLE 4

Averages of sunshine duration in hours - monthly totals and daily means  
over 30 years period from 1931 to 1960

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	hr												
<u>Montrose</u>													
Monthly total	53	81	102	154	177	181	159	143	129	94	59	43	1375
Daily mean	1.72	2.87	3.30	5.13	5.72	6.03	5.12	4.62	4.31	3.04	1.97	1.40	3.77
<u>Arbroath</u>													
Monthly total	56	86	115	166	198	200	180	157	139	102	63	43	1505
Daily mean	1.79	3.04	3.71	5.54	6.40	6.67	5.80	5.05	4.63	3.28	2.10	1.38	4.12
<u>Dundee</u>													
Monthly total	53	81	104	146	174	174	158	142	125	93	57	41	1348
Daily mean	1.70	2.86	3.35	4.87	5.60	5.80	5.09	4.59	4.18	2.99	1.92	1.34	3.69
<u>Perth</u>													
Monthly total	41	74	100	147	180	186	163	136	120	85	49	31	1312
Daily mean	1.32	2.63	3.22	4.89	5.79	6.21	5.25	4.40	3.99	2.73	1.65	1.00	3.59
<u>Leuchars</u>													
Monthly total	56	84	115	162	194	198	178	152	137	100	64	45	1485
Daily mean	1.82	2.99	3.71	5.41	6.26	6.59	5.74	4.92	4.55	3.24	2.13	1.44	4.07
<u>St Andrews</u>													
Monthly total	55	82	110	161	189	198	177	150	134	99	63	43	1461
Daily mean	1.77	2.91	3.56	5.37	6.09	6.59	5.70	4.85	4.48	3.19	2.09	1.39	4.00

Note: The averages of sunshine quoted above for Arbroath, Dundee, Perth, Leuchars and St Andrews have been calculated from recordings made during the 30 years period from 1931 to 1960 which is the standard period for sunshine averages in current use in the Meteorological Office. The averages quoted for Montrose have been estimated from recordings made during the period from 1931 to 1953.

TABLE 4A

Statistics of monthly and annual sunshine durations for Leuchars, Fife  
(Period of records 49 years from 1922 to 1970)

Statistics of monthly sunshine durations

Month	Highest sunshine duration	Sunshine duration seldom* above	Median†	Sunshine duration seldom* below	Lowest sunshine duration
January	101 hours in January 1959	70 hours	54 hours	41 hours	21 hours in January 1942
February	128 hours in February 1970	101 hours	76 hours	65 hours	33 hours in February 1923
March	187 hours in March 1929	135 hours	116 hours	93 hours	49 hours in March 1964
April	215 hours in April 1942	187 hours	161 hours	131 hours	98 hours in April 1937
May	256 hours in May 1942	215 hours	189 hours	151 hours	115 hours in May 1967
June	264 hours in June 1949	223 hours	202 hours	175 hours	109 hours in June 1966
July	262 hours in July 1955	205 hours	172 hours	140 hours	91 hours in July 1931
August	214 hours in August 1947	180 hours	157 hours	127 hours	97 hours in August 1963
September	179 hours in September 1942	156 hours	134 hours	106 hours	77 hours in September 1956
October	143 hours in October 1958	118 hours	101 hours	83 hours	48 hours in October 1960
November	109 hours in November 1947	79 hours	68 hours	53 hours	33 hours in November 1968
December	82 hours in December 1967	55 hours	48 hours	37 hours	16 hours in December 1934

Statistics of annual sunshine durations

<u>Period of record</u>	<u>Highest Annual sunshine duration</u>	<u>Annual sunshine duration seldom* above</u>	<u>Median†</u>	<u>Annual sunshine duration seldom* below</u>	<u>Lowest annual sunshine duration</u>
49 years	1733 hours in 1949	1572 hours	1449 hours	1365 hours	1185 hours in 1941

\*Seldom = 20 per cent of occasions or 1 year in 5; the figures given are the upper and lower quintiles.

†Median = the "middle" value, i.e. half the sunshine durations exceed it and half fall below it.

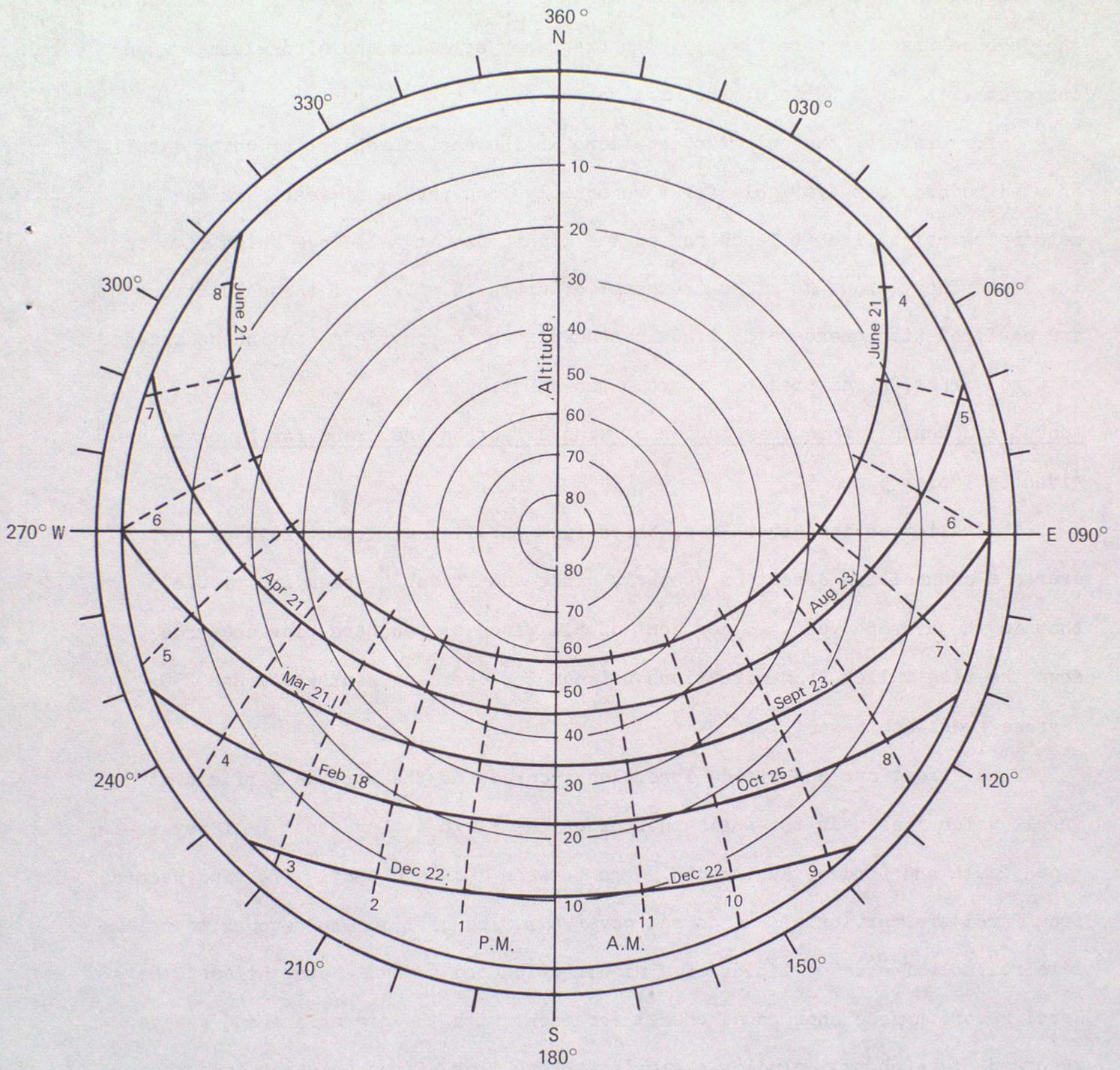


Fig.2

SOLAR CHART FOR LATITUDE 56°N

## 5. Winds

In common with Edinburgh and the Firth of Forth region further to the south, the Tayside area has a relatively high frequency of gales and strong winds when compared with other parts of the British Isles.

Unfortunately, the only two locations in the entire region for which detailed wind records are available for a reasonably long period of years are the meteorological office at Leuchars and the lighthouse at Bell Rock which lies in the Tay estuary about 12 miles southeast of Arbroath. Both of these locations are equipped with anemographs i.e. instruments which provide a continuous trace of wind direction and speed on a graduated chart.

Annual and monthly frequency tables of wind direction and speed for Leuchars are given in Tables 5 and 5A.

The valley of the River Eden, which runs parallel with the Firth of Tay, exerts a channelling effect on westerly winds and it can be seen from Table 5 that in the average year, 28 per cent of all winds at Leuchars blow seawards down the Eden valley from directions between 230 degrees (southwest) and 250 degrees (west-south-west).

Wind directions and speeds were also recorded at the wartime airfield at Errol (which lies near the northern bank of the Firth of Tay about half way between Perth and Dundee) during the years between 1941 and 1944. The wind records from Errol are very brief and do not cover a period of time long enough to calculate reliable frequency tables of wind direction and speed. Nevertheless, the Errol recordings do show good general agreement with the directions and speeds recorded at Leuchars including a similar channelling effect seawards down the Firth of Tay giving a high frequency of winds from the sector between southwest and west-south-west. Thus, it would be reasonable to assume that the Leuchars frequencies in Tables 5 and 5A give a reasonably reliable guide to the wind regime in Dundee and perhaps to most other locations in the region.

Owing to the complex topography and the complete absence of satisfactory wind records, the wind regime in Perth is most difficult to assess. Because of the ridge which lies to the southwest and south of Perth, the highest frequency of winds in Perth is almost certainly from the sector between west-south-west and west. However, the valley of the Tay bends sharply at Perth to follow a more northwesterly course and this may lead to a higher frequency of northwesterly winds when Perth is compared with Leuchars and other locations in the region most of which are relatively sheltered to winds from the northwest.

One feature of the monthly tables in Table 5A which is worthy of note is the relatively high frequency of easterly winds in the months of April, May and June particularly from the sector between about east-north-east and east. This increase in the frequency of easterly winds in the spring and early summer is prevalent along the whole of the east coast of Scotland and, in some years, easterly winds in the spring can be more frequent than from any other direction. There is evidence that easterly winds find their way to the west coast of Scotland through the gaps in the high ground and from the Tayside region they have relatively easy access particularly up the estuaries of the Tay and Eden. Annual and monthly frequency tables of wind direction and speed for Bell Rock lighthouse are given in Tables 5B and 5C. These show that the wind blows most frequently from the sector between 230 and 250 degrees. However, compared with Leuchars there are fewer winds from this direction and the winds are distributed more evenly round the compass. The tables also show that Bell Rock has a higher frequency of strong winds than Leuchars. This would be expected in view of the fact that the winds at Bell Rock have an unobstructed passage over the relatively smooth surface of the sea and that the anemograph at Bell Rock has an effective height of 38 metres compared with 13 metres at Leuchars.

### Extreme hourly mean wind speeds

A statistical treatment of the highest hourly mean wind speeds (i.e. the highest wind speeds averaged over the 60 minutes between hours) corrected to a standard height of 10 metres above ground level, recorded at Leuchars and Bell Rock in each year during a long period of years, yields the following results:-

Maximum hourly mean wind speeds at 10 metres (33 feet)  
above the ground likely to be exceeded on the average  
only once in the stated number of years

	<u>10 years</u>	<u>20 years</u>	<u>50 years</u>	<u>100 years</u>
Leuchars	53 mph	56 mph	62 mph	66 mph
Bell Rock	56 mph	59 mph	63 mph	67 mph

While the maximum hourly mean wind speed likely to be exceeded on the average only once in, say, 50 years is often referred to as the "1 in 50 year" hourly mean speed it is actually that speed which is likely to be exceeded with a probability of  $0.02 = \frac{1}{50}$  (or a 2 per cent probability) in any one year.

Similarly, the "1 in 100 year" speed is that speed likely to be exceeded with a probability of  $0.01 = \frac{1}{100}$  (or a 1 per cent probability) in any one year.

### Estimation of maximum wind speeds for the calculation of wind loadings on buildings and structures

The recommended procedures for the calculation of wind loadings on buildings are explained in 'Wind Loads' - CP3 - Chapter V - Part 2 of the British Standard Code of Practice published on 31 July 1970.

It can be seen from the Code of Practice that the first step in the assessment of wind load is to estimate the value of the maximum 3-second gust speed likely to be exceeded on the average only once in 50 years at a height of 10 metres above the ground in open level country in the locality of the structure. A map of these basic design maximum 3-second gust speeds is provided in the Code of Practice but for ease of reference, the basic 3-second gust speeds for the main centres in the Tayside region are given below:-

Maximum 3-second gust speed likely to be exceeded on the average only once in 50 years at 10 metres above the ground

<u>Location</u>	<u>metres per second</u>	<u>(mph)</u>
Montrose	48	(108)
Arbroath	48	(108)
Carnoustie	48	(108)
Dundee	50	(112)
Perth	50	(112)
Cupar	49	(110)
Tayport	48	(108)
Leuchars	48	(108)
St Andrews	48	(108)

Having estimated the value of the maximum 3-second gust speed it is then necessary to adjust this basic speed by using two factors ( $S_1$  and  $S_2$ ) which depend on the actual site and the nature and size of the building.

Topography factor -  $S_1$

This factor, described more fully in the Code, takes account of the effect of topography on the exposure of the site. In general, the topography factor for Dundee, Perth, Cupar and other centres of population in the region will be 1.0. However, a topography factor of between 1.05 and 1.10 would, for example, be appropriate for structures to be erected near the tops of low hills which rise abruptly from the general level of the terrain by 100 metres or more.

Ground roughness, building size and height above ground factor -  $S_2$

It is also necessary to adjust the basic maximum gust speed by the  $S_2$  factor which combines the effects of ground roughness, building size and the variation of wind speed with height. The ground roughness is dependent on the number and size of obstacles on the surface and may be described 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 centre 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. However, before combining the  $S_2$  factor with the basic gust speed, it should be realised that it takes a little time for the slowing-down process to take effect and that in the region under consideration, the transition from built-up area to open country is very abrupt - considerably more abrupt for example, than in cities like London, Birmingham and Manchester. Consequently, there is little doubt that strong winds on the outskirts of the cities, towns and villages in the Tayside region are able to bring something like their full effect into the built-up areas.

The reader will notice from Table 3, page 15 of the Code of Practice that the  $S_2$  factors for height and surface roughness have been classified under four categories of terrain numbered 1 to 4. Because of the "open" nature of the region under consideration, it is considered that the  $S_2$  factors quoted in the Code for "city centres" (viz Category 4 factors) are not applicable to any location in the region and, in general, it is thought that places in the region are more closely related to the height and surface roughness factors quoted in Categories 1 to 3 with the following classifications of environment:-

- Category 1 - open fairly level country immediately outside the towns and villages
- Category 2 - small towns and villages and districts on or near the fringe of the main built-up areas
- Category 3 - parts of the cities of Dundee and Perth in which the existing buildings are closely packed together.

The reader may wish to note that advice on design wind speeds, topographical effects etc can be given for a specific site and if there are any unusual features of local topography, exposure, or of the structure itself, advice on the appropriate gust speed and factors to be used should be sought from the Meteorological Office at 26 Palmerston Place, Edinburgh EH12 5AN 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 (less than 0.3 m/sec)
Light	1 to 12 mph (0.3 to 5.4 m/sec)
Moderate	13 to 18 mph (5.5 to 7.9 m/sec)
Fresh	19 to 24 mph (8.0 to 10.7 m/sec)
Strong	25 to 38 mph (10.8 to 17.1 m/sec)
Gale	39 to 46 mph (17.2 to 20.7 m/sec)
Severe Gale	Over 46 mph (over 20.7 m/sec)

The average speeds quoted above 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 limit of 39 mph shown in the above table.

The exceptionally severe gale of 15 January 1968

The westerly gale which affected the central belt of Scotland during the early hours of 15 January 1968 was the worst in living memory and caused enormous damage and considerable loss of life.

Greenock, Glasgow and many other places in the Clyde/Forth valley were particularly hard-hit and the damage to buildings alone has been assessed at £18m. In addition, some 17,000 acres of woodland, representing about 40m cubic feet of timber, were devastated.

In the Tayside region as elsewhere, there was considerable damage to roofs and chimney stacks. The gale also took a heavy toll of trees and woodland and several roads in the region were blocked by trees and other debris. Electricity supplies and telephone communications were disrupted and at Dundee, the vessel 'Hounslow' was swept from her moorings and struck a jetty before grounding.

It can be seen from Table 5D that at Leuchars, the gale reached its peak strength between 0300 and 0400 hours GMT on 15 January 1968 with an average wind speed over this period of 60 minutes of 65 mph from direction 230 degrees (south-west) and a highest gust of 106 mph at 0315 hours GMT.

At Bell Rock (see Table 5E), the gale reached its peak strength between 0400 and 0500 hours GMT on 15 January 1968 with an average wind speed over this period of 60 minutes of 75 mph from direction 240 degrees and a highest gust of 111 mph at 0410 hours GMT.

The actual numbers of days with gales at Leuchars during each month and year during the 20 years from 1952 to 1971 are given in Table 5F. At Leuchars, gales have blown from all points of the compass between northeast through south to northwest but the most frequent and severe gales have occurred from the sector between southwest and west. Although less frequent than from westerly directions, strong winds and gales from easterly directions are by no means uncommon at Leuchars. One of the worst easterly gales during recent years occurred around midday on 14 March 1964 when the Leuchars anemograph recorded an hourly mean speed of 46 mph and a highest gust of 65 mph from an east-south-easterly direction. However, when considering winds from an easterly direction, it should be borne in mind that there are several stretches of the Tayside coastline which are more exposed to winds from the east than Leuchars. For example, it would be reasonable to assume that exposed places on the sea fronts of Montrose, Arbroath, Carnoustie and St Andrews experience higher wind speeds from easterly directions than Leuchars.

The numbers of days and hours with gusts to 39 mph or more and 55 mph or more at Leuchars and Bell Rock are given in Tables 5G and 5H.

The speed, direction and date of occurrence of the highest gusts recorded at Leuchars in each month and year during the 10 years from 1962 to 1971 are given in Table 5I.

#### 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 gusts of wind of 40 mph or more are occurring.

Records showing the incidence of gusts of 40 mph or more during the working part of the day are not readily available but at Leuchars, gusts of 40 mph or more, first start to occur when the hourly mean wind speed reaches the level of about 20 mph and gusts to 40 mph or more, become quite frequent with hourly mean wind speeds of 25 mph or more. Accordingly, in view of the gusty nature of the winds, statistics of hourly mean 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 5J gives the total number of days at Leuchars on which the hourly mean wind speed reached 25 mph or more in at least one hour between 0700 and 1700 hours GMT during the 10 years from 1961 to 1970 and also the total number of hours in which hourly mean speeds of 25 mph or more were recorded between 0700 and 1700 hours GMT.

It should be borne in mind when studying Table 5J that the average wind speeds of 25 mph or more were recorded at a height of 43 feet (13 metres) above ground level and that considerably higher speeds could be experienced at heights in excess of 43 feet above the ground. For example, an hourly mean speed of 25 mph or more with gusts to 40 mph or more at a height of 43 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 5J it should be noted that the figures relate to a 7-day working week and not to a 5-day working week.

A table for converting miles per hour into metres per second is at Table 5K.



TABLE 5A

Monthly percentage frequencies of wind direction and speed at  
Leuchars  
 (10 years from 1962 to 1971)

Wind direction in degrees (True)

Mean wind speed	550-010	020-040	050-070	080-100	110-130	140-160	170-190	200-220	230-250	260-280	290-310	320-340	All directions
<b>JANUARY</b>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	12.5%
4-12 mph	2.5	2.1	0.8	1.5	2.6	1.8	1.3	2.5	16.1	6.7	2.3	1.4	41.6%
13-24 mph	0.6	1.5	1.8	2.4	4.8	1.7	1.0	4.7	12.6	4.6	1.6	0.5	37.8%
25-38 mph	0+	0+	1.1	0.7	1.6	0.2	0.3	1.5	1.7	0.5	0.1		7.7%
39 mph or more				0.1	0.1			0.1	0.1	0+	0+		0.4%
Total	3.1	3.6	3.7	4.7	9.1	3.7	2.6	8.8	30.5	11.8	4.0	1.9	100.0%
<b>FEBRUARY</b>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	9.8%
4-12 mph	2.8	2.9	1.5	1.9	2.8	1.3	1.1	1.7	14.6	6.0	3.0	1.8	41.4%
13-24 mph	0.6	1.8	4.3	3.4	4.1	1.0	1.1	2.5	11.0	4.1	2.6	1.2	37.7%
25-38 mph	0.1		1.4	1.1	2.0	0.1	0.3	0.9	2.7	1.4	0.4	0.1	10.5%
39 mph or more					0.1		0+		0.2	0.3	0+		0.6%
Total	3.5	4.7	7.2	6.4	9.0	2.4	2.5	5.1	28.5	11.8	6.0	3.1	100.0%
<b>MARCH</b>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	9.0%
4-12 mph	2.3	2.0	1.9	3.0	3.1	1.2	0.8	2.0	8.9	5.4	2.9	2.1	35.6%
13-24 mph	1.3	1.0	2.4	3.3	5.0	1.3	0.8	3.1	13.3	5.4	4.3	1.4	42.6%
25-38 mph	0.2	0.3	0.1	1.5	1.8	0.2	0.1	0.9	4.4	2.0	0.7	0.3	12.5%
39 mph or more					0.2				0+	0.1	0+		0.3%
Total	3.8	3.3	4.4	7.8	10.1	2.7	1.7	6.0	26.6	12.9	7.9	3.8	100.0%
<b>APRIL</b>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	10.0%
4-12 mph	2.9	2.7	3.7	4.5	2.6	0.8	1.0	2.8	8.2	4.6	1.8	1.5	37.1%
13-24 mph	1.8	2.7	7.5	6.2	2.6	0.8	0.7	2.8	10.9	5.4	3.5	1.4	46.3%
25-38 mph	0.2		0.7	0.9	0.1		0.1	0.3	1.8	1.5	0.7	0.3	6.6%
39 mph or more									0+	0+			0.4%
Total	4.9	5.4	11.9	11.6	5.3	1.6	1.8	5.9	20.9	11.5	6.0	3.2	100.0%

TABLE 5A (Contd)

Monthly percentage frequencies of wind direction and speed at  
Leuchars  
 (10 years from 1962 to 1971)

Wind direction in degrees (True)													
Mean wind speed	350-010	020-040	050-070	080-100	110-130	140-160	170-190	200-220	230-250	260-280	290-310	320-340	All directions
<u>MAY</u>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	9.7%
4-12 mph	2.1	3.2	5.1	7.3	3.6	1.3	1.4	2.9	9.6	3.4	1.8	1.2	42.9%
13-24 mph	1.5	2.2	6.5	6.9	3.8	1.4	1.5	4.3	9.3	3.8	1.6	0.5	43.3%
25-38 mph		0+	0.1	0.2	0.3		0.2	0.5	1.6	0.7	0.3		3.9%
39 mph or more									0.2		0+		0.2%
Total	3.6	5.4	11.7	14.4	7.7	2.7	3.1	7.7	20.7	7.9	3.7	1.7	100.0%
<u>JUNE</u>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	11.7%
4-12 mph	1.1	3.3	7.0	8.2	4.8	1.2	1.2	2.9	10.4	2.9	1.3	0.8	45.1%
13-24 mph	0.8	1.5	5.3	5.8	1.7	1.0	1.1	3.3	12.6	5.3	1.4	0.3	40.1%
25-38 mph		0+	0.1		0.1	0+	0.1	0.5	1.5	0.8	0+		3.1%
39 mph or more										0+			0+
Total	1.9	4.8	12.4	14.0	6.6	2.2	2.4	6.7	24.5	9.0	2.7	1.1	100.0%
<u>JULY</u>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	8.9%
4-12 mph	1.8	3.2	5.0	7.2	5.4	1.3	1.1	2.8	11.6	6.2	2.8	1.4	49.8%
13-24 mph	0.9	1.6	4.3	2.8	1.5	0.5	0.6	2.8	14.8	5.7	2.1	0.8	38.4%
25-38 mph			0.1		0+			0+	2.0	0.8	0+	0+	2.9%
39 mph or more													0.0%
Total	2.7	4.8	9.4	10.0	6.9	1.8	1.7	5.6	28.4	12.7	4.9	2.2	100.0%
<u>AUGUST</u>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	12.5%
4-12 mph	2.5	3.8	5.1	6.9	4.2	1.2	1.4	3.6	13.8	5.8	2.2	1.6	52.1%
13-24 mph	0.7	2.3	4.0	3.9	1.7	0.6	0.6	3.3	9.6	4.0	2.1	0.6	33.4%
25-38 mph		0+	0.1	0+		0+		0.3	1.1	0.3	0.2	0+	2.0%
39 mph or more								0+	0+				0+
Total	3.2	6.1	9.2	10.8	5.9	1.8	2.0	7.2	24.5	10.1	4.5	2.2	100.0%

TABLE 5A (Contd)

Mean wind speed	Wind direction in degrees (True)												All directions
	350-010	020-040	050-070	080-100	110-130	140-160	170-190	200-220	230-250	260-280	290-310	320-340	
<b>SEPTEMBER</b>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	13.9
4-12 mph	1.8	2.9	2.5	4.7	4.1	1.7	1.5	4.4	15.3	5.9	2.2	1.3	43.3
13-24 mph	0.5	1.0	2.6	1.9	2.7	1.0	1.0	3.9	13.1	4.4	1.6	0.5	34.2
25-38 mph	0+	0+	0.1	0.1	0.2	0+	0.1	0.6	1.4	0.8	0.1		3.4
39 mph or more					0+	0+		0+	0.2	0+			0.2
Total	2.3	3.9	5.2	6.7	7.0	2.7	2.6	8.9	30.0	11.1	3.9	1.8	100.0
<b>OCTOBER</b>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	17.0
4-12 mph	1.3	1.0	1.4	2.8	2.6	1.5	1.3	3.6	14.3	5.2	1.5	1.4	37.9
13-24 mph	0.7	0.5	0.9	1.5	2.5	1.1	1.0	6.1	17.4	3.8	2.0	0.5	38.0
25-38 mph	0+	0+	0+	0.2	0.1	0+	0.2	1.8	3.3	0.8	0.3	0.1	6.8
39 mph or more								0.1	0.2	0+			0.3
Total	2.0	1.5	2.3	4.5	5.2	2.6	2.5	11.6	35.2	9.8	3.8	2.0	100.0
<b>NOVEMBER</b>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	11.2
4-12 mph	2.7	2.9	1.1	1.3	2.0	1.4	0.7	2.1	14.9	6.7	3.0	2.0	40.8
13-24 mph	3.1	2.2	1.4	1.9	2.9	1.0	0.3	3.1	13.8	4.7	2.9	2.6	39.9
25-38 mph	0+	0.1	1.1	1.1	0.7	0+		0.5	2.3	1.5	0.4	0.2	7.9
39 mph or more			0.1	0+	0+				0.1	0+			0.2
Total	5.8	5.2	3.7	4.3	5.6	2.4	1.0	5.7	31.1	12.9	6.3	4.8	100.0
<b>DECEMBER</b>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	9.8
4-12 mph	3.0	1.9	0.6	0.7	1.8	1.4	1.4	2.8	16.2	7.5	2.9	2.5	42.7
13-24 mph	1.5	1.9	1.4	1.6	1.7	1.1	1.1	5.1	15.1	4.8	4.3	1.9	41.5
25-38 mph	0+		0.2	0.7	0.1	0.1	0.2	0.6	3.0	0.8	0.2	0.1	6.0
39 mph or more				0+			0+		0+	0+			0+
Total	4.5	3.8	2.2	3.0	3.6	2.6	2.7	8.5	34.3	13.1	7.4	4.5	100.0



TABLE 5C

Monthly percentage frequencies of wind direction and speed at  
Bell Rock Lighthouse, Tay Estuary  
(10 years from 1961-1970)

Mean wind speed	Wind direction in degrees (True)												All directions
	350-010	020-040	050-070	080-100	110-130	140-160	170-190	200-220	230-250	260-280	290-310	320-340	
<b>JANUARY</b>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	4.4%
4-12 mph	0.7	0.4	0.6	0.5	0.5	0.8	1.4	1.8	2.3	3.1	1.8	0.8	14.7%
13-24 mph	3.0	1.9	2.3	1.8	2.4	3.3	4.9	4.7	7.2	7.5	3.7	3.3	46.0%
25-38 mph	1.5	1.1	2.4	0.6	2.8	5.1	3.0	3.2	6.1	2.7	0.9	1.6	31.0%
39 mph or more	0.1	0.2	0.2	0.1	0.2	0.9	0.3	0.5	0.9	0.4	0.0+	0.1	3.9%
Total	5.3	3.6	5.5	3.0	5.9	10.1	9.6	10.2	16.5	13.7	6.4	5.8	100.0%
<b>FEBRUARY</b>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	3.4%
4-12 mph	1.2	1.0	0.8	0.8	0.6	0.9	1.2	1.0	2.0	2.4	2.1	1.3	15.3%
13-24 mph	4.9	2.3	3.2	3.3	3.6	3.1	4.3	3.2	4.4	8.5	3.9	3.7	48.4%
25-38 mph	1.5	0.7	1.9	2.8	2.2	2.7	3.0	2.6	4.5	3.2	0.8	1.8	27.7%
39 mph or more	0.3	0.1	0.1	0.2	0.1	1.0	0.2	0.3	1.1	1.0	0.3	0.2	4.9%
Total	7.9	4.1	6.0	7.1	6.5	7.7	8.7	7.1	12.0	15.1	7.1	7.0	99.7%
												Defective record	0.3%
												Total	100.0%
<b>MARCH</b>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	5.7%
4-12 mph	1.4	1.4	1.7	1.2	1.2	0.8	0.9	1.3	1.4	1.8	1.2	1.2	15.5%
13-24 mph	4.3	2.5	2.6	1.4	2.5	3.6	2.9	3.7	6.2	6.6	3.9	3.5	43.7%
25-38 mph	1.7	0.6	0.7	0.8	4.0	2.9	1.6	3.4	5.7	4.9	3.0	1.3	30.6%
39 mph or more	0.3	0.1	0.0+	0.1	1.1	0.3	0.1	0.3	1.0	0.8	0.3	0.1	4.5%
Total	7.7	4.6	5.0	3.5	8.8	7.6	5.5	8.7	14.3	14.1	8.4	6.1	100.0%
<b>APRIL</b>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	7.3%
4-12 mph	1.4	1.4	1.4	1.7	1.3	1.6	2.1	2.1	2.1	1.9	1.2	0.8	19.0%
13-24 mph	4.8	5.3	5.1	2.3	4.1	4.2	4.3	4.8	7.2	5.8	2.7	2.1	52.7%
25-38 mph	2.2	2.2	1.0	2.0	1.1	2.1	0.7	1.3	2.9	2.3	1.0	0.9	19.7%
39 mph or more	0.1			0.0+		0.1		0.1	0.3	0.3	0.2	0.2	1.3%
Total	8.5	8.9	7.5	6.0	6.5	8.0	7.1	8.3	12.5	10.3	5.1	4.0	100.0%

TABLE 5C (contd)

Wind direction in degrees (True)

Mean wind speed	350-010	020-040	050-070	080-100	110-130	140-160	170-190	200-220	230-250	260-280	290-310	320-340	All directions
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MAY

Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	9.7%
4-12 mph	1.5	2.1	3.7	2.7	2.7	2.5	2.3	2.0	2.0	1.7	0.9	0.7	24.8%
13-24 mph	3.4	6.0	4.6	2.5	3.6	4.6	4.3	4.3	7.0	4.9	1.9	1.9	49.0%
25-38 mph	1.4	1.3	0.4	0.6	1.3	2.6	1.5	1.1	2.5	1.5	0.4	0.5	15.1%
39 mph or more	0.0+	0.0+			0.0+	0.1	0.0+	0.1	0.7	0.1	0.2	0.1	1.3%
<b>Total</b>	<b>6.3</b>	<b>9.4</b>	<b>8.7</b>	<b>5.8</b>	<b>7.6</b>	<b>9.8</b>	<b>8.1</b>	<b>7.5</b>	<b>12.2</b>	<b>8.2</b>	<b>3.4</b>	<b>3.2</b>	<b>99.9%</b>

Defective record	0.1%
<b>Total</b>	<b>100.0%</b>

JUNE

Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	11.3%
4-12 mph	0.8	1.5	3.9	3.4	2.9	3.1	2.3	2.3	2.2	1.7	0.9	0.4	25.4%
13-24 mph	1.8	2.9	5.2	1.8	2.4	5.3	4.8	5.2	9.1	7.5	1.9	0.8	48.7%
25-38 mph	0.7	0.6	0.1		0.1	1.4	1.1	1.7	5.2	2.3	0.3	0.3	13.8%
39 mph or more		0.0+			0.0+	0.1	0.0+	0.2	0.2	0.2	0.0+		0.7%
<b>Total</b>	<b>3.3</b>	<b>5.0</b>	<b>9.2</b>	<b>5.2</b>	<b>5.4</b>	<b>9.9</b>	<b>8.2</b>	<b>9.4</b>	<b>16.7</b>	<b>11.7</b>	<b>3.1</b>	<b>1.5</b>	<b>99.9%</b>

Defective record	0.1%
<b>Total</b>	<b>100.0%</b>

JULY

Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	12.0%
4-12 mph	1.3	2.3	3.1	3.2	2.0	2.1	2.2	1.9	2.7	2.1	1.2	0.9	25.0%
13-24 mph	2.8	5.0	3.4	1.3	1.6	3.5	3.5	5.6	8.8	8.4	2.7	1.8	48.4%
25-38 mph	0.9	1.1	0.3	0.2	0.2	0.9	0.3	1.6	4.2	3.7	0.5	0.3	14.2%
39 mph or more	0.0+	0.0+			0.0+			0.1	0.3	0.0+		0.0+	0.4%
<b>Total</b>	<b>5.0</b>	<b>8.4</b>	<b>6.8</b>	<b>4.7</b>	<b>3.8</b>	<b>6.5</b>	<b>6.0</b>	<b>9.2</b>	<b>16.0</b>	<b>14.2</b>	<b>4.4</b>	<b>3.0</b>	<b>100.0%</b>

AUGUST

Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	12.6%
4-12 mph	1.4	2.2	3.2	1.9	1.5	1.8	2.2	2.5	2.6	2.1	1.3	1.1	23.8%
13-24 mph	2.7	4.4	4.8	2.2	2.3	4.1	4.0	6.2	8.6	5.3	2.6	1.7	48.9%
25-38 mph	0.8	1.1	0.5	0.1	0.5	1.3	0.8	1.7	3.8	2.2	0.7	0.4	13.9%
39 mph or more	0.1	0.1		0.0+	0.0+	0.0+	0.0+	0.1	0.3	0.1		0.1	0.8%
<b>Total</b>	<b>5.0</b>	<b>7.8</b>	<b>8.5</b>	<b>4.2</b>	<b>4.3</b>	<b>7.2</b>	<b>7.0</b>	<b>10.5</b>	<b>15.3</b>	<b>9.7</b>	<b>4.6</b>	<b>3.3</b>	<b>100.0%</b>

TABLE 5C (contd)

Wind direction in degrees (True)														
Mean wind speed	350-010	020-040	050-070	080-100	110-130	140-160	170-190	200-220	230-250	260-280	290-310	320-340	All directions	
<b>SEPTEMBER</b>														
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	7.8%	
4-12 mph	0.8	1.3	1.4	1.3	1.3	2.2	2.8	2.5	2.5	2.4	1.6	0.8	20.9%	
13-24 mph	2.8	3.4	2.6	0.9	2.2	5.6	6.1	6.0	9.1	7.4	3.2	1.4	50.7%	
25-38 mph	0.9	1.0	0.5	0.1	0.4	2.6	1.5	2.1	4.7	3.6	1.1	0.1	18.6%	
39 mph or more	0.1	0.1	0.0+		0.1	0.3	0.1	0.2	0.7	0.3	0.0+		1.9%	
Total	4.6	5.8	4.5	2.3	4.0	10.7	10.5	10.8	17.0	13.7	5.9	2.3	99.9%	
													Defective record	0.1%
													Total	100.0%
<b>OCTOBER</b>														
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	7.5%	
4-12 mph	0.8	0.5	0.5	1.1	1.1	1.4	2.6	2.4	3.1	2.1	1.2	0.4	17.2%	
13-24 mph	1.5	0.9	0.5	0.9	2.2	5.7	6.8	6.3	9.2	7.2	2.9	1.2	45.3%	
25-38 mph	1.3	0.2	0.3	0.3	0.9	2.3	2.4	3.6	6.9	4.1	1.6	0.9	24.8%	
39 mph or more	0.7	0.0+	0.0+		0.0+	0.4	0.1	0.8	1.6	0.9	0.2	0.2	4.9%	
Total	4.3	1.6	1.3	2.3	4.2	9.8	11.9	13.1	20.8	14.3	5.9	2.7	99.7%	
													Defective record	0.3%
													Total	100.0%
<b>NOVEMBER</b>														
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	4.0%	
4-12 mph	0.9	1.0	0.8	0.7	0.7	0.6	0.9	1.3	2.0	2.4	1.9	1.2	14.4%	
13-24 mph	3.3	2.8	2.2	2.0	2.0	2.6	3.7	2.9	6.7	7.3	4.4	2.3	42.2%	
25-38 mph	4.3	2.2	1.0	2.1	1.9	2.3	1.8	1.9	5.7	5.8	2.3	2.3	33.6%	
39 mph or more	1.0	0.6	0.3	0.2	0.4	0.3	0.0+	0.3	0.9	0.7	0.5	0.6	5.8%	
Total	9.5	6.6	4.3	5.0	5.0	5.8	6.4	6.4	15.3	16.2	9.1	6.4	100.0%	
<b>DECEMBER</b>														
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	3.2%	
4-12 mph	0.6	0.2	0.5	0.5	0.3	0.6	1.0	1.8	2.1	2.1	2.1	1.0	12.8%	
13-24 mph	4.1	1.4	1.8	2.0	1.1	2.5	4.8	4.8	8.0	9.3	6.2	3.9	49.9%	
25-38 mph	4.6	1.3	0.7	0.7	1.1	1.8	3.1	2.4	5.4	2.9	2.9	3.1	30.0%	
39 mph or more	0.4	0.1	0.1	0.2	0.1	0.2	0.7	0.3	1.3	0.3	0.2	0.2	4.1%	
Total	9.7	3.0	3.1	3.4	2.6	5.1	9.6	9.3	16.8	14.6	11.4	8.2	100.0%	

TABLE 5D

The very severe gale of 15 January 1968

Hourly mean wind directions and speeds and speeds of highest gusts recorded at the Meteorological Office at Leuchars, Fife, between 2000 hours GMT on 14 January 1968 and 1500 hours GMT on 15 January 1968

<u>Hour - Greenwich Mean Time</u>	<u>Wind direction averaged over 60 minutes</u>	<u>Wind speed averaged over 60 minutes</u>	<u>Highest gust during 60 minutes</u>
<u>Date: 14 January 1968</u>			
Between 2000 and 2100 hours	From 120 degrees	8 mph	12 mph
" 2100 " 2200 "	" 100 "	7 "	15 "
" 2200 " 2300 "	" 230 "	19 "	55 "
" 2300 " 2400 "	" 230 "	37 "	67 "
<u>Date: 15 January 1968</u>			
Between 0000 and 0100 hours	From 220 degrees	33 mph	59 mph
" 0100 " 0200 "	" 220 "	37 "	66 "
" 0200 " 0300 "	" 220 "	53 "	98 "
" 0300 " 0400 "	" 230 "	65 "	106 " *
" 0400 " 0500 "	" 240 "	62 "	92 "
" 0500 " 0600 "	" 250 "	59 "	91 "
" 0600 " 0700 "	" 250 "	47 "	74 "
" 0700 " 0800 "	" 260 "	50 "	76 "
" 0800 " 0900 "	" 260 "	48 "	78 "
" 0900 " 1000 "	" 260 "	39 "	60 "
" 1000 " 1100 "	" 260 "	37 "	54 "
" 1100 " 1200 "	" 260 "	32 "	54 "
" 1200 " 1300 "	" 260 "	32 "	52 "
" 1300 " 1400 "	" 260 "	30 "	46 "
" 1400 " 1500 "	" 260 "	28 "	44 "

\*The highest gust of 106 mph was recorded at 0315 hours GMT

TABLE 5E

The very severe gale of 15 January 1968

Hourly mean wind directions and speeds and speeds of highest gusts recorded  
at Bell Rock Lighthouse between 2000 hours GMT on 14 January 1968  
and 1500 hours GMT on 15 January 1968

<u>Hour - Greenwich Mean Time</u>	<u>Wind direction averaged over 60 minutes</u>	<u>Wind speed averaged over 60 minutes</u>	<u>Highest gust during 60 minutes</u>
<u>Date: 14 January 1968</u>			
Between 2000 and 2100 hours	From 170 degrees	15 mph	20 mph
" 2100 " 2200 "	" 150 "	17 "	25 "
" 2200 " 2300 "	" 200 "	23 "	32 "
" 2300 " 2400 "	" 230 "	38 "	59 "
<u>Date: 15 January 1968</u>			
Between 0000 and 0100 hours	From 230 degrees	40 mph	58 mph
" 0100 " 0200 "	" 220 "	46 "	71 "
" 0200 " 0300 "	" 220 "	52 "	78 "
" 0300 " 0400 "	" 230 "	60 "	100 "
" 0400 " 0500 "	" 240 "	75 "	111 "
" 0500 " 0600 "	" 250 "	71 "	101 "
" 0600 " 0700 "	" 260 "	69 "	104 "
" 0700 " 0800 "	" 260 "	61 "	83 "
" 0800 " 0900 "	" 270 "	53 "	75 "
" 0900 " 1000 "	" 270 "	43 "	55 "
" 1000 " 1100 "	" 270 "	41 "	54 "
" 1100 " 1200 "	" 260 "	36 "	45 "
" 1200 " 1300 "	" 270 "	32 "	40 "
" 1300 " 1400 "	" 260 "	33 "	46 "
" 1400 " 1500 "	" 260 "	35 "	47 "

\*The highest gust of 111 mph was recorded at 0410 hours GMT

TABLE 5F

Actual and average number of days with gales during the 20 years  
from 1952 to 1971 at Leuchars

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
1952								1		1			2
1953	1												1
1954	1			1							3	5	10
1955	1									1		2	4
1956			1								2	4	7
1957	4	2		1					1		1	3	12
1958	1	1	1		1								4
1959		1								1		6	8
1960	1	1		1									3
1961	1	1	2		1	2		1	1	3			12
1962	5	5		1	2	1		2	1			3	20
1963	1	1			2				1	3			8
1964	2	2	2		1		1				1	3	12
1965	2	2			1	3			1	1	4		14
1966	2		2	2	1				1		2	2	12
1967		4	10	1						2	1	1	19
1968	3	1	4							2			10
1969	1			1					4		2		8
1970		1	3					1	1	1	1		8
1971	1									1			2
20 years average	1.3	1.1	1.2	0.4	0.5	0.3	0.1	0.3	0.5	0.8	0.9	1.4	8.8

TABLE 5G

Number of days and hours with gusts of 39 mph or more at Leuchars  
(10 years from 1962 to 1971)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
1962	17 80	17 126	4 13	3 22	4 40	9 58	0 0	11 66	3 15	5 34	3 10	9 63	85 527
1963	10 81	6 44	6 37	6 38	11 45	3 7	0 0	1 2	7 42	10 61	8 52	6 25	74 434
1964	7 59	7 42	9 74	8 34	10 79	6 20	9 65	3 12	9 23	4 12	10 52	10 53	92 525
1965	10 45	3 35	7 67	8 60	2 24	9 55	2 3	6 26	7 21	5 63	13 100	0 0	72 499
1966	9 51	10 83	19 88	8 24	3 17	1 1	1 3	1 6	4 22	3 5	8 52	11 81	78 433
1967	5 21	12 98	26 225	6 68	2 9	3 14	4 7	1 3	3 13	15 85	6 41	10 50	93 634
1968	10 49	4 18	13 101	2 4	0 0	3 3	2 16	1 1	3 13	8 51	8 30	7 15	61 301
1969	9 46	10 57	7 97	9 37	1 1	1 1	6 25	0 0	8 47	12 55	7 61	7 10	77 437
1970	7 12	7 54	11 79	7 24	5 28	2 11	8 71	6 35	6 48	14 88	10 52	6 24	89 526
1971	8 61	6 38	6 42	4 33	0 0	1 1	1 10	2 3	1 12	13 53	12 58	13 91	67 402
10-year means	9.2 50.5	8.2 59.5	10.8 82.3	6.1 34.4	3.8 24.3	3.8 17.1	3.3 20.0	3.2 15.4	5.1 25.6	8.9 50.7	8.5 50.8	7.9 41.2	78.8 471.8

TABLE 5G (Contd.)

Number of days and hours with gusts to 55 mph or more at Leuchars  
(10 years from 1962 to 1971)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
1962	Days 4	5	0	1	2	1	0	2	1	0	0	4	20
	Hours 8	41	0	5	18	7	0	10	6	0	0	9	104
1963	Days 1	1	0	1	1	0	0	0	1	3	1	0	9
	Hours 8	2	0	1	1	0	0	0	9	5	1	0	27
1964	Days 2	2	1	0	1	0	3	0	0	0	2	4	15
	Hours 6	6	13	0	8	0	9	0	0	0	4	4	50
1965	Days 2	2	0	2	1	4	0	0	1	2	3	0	17
	Hours 7	13	0	2	8	4	0	0	3	8	4	0	49
1966	Days 2	0	3	2	1	0	0	0	1	0	2	1	12
	Hours 2	0	10	2	3	0	0	0	9	0	5	2	33
1967	Days 0	3	10	2	0	0	0	0	1	2	0	0	18
	Hours 0	8	37	2	0	0	0	0	1	7	0	0	55
1968	Days 4	1	4	0	0	0	0	0	0	2	0	0	11
	Hours 14	1	7	0	0	0	0	0	0	7	0	0	29
1969	Days 0	0	0	0	0	0	0	0	4	0	3	0	7
	Hours 0	0	0	0	0	0	0	0	17	0	6	0	23
1970	Days 0	4	4	0	0	0	0	0	1	4	1	1	15
	Hours 0	11	6	0	0	0	0	0	1	9	9	1	37
1971	Days 2	0	0	1	0	0	0	0	1	2	1	1	8
	Hours 4	0	0	1	0	0	0	0	1	9	1	1	17
10-year means	Days 1.7	1.8	2.2	0.9	0.6	0.5	0.3	0.2	1.1	1.5	1.3	1.1	13.2
	Hours 4.9	8.2	7.3	1.3	3.8	1.1	0.9	1.0	4.7	4.5	3.0	1.7	42.4

TABLE 5H

Number of days and hours with gusts of 39 mph or more at Bell Rock Lighthouse  
(10 years from 1962 to 1971)

<u>Year</u>	<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 Total</u>
1962	Days 20 Hours 225	21 224	10 46	9 49	11 73	12 96	6 16	15 127	8 51	11 105	10 104	15 147	148 1263
1963	Days 19 Hours 187	11 109	14 102	9 90	9 44	4 20	2 3	3 16	10 66	12 101	13 116	13 100	119 954
1964	Days 13 Hours 68	10 93	11 166	6 12	10 37	6 13	10 48	7 38	12 67	6 41	16 116	19 207	127 906
1965	Days 16 Hours 129	8 66	15 121	11 97	7 49	7 66	3 10	10 48	13 88	7 101	23 289	15 69	135 1133
1966	Days 14 Hours 138	16 132	19 143	10 65	6 30	1 8	2 5	7 41	6 53	12 66	19 240	23 217	135 1145
1967	Days 19 Hours 102	20 190	28 334	14 132	10 91	8 43	5 8	4 11	7 51	26 227	14 99	18 158	172 1446
1968	Days 16 Hours 105	5 26	14 126	4 11	5 7	2 2	6 32	0 0	5 28	9 102	14 170	13 110	93 719
1969	Days 11 Hours 77	14 113	8 113	7 39	1 1	3 15	5 22	4 7	10 79	14 70	23 235	11 83	111 854
1970	Days 15 Hours 104	13 104	11 88	9 37	6 32	2 17	13 66	4 43	10 63	17 173	18 145	10 82	128 954
1971	Days 13 Hours 111	12 92	7 76	6 50	3 4	1 9	1 13	5 28	3 21	14 117	20 235	23 191	108 947
10-year means	Days 15.6 Hours 124.6	13.0 114.9	13.7 132.0	8.5 58.2	6.8 36.8	4.6 28.9	5.3 22.3	5.9 35.9	8.4 56.7	12.8 110.3	17.0 174.9	16.0 136.4	127.6 1031.9

TABLE 5H (Contd)

Number of days and hours with gusts of 55 mph or more at Bell Rock Lighthouse  
(10 years from 1962 to 1971)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
1962	Days	12	9	1	1	1	0	3	3	4	4	8	50
	Hours	46	64	3	5	22	4	14	12	17	27	24	238
1963	Days	2	1	2	1	0	0	0	3	3	2	1	15
	Hours	15	1	2	2	0	0	0	16	7	6	2	51
1964	Days	3	3	5	0	2	0	2	0	0	4	7	28
	Hours	8	7	36	0	8	0	5	0	0	20	31	123
1965	Days	5	2	4	4	1	4	0	3	4	9	4	40
	Hours	18	17	11	7	9	10	0	9	28	62	4	175
1966	Days	1	1	4	0	1	0	0	1	4	6	6	24
	Hours	2	1	14	0	4	0	0	10	9	44	19	103
1967	Days	4	8	12	5	1	0	0	2	8	5	6	51
	Hours	9	34	69	35	4	0	0	3	32	13	11	210
1968	Days	4	2	5	0	0	0	0	0	2	2	3	18
	Hours	19	7	25	0	0	0	0	0	24	6	9	90
1969	Days	3	4	0	2	0	0	0	5	0	6	3	25
	Hours	8	7	0	2	0	0	0	18	0	19	10	64
1970	Days	1	3	4	0	0	0	3	1	10	3	4	29
	Hours	4	10	12	0	0	0	4	3	37	15	5	90
1971	Days	5	3	3	1	0	0	1	1	5	8	7	34
	Hours	17	6	25	2	0	0	1	5	12	55	30	153
10-year means	Days	4.0	3.6	4.0	1.4	0.9	0.5	0.9	1.9	4.0	4.9	4.9	31.2
	Hours	14.6	15.4	19.7	5.3	4.7	1.4	0.8	7.6	16.6	26.7	14.5	129.7

TABLE 5I

Speed, direction and date of occurrence of highest gust recorded  
at Leuchars in each month of the year during the  
10 years from 1962 to 1971

	<u>Highest gust</u>		
<u>January</u>			
January 1962	82 mph (37 m/sec)	from 230 degrees	on 17 January 1962
January 1963	61 mph (27 m/sec)	from 100 degrees	on 20 January 1963
January 1964	66 mph (29 m/sec)	from 250 degrees	on 31 January 1964
January 1965	69 mph (31 m/sec)	from 280 degrees	on 14 January 1965
January 1966	59 mph (26 m/sec)	from 210 degrees	on 28 January 1966
January 1967	50 mph (22 m/sec)	from 120 degrees	on 23 January 1967
January 1968	106 mph (47 m/sec)	from 230 degrees	on 15 January 1968
January 1969	54 mph (24 m/sec)	from 120 degrees	on 17 January 1969
January 1970	43 mph (19 m/sec)	from 140 degrees	on 24 January 1970
January 1971	60 mph (27 m/sec)	from 250 degrees	on 24 January 1971
<u>February</u>			
February 1962	85 mph (38 m/sec)	from 260 degrees	on 12 February 1962
February 1963	57 mph (25 m/sec)	from 110 degrees	on 6 February 1963
February 1964	61 mph (27 m/sec)	from 270 degrees	on 1 February 1964
February 1965	75 mph (33 m/sec)	from 290 degrees	on 13 February 1965
February 1966	52 mph (23 m/sec)	from 220 degrees	on 27 February 1966
February 1967	65 mph (29 m/sec)	from 240 degrees	on 27 February 1967
February 1968	57 mph (25 m/sec)	from 260 degrees	on 1 February 1968
February 1969	48 mph (21 m/sec)	from 320 degrees	on 7 February 1969
February 1970	63 mph (28 m/sec)	from 260 degrees	on 3 February 1970
February 1971	54 mph (24 m/sec)	from 230 degrees	on 12 February 1971
<u>March</u>			
March 1962	47 mph (21 m/sec)	from 130 degrees	on 8 March 1962
March 1963	54 mph (24 m/sec)	from 230 degrees	on 24 March 1963
March 1964	65 mph (29 m/sec)	from 110 degrees	on 14 March 1964
March 1965	51 mph (23 m/sec)	from 240 degrees	on 16 March 1965
March 1966	62 mph (28 m/sec)	from 260 degrees	on 23 March 1966
March 1967	62 mph (28 m/sec)	from 290 degrees	on 19 March 1967
March 1968	60 mph (27 m/sec)	from 290 degrees	on 5 March 1968
March 1969	50 mph (22 m/sec)	from 090 degrees	on 14 March 1969
March 1970	58 mph (26 m/sec)	from 280 degrees	on 17 March 1970
March 1971	54 mph (24 m/sec)	from 030 degrees	on 19 March 1971
<u>April</u>			
April 1962	63 mph (28 m/sec)	from 260 degrees	on 1 April 1962
April 1963	55 mph (25 m/sec)	from 230 degrees	on 12 April 1963
April 1964	54 mph (24 m/sec)	from 270 degrees	on 12 April 1964
April 1965	55 mph (25 m/sec)	from 280 degrees	on 18 April 1965
April 1966	57 mph (25 m/sec)	from 210 degrees	on 29 April 1966
April 1967	55 mph (25 m/sec)	from 320 degrees	on 5 April 1967
April 1968	44 mph (20 m/sec)	from 290 degrees	on 3 April 1968
April 1969	54 mph (24 m/sec)	from 240 degrees	on 11 April 1969
April 1970	54 mph (24 m/sec)	from 280 degrees	on 23 April 1970
April 1971	55 mph (25 m/sec)	from 250 degrees	on 18 April 1971

TABLE 5I (Contd)

<u>May</u>	<u>Highest gust</u>		
May 1962	75 mph (33 m/sec)	from 240 degrees	on 16 May 1962
May 1963	55 mph (25 m/sec)	from 230 degrees	on 13 May 1963
May 1964	63 mph (28 m/sec)	from 230 degrees	on 8 May 1964
May 1965	76 mph (34 m/sec)	from 250 degrees	on 8 May 1965
May 1966	62 mph (28 m/sec)	from 290 degrees	on 23 May 1966
May 1967	52 mph (23 m/sec)	from 110 degrees	on 4 May 1967
May 1968	37 mph (17 m/sec)	from 040 degrees	on 5 May 1968
May 1969	40 mph (18 m/sec)	from 360 degrees	on 18 May 1969
May 1970	53 mph (24 m/sec)	from 310 degrees	on 21 May 1970
May 1971	37 mph (17 m/sec)	from 240 degrees	on 27 May 1971
<u>June</u>			
June 1962	66 mph (29 m/sec)	from 250 degrees	on 24 June 1962
June 1963	46 mph (21 m/sec)	from 040 degrees	on 29 June 1963
June 1964	50 mph (22 m/sec)	from 260 degrees	on 26 June 1964
June 1965	59 mph (26 m/sec)	from 230 degrees	on 26 June 1965
June 1966	51 mph (23 m/sec)	from 280 degrees	on 27 June 1966
June 1967	50 mph (22 m/sec)	from 240 degrees	on 20 June 1967
June 1968	41 mph (18 m/sec)	from 240 degrees	on 6 June 1968
June 1969	40 mph (18 m/sec)	from 130 degrees	on 18 June 1969
June 1970	50 mph (22 m/sec)	from 250 degrees	on 25 June 1970
June 1971	41 mph (18 m/sec)	from 060 degrees	on 11 June 1971
<u>July</u>			
July 1962	37 mph (17 m/sec)	from 120 degrees	on 19 July 1962
July 1963	36 mph (16 m/sec)	from 250 degrees	on 20 July 1963
July 1964	63 mph (28 m/sec)	from 250 degrees	on 8 July 1964
July 1965	43 mph (19 m/sec)	from 050 degrees	on 29 July 1965
July 1966	44 mph (20 m/sec)	from 250 degrees	on 23 July 1966
July 1967	44 mph (20 m/sec)	from 250 degrees	on 10 July 1967
July 1968	50 mph (22 m/sec)	from 250 degrees	on 3 July 1968
July 1969	53 mph (24 m/sec)	from 230 degrees	on 4 July 1969
July 1970	51 mph (23 m/sec)	from 260 degrees	on 13 July 1970
July 1971	54 mph (24 m/sec)	from 270 degrees	on 15 July 1971
<u>August</u>			
August 1962	66 mph (29 m/sec)	from 230 degrees	on 11 August 1962
August 1963	43 mph (19 m/sec)	from 070 degrees	on 31 August 1963
August 1964	54 mph (24 m/sec)	from 250 degrees	on 24 August 1964
August 1965	53 mph (24 m/sec)	from 210 degrees	on 5 August 1965
August 1966	45 mph (20 m/sec)	from 220 degrees	on 10 August 1966
August 1967	46 mph (21 m/sec)	from 250 degrees	on 30 August 1967
August 1968	40 mph (18 m/sec)	from 240 degrees	on 20 August 1968
August 1969	38 mph (17 m/sec)	from 310 degrees	on 27 August 1969
August 1970	53 mph (24 m/sec)	from 320 degrees	on 17 August 1970
August 1971	46 mph (21 m/sec)	from 230 degrees	on 31 August 1971

TABLE 5I (Contd)

Highest gustSeptember

September 1962	66 mph (29 m/sec)	from 130 degrees	on 30 September 1962
September 1963	66 mph (29 m/sec)	from 260 degrees	on 26 September 1963
September 1964	47 mph (21 m/sec)	from 260 degrees	on 11 September 1964
September 1965	59 mph (26 m/sec)	from 230 degrees	on 21 September 1965
September 1966	63 mph (28 m/sec)	from 240 degrees	on 6 September 1966
September 1967	55 mph (25 m/sec)	from 250 degrees	on 2 September 1967
September 1968	47 mph (21 m/sec)	from 240 degrees	on 28 September 1968
September 1969	73 mph (33 m/sec)	from 240 degrees	on 28 September 1969
September 1970	61 mph (27 m/sec)	from 230 degrees	on 1 September 1970
September 1971	57 mph (25 m/sec)	from 260 degrees	on 1 September 1971

October

October 1962	52 mph (23 m/sec)	from 220 degrees	on 27 October 1962
October 1963	65 mph (29 m/sec)	from 230 degrees	on 9 October 1963
October 1964	51 mph (23 m/sec)	from 250 degrees	on 22 October 1964
October 1965	65 mph (29 m/sec)	from 230 degrees	on 28 October 1965
October 1966	41 mph (18 m/sec)	from 310 degrees	on 31 October 1966
October 1967	66 mph (29 m/sec)	from 210 degrees	on 26 October 1967
October 1968	68 mph (30 m/sec)	from 250 degrees	on 13 October 1968
October 1969	48 mph (21 m/sec)	from 210 degrees	on 15 October 1969
October 1970	75 mph (33 m/sec)	from 310 degrees	on 18 October 1970
October 1971	66 mph (29 m/sec)	from 230 degrees	on 22 October 1971

November

November 1962	45 mph (20 m/sec)	from 020 degrees	on 17 November 1962
November 1963	57 mph (25 m/sec)	from 250 degrees	on 21 November 1963
November 1964	63 mph (28 m/sec)	from 220 degrees	on 14 November 1964
November 1965	63 mph (28 m/sec)	from 330 degrees	on 23 November 1965
November 1966	61 mph (27 m/sec)	from 280 degrees	on 30 November 1966
November 1967	54 mph (24 m/sec)	from 050 degrees	on 2 November 1967
November 1968	45 mph (20 m/sec)	from 030 degrees	on 1 November 1968
November 1969	60 mph (27 m/sec)	from 050 degrees	on 22 November 1969
November 1970	65 mph (29 m/sec)	from 250 degrees	on 1 November 1970
November 1971	57 mph (25 m/sec)	from 250 degrees	on 2 November 1971

December

December 1962	71 mph (32 m/sec)	from 270 degrees	on 15 December 1962
December 1963	52 mph (23 m/sec)	from 220 degrees	on 28 December 1963
December 1964	62 mph (28 m/sec)	from 240 degrees	on 31 December 1964
December 1965	37 mph (17 m/sec)	from 260 degrees	on 19 December 1965
December 1966	63 mph (28 m/sec)	from 240 degrees	on 17 December 1966
December 1967	54 mph (24 m/sec)	from 230 degrees	on 15 December 1967
December 1968	46 mph (21 m/sec)	from 100 degrees	on 16 December 1968
December 1969	45 mph (20 m/sec)	from 160 degrees	on 14 December 1969
December 1970	55 mph (25 m/sec)	from 210 degrees	on 16 December 1970
December 1971	63 mph (28 m/sec)	from 250 degrees	on 14 December 1971

TABLE 5I (Contd)

Speed, direction and date of occurrence of highest gust recorded  
at Leuchars in each year during the 10 years from  
1962 to 1971

<u>Year</u>	<u>Highest gust</u>
1962	85 mph (38 m/sec) from 260 degrees on 12 February
1963	66 mph (29 m/sec) from 260 degrees on 26 September
1964	66 mph (29 m/sec) from 250 degrees on 31 January
1965	76 mph (34 m/sec) from 250 degrees on 8 May
1966	(63 mph (28 m/sec) from 240 degrees on 6 September (63 mph (28 m/sec) from 240 degrees on 17 December
1967	66 mph (29 m/sec) from 210 degrees on 26 October
1968	106 mph (47 m/sec) from 230 degrees on 15 January
1969	73 mph (33 m/sec) from 240 degrees on 28 September
1970	75 mph (33 m/sec) from 310 degrees on 18 October
1971	66 mph (29 m/sec) from 230 degrees on 22 October

TABLE 5J

Number of days on which the hourly mean wind speed reached 25 mph or more  
in at least one hour between 0700 hours and 1700 hours  
Greenwich Mean Time at  
Leuchars - 10 years from 1961 to 1970

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
	<u>Number of days</u>												
1961	4	5	11	2	2	4	2	3	4	7	2	2	48
1962	11	12	2	4	3	6	0	7	2	6	2	6	61
1963	6	4	5	8	12	2	0	2	6	6	4	5	60
1964	5	6	9	8	11	4	8	3	5	1	7	5	72
1965	7	2	7	7	2	9	1	6	4	3	12	0	60
1966	5	10	19	11	3	3	2	1	3	2	6	8	73
1967	5	11	24	7	4	4	4	1	3	11	3	4	81
1968	7	2	13	5	1	3	2	0	2	6	7	1	49
1969	6	7	8	7	3	2	6	0	6	6	9	4	64
1970	5	5	9	7	9	3	7	6	7	9	6	3	76
10 year mean	6.1	6.4	10.7	6.6	5.0	4.0	3.2	2.9	4.2	5.7	5.8	3.8	64.4

Number of hours between 0700 hours and 1700 hours Greenwich Mean Time  
with hourly mean wind speeds of 25 mph or more at  
Leuchars - 10 years from 1961 to 1970

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
	<u>Number of hours</u>												
1961	15	19	49	7	12	27	9	15	14	40	2	4	213
1962	43	61	14	22	21	32	0	41	6	25	8	31	304
1963	45	37	26	29	46	8	0	7	29	31	25	10	293
1964	22	18	59	35	57	18	35	12	17	5	20	13	311
1965	21	14	31	34	18	40	4	18	11	26	63	0	280
1966	26	55	89	53	12	11	7	2	12	5	28	41	341
1967	17	72	135	39	13	14	6	3	14	53	17	16	399
1968	24	9	70	12	1	16	11	0	12	27	28	1	211
1969	31	45	58	37	5	7	20	0	24	24	47	13	311
1970	16	30	52	35	33	11	47	23	39	43	30	11	370
10 year mean	26.0	36.0	58.3	30.3	21.8	18.4	13.9	12.1	17.8	27.9	26.8	14.0	303.3
10 year mean expressed as percentage of total working time	8%	13%	19%	10%	7%	6%	4%	4%	6%	9%	9%	5%	8%

TABLE 5K

Table for converting miles per hour to metres per second

(1 mile per hour = 0.44704 metres per second)

Miles per hour	0	1	2	3	4	5	6	7	8	9
	Metres per second									
0	0.0	0.4	0.9	1.3	1.8	2.2	2.7	3.1	3.6	4.0
10	4.5	4.9	5.4	5.8	6.3	6.7	7.2	7.6	8.0	8.5
20	8.9	9.4	9.8	10.3	10.7	11.2	11.6	12.1	12.5	13.0
30	13.4	13.9	14.3	14.8	15.2	15.6	16.1	16.5	17.0	17.4
40	17.9	18.3	18.8	19.2	19.7	20.1	20.6	21.0	21.5	21.9
50	22.4	22.8	23.2	23.7	24.1	24.6	25.0	25.5	25.9	26.4
60	26.8	27.3	27.7	28.2	28.6	29.1	29.5	30.0	30.4	30.8
70	31.3	31.7	32.2	32.6	33.1	33.5	34.0	34.4	34.9	35.3
80	35.8	36.2	36.7	37.1	37.6	38.0	38.4	38.9	39.3	39.8
90	40.2	40.7	41.1	41.6	42.0	42.5	42.9	43.4	43.8	44.3
100	44.7	45.2	45.6	46.0	46.5	46.9	47.4	47.8	48.3	48.7
110	49.2	49.6	50.1	50.5	51.0	51.4	51.9	52.3	52.8	53.2
120	53.6	54.1	54.5	55.0	55.4	55.9	56.3	56.8	57.2	57.7
130	58.1	58.6	59.0	59.5	59.9	60.4	60.8	61.2	61.7	62.1
140	62.6	63.0	63.5	63.9	64.4	64.8	65.3	65.7	66.2	66.6
150	67.1	67.5	68.0	68.4	68.8	69.3	69.7	70.2	70.6	71.1

## 6. Visibility

The Meteorological Office at Leuchars is the only location in the whole of the Tayside region for which detailed records of visibility are available. Nevertheless, experience suggests that the Leuchars records of visibility should give a reasonably good guide to visibility at other places on the coast like Montrose, Arbroath, Carnoustie and St Andrews.

One of the most marked characteristics of the weather in the coastal region is the high frequency of good visibility. Radiation fog\* and thick smoke haze are very infrequent on the coast. Indeed, the most unpleasant fogs which occur on the coast are not the smoke, radiation or sea fogs of winter but the haars (North Sea fogs) which occur from time to time during the period from April to September and which often ruin potentially brilliantly fine days during the spring and summer. The basic cause of these haars is the cooling of warm moist air masses as they move in-shore over the cold coastal waters of the North Sea. 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 on the lower lying parts of the coast, the higher districts may be in sunshine above it. Frequently by the time it has reached say Dundee or Perth, the haar has lifted into an unbroken layer of low stratus cloud obscuring the sun and the higher ground and perhaps the higher buildings but with reasonably good visibility beneath it. 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. When the depth of haar is not great it may disappear with dramatic suddenness leaving a cloudless sky but is likely to re-form again towards sunset. The deeper haars may persist all day particularly at places on the coast, a frustrating

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\*(Radiation fog is a common type of fog which forms overland on nights characterized by light winds, clear skies and moist air in the lower levels which is cooled to below its dew point by contact with the cold ground.)

situation which is not helped by the knowledge that places a few miles inland or further west are enjoying glorious sunshine. The higher ground or a long land track tend to break up the haar and areas to the west of the region, particularly those which are sheltered to the east by higher ground, suffer much less from haar than do the eastern parts of the region.

It has been noticed at Leuchars airfield that when haar persists over the sea after a morning dispersal overland, there remains a serious danger of deterioration at the airfield because the fog is liable to return very suddenly shortly after the onset of a sea breeze. The return of fog is often preceded by a rapid fall of temperature - on occasion by as much as 8°C (15°F) within a few minutes. Consequently, when haar lies off the coast, a high temperature and low humidity at Leuchars give no guarantee that an appreciable interval will elapse before the fog returns.

It has also been noticed that the state of tide has a significant effect on the behaviour of haar on the coast. At low tide, extensive areas of sand are exposed along the coastline and these are readily heated by the sun assisting morning dispersal of fog. However, a rising tide covering the sand favours encroachment of fog from the sea.

As mentioned earlier, radiation fogs are infrequent on the coast but patches of fog are not uncommon over the extensively wooded areas to the north and north-east of Leuchars. It is also known that radiation fogs are not uncommon in the valley of the River Eden but otherwise the inland part of the region does not appear to be especially prone to fog of this kind.

No visibility records are available from Dundee but local experience suggests that radiation fogs are relatively few in number. However, in winter the fogs which do occur are likely to be thickened by the output of domestic and industrial smoke although the number of fogs with a high smoke content is probably lower than in Glasgow or Edinburgh.

Because of the surrounding hills, Perth is less "well-ventilated" than Dundee and other places in the region and probably has a higher frequency of calms and light winds. For this reason it is thought that Perth probably also has a higher frequency of radiation fogs particularly over the lower-lying and extensive Inch areas of parkland near the city centre. The radiation fogs in Perth are no doubt thickened by domestic smoke from time to time, particularly during the winter months but there is certainly no evidence of dense smoke fogs and Perth does not have the reputation of being a foggy place. When compared with Dundee and other locations in the region, Perth may have a higher frequency of radiation fogs but this is almost certainly offset by a lower frequency of occasions with poor visibility in sea fog.

Wind directions associated with poor visibility at Leuchars are shown in Table 6. It can be seen from this Table that about 45 per cent of all occasions of fog or poor visibility at Leuchars during the winter months are associated with Calms i.e. a wind speed of less than 1 mph. On the other hand, it is interesting to note that in summer, about 50 per cent of occasions with fog or poor visibility are associated with winds from the sector between northeast and east which bring in-shore the troublesome haar.

Frequencies of visibility below certain limits at various times of the day at Leuchars are given in Table 6A.

The numbers of days and hours with "fog", "thick fog" and "dense fog" at Leuchars are given in Tables 6B and 6C. The figures in Tables 6B and 6C were obtained from a search through the Leuchars registers of observations for the 10 years from 1961 to 1970. These registers contain routine observations of visibility made at each hour on the hour, but notice was also taken of certain additional observations of fog made between the routine hourly observations. Thus, the number of "hours" with fog, thick fog and dense fog shown in Table 6C are really hours in which the

visibility fell to below the stated limits for some time during the hour rather than an indication of the total duration of fog in hours. Similarly, in Table 6B, the number of "days" with fog are days on which the visibility fell to below the stated limits at some time during the day.

At Montrose, Arbroath, Mylnefield and Perth, observations of visibility are made once-daily at 0900 hours GMT. The number of mornings with fog at 0900 hours at these four locations are compared with similar observations made at the Meteorological Office at Leuchars in Table 6D.

TABLE 6

Percentage distribution of fog and poor visibility according to wind direction during the winter and summer "half years" at Leuchars, Fife - calculated from observations made 8 times per day at 00, 03, 06, 09, 12, 15, 18 and 21h GMT during the 14 years from 1957 to 1970

Wind direction measured in degrees from True North	Winter Half-Year (October to March)				Summer Half-Year (April to September)				Totals
	Visibility less than 440 yards	Visibility 440 to 1,090 yards	Visibility 1,100 to 2,190 yards	Totals	Visibility less than 440 yards	Visibility 440 to 1,090 yards	Visibility 1,100 to 2,190 yards	Totals	
(degrees)	%	%	%	%	%	%	%	%	%
350 to 010	0.5	0.7	0.8	2.0	0.7	0.4	0.9	2.0	2.0
020 to 040	0.5	0.6	2.1	3.2	0.8	2.5	3.8	7.1	7.1
050 to 070	1.2	0.6	2.6	4.4	7.4	10.2	11.9	29.5	29.5
080 to 100	3.1	1.6	4.9	7.6	2.6	8.3	9.1	20.0	20.0
110 to 130	1.0	1.2	4.2	6.4	0.9	1.1	2.5	4.5	4.5
140 to 160	0.0	0.2	1.4	1.6	0.0	0.1	0.4	0.5	0.5
170 to 190	0.0	0.1	0.3	0.4	0.1	0.2	0.0	0.3	0.3
200 to 220	0.3	0.4	2.1	2.8	0.5	0.4	0.4	1.3	1.3
230 to 250	3.0	2.6	6.0	11.6	1.9	0.9	1.1	3.9	3.9
260 to 280	1.3	2.3	4.6	8.2	1.4	0.5	1.1	3.0	3.0
290 to 310	0.8	0.8	2.2	3.8	0.3	0.4	0.3	1.0	1.0
320 to 340	1.3	0.8	1.2	3.3	0.3	0.0	0.4	0.7	0.7
Calms	15.4	10.2	19.1	44.7	10.0	7.9	8.3	26.2	26.2
Totals	26.4	22.1	51.5	100.0	26.9	32.9	40.2	100.0	100.0

Example

Out of the total number of 3-hourly observations of fog or poor visibility during the summer "half years" in the 14 years from 1957 to 1970, 7.4 per cent of the total observations had visibilities of less than 440 yards associated with winds from the sector between 050 and 070 degrees.

TABLE 6A

Percentage frequency of occurrence of visibilities less than the stated limits at 0000, 0300, 0600, 0900, 1200, 1500, 1800 and 2100 hours GMT - calculated from visibilities observed at these 3-hourly intervals during the 14 years from 1957 to 1970 at Leuchars

Time of observation GMT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	%	%	%	%	%	%	%	%	%	%	%	%	%

Percentage frequency of occurrence of visibilities less than 5 miles (8000 metres)

00h midnight	28.1	24.1	27.9	17.9	23.7	23.3	15.4	23.0	22.1	30.2	27.4	24.2	24.0
03h	26.3	26.1	26.7	18.6	27.0	28.8	19.6	24.4	26.7	30.6	25.2	21.2	25.1
06h	21.9	25.1	27.2	23.1	26.0	26.0	15.7	22.6	28.3	30.0	21.9	18.0	23.8
09h	24.7	25.8	23.7	18.8	18.9	19.5	10.8	18.0	22.6	30.6	23.3	22.4	21.6
12h noon	26.7	26.3	21.9	12.6	16.1	15.2	8.8	14.7	13.3	21.7	24.5	25.1	18.9
15h	27.9	21.8	19.8	12.9	14.5	12.1	7.6	12.2	13.6	21.2	21.9	28.8	17.9
18h	32.9	27.8	23.3	13.8	17.3	13.8	8.8	13.8	16.7	27.4	27.1	28.6	20.9
21h	30.6	26.8	24.2	16.4	24.2	18.6	13.4	21.0	19.0	29.3	29.3	27.4	23.4

Percentage frequency of occurrence of visibilities less than 2½ miles (4000 metres)

00h midnight	15.4	12.7	12.9	8.3	14.3	14.5	8.8	11.8	11.7	15.2	13.1	11.3	12.5
03h	12.4	11.4	15.4	9.0	16.8	18.1	11.1	12.9	13.8	17.7	13.8	10.4	13.6
06h	9.4	12.4	14.7	12.9	15.2	16.2	9.7	12.7	18.3	20.3	12.4	8.8	13.6
09h	12.9	14.9	15.9	8.8	9.7	10.7	6.5	8.1	11.0	17.1	14.5	13.1	11.9
12h noon	13.6	12.2	9.7	5.2	7.6	7.6	3.7	6.2	5.0	9.0	12.4	13.8	8.8
15h	14.7	10.1	8.8	4.5	8.3	6.0	4.1	5.5	5.7	8.5	10.0	12.9	8.3
18h	17.5	15.4	10.8	6.9	11.1	6.2	3.9	6.7	7.6	12.2	13.1	15.4	10.6
21h	15.7	12.7	12.7	7.9	15.2	11.0	6.9	11.1	10.2	14.3	14.0	13.1	12.1

Percentage frequency of occurrence of visibilities less than 2200 yards (2000 metres)

00h midnight	5.5	4.6	5.3	3.3	7.6	8.8	3.5	6.2	7.1	7.8	7.1	6.0	6.1
03h	5.3	5.1	4.4	3.8	9.4	11.0	6.5	6.9	7.9	8.3	5.2	2.8	6.4
06h	3.5	5.6	5.1	5.2	7.6	10.0	6.0	7.6	10.5	9.2	5.7	2.8	6.6
09h	5.1	7.8	8.1	2.6	3.9	5.7	3.5	3.7	5.2	6.7	9.0	6.0	5.6
12h noon	6.0	5.3	3.5	2.4	2.3	2.9	1.8	1.8	1.9	2.3	6.0	5.8	3.5
15h	3.5	5.3	2.1	1.9	3.2	1.7	1.8	2.3	1.7	2.3	3.3	5.3	2.9
18h	5.3	5.8	3.7	2.4	4.1	3.6	1.8	2.8	3.3	6.9	5.7	7.6	4.4
21h	6.9	4.6	4.6	3.8	7.1	6.0	3.7	6.0	5.0	8.5	6.2	5.5	5.7

Example

In January, visibility at 1200 hours GMT was less than 2½ miles (less than 4000 metres) on 13.6 per cent of occasions during the 14 years from 1957 to 1970.

TABLE 6A (Contd)

Time of observation GMT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	%	%	%	%	%	%	%	%	%	%	%	%	%
<u>Percentage frequency of occurrence of visibilities less than 1100 yards</u> <u>(1000 metres)</u>													
00h midnight	2.8	3.0	1.6	2.1	3.9	5.7	1.6	4.6	5.2	5.5	3.6	2.5	3.5
03h	2.5	2.8	2.8	2.1	5.3	8.1	3.9	3.9	5.2	5.1	3.1	1.2	3.8
06h	1.8	2.0	2.8	3.1	5.1	7.9	3.9	4.6	6.9	7.8	4.5	1.4	4.3
09h	2.5	3.5	2.5	1.2	1.8	3.1	1.6	1.8	2.9	3.5	4.8	2.3	2.6
12h noon	2.1	2.5	1.6	1.2	0.9	1.4	0.9	0.5	1.7	1.4	1.9	1.6	1.5
15h	1.6	1.8	0.2	1.2	1.2	1.0	0.7	1.4	0.5	1.2	1.4	2.3	1.2
18h	3.0	2.0	1.8	1.2	2.5	2.4	0.9	1.6	1.9	3.2	3.1	2.8	2.2
21h	3.2	2.0	0.9	2.1	3.0	5.0	1.8	3.5	2.9	5.3	2.6	2.3	2.9
<u>Percentage frequency of occurrence of visibilities less than 440 yards</u> <u>(400 metres)</u>													
00h midnight	2.1	1.3	1.2	0.7	1.6	2.1	1.2	2.8	2.9	3.2	1.4	1.2	1.8
03h	1.2	1.5	1.8	0.7	2.5	5.7	2.3	1.6	3.3	3.5	1.4	0.5	2.2
06h	0.9	1.3	1.6	1.7	1.4	5.2	1.6	2.3	5.5	5.3	2.4	1.2	2.5
09h	1.8	2.3	1.6	0.0	0.2	0.7	0.2	0.9	1.2	3.0	2.9	0.7	1.3
12h noon	0.9	1.0	0.5	0.0	0.0	0.5	0.2	0.0	0.0	0.5	1.2	0.5	0.4
15h	0.5	1.3	0.0	0.0	0.0	0.0	0.5	0.5	0.2	0.5	0.7	0.7	0.4
18h	1.4	1.3	0.0	0.5	0.5	1.0	0.2	0.9	0.5	1.4	1.9	1.4	0.9
21h	2.1	1.0	0.5	0.5	1.4	2.4	0.9	1.8	1.0	2.5	1.7	1.4	1.4
<u>Percentage frequency of occurrence of visibilities less than 220 yards</u> <u>(200 metres)</u>													
00h midnight	0.5	0.0	0.7	0.5	0.2	1.0	0.7	1.4	1.9	1.6	1.0	0.5	0.8
03h	0.0	0.8	0.7	0.0	1.2	2.4	1.2	0.7	0.7	1.8	1.0	0.5	0.9
06h	0.5	0.3	1.2	0.7	1.2	2.9	0.9	0.7	2.6	2.8	0.5	0.2	1.2
09h	1.4	1.5	0.9	0.0	0.0	0.5	0.0	0.5	0.2	2.3	1.2	0.5	0.7
12h noon	0.7	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.1
15h	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.5	0.5	0.7	0.2
18h	0.9	0.8	0.0	0.5	0.0	0.0	0.0	0.0	0.2	0.7	1.2	0.9	0.4
21h	1.2	0.5	0.0	0.5	0.0	1.2	0.0	1.2	0.5	1.4	0.7	1.2	0.7

TABLE 6A (Contd)

Time of observation GMT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	%	%	%	%	%	%	%	%	%	%	%	%	%
<u>Percentage frequency of occurrence of visibilities less than 110 yards</u>													
<u>(100 metres)</u>													
00h midnight	0.0	0.0	0.2	0.0	0.0	0.5	0.5	0.5	0.2	0.7	0.5	0.2	0.3
03h	0.0	0.3	0.5	0.0	0.5	1.2	0.2	0.2	0.0	0.9	0.0	0.5	0.4
06h	0.0	0.0	0.5	0.0	0.2	1.0	0.0	0.0	1.4	0.9	0.0	0.0	0.3
09h	0.2	0.5	0.7	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.2	0.5	0.3
12h noon	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1
15h	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.5	0.1
18h	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.7	0.2	0.1
21h	0.7	0.0	0.0	0.2	0.0	0.2	0.0	0.2	0.0	0.7	0.2	0.5	0.2
<u>Percentage frequency of occurrence of visibilities less than 55 yards</u>													
<u>(50 metres)</u>													
00h midnight	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.0	0.1
03h	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.2	0.0	0.0	0.1
06h	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.2	0.2	0.0	0.0	0.1
09h	0.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1
12h noon	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
15h	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1
18h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.1
21h	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1

TABLE 6B

Number of days with "fog", "thick fog" and "dense fog" at any time of day\*  
at Leuchars  
(10 years from 1961 to 1970)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
<u>Number of days with "fog" - visibility less than 1100 yards (1000 metres)</u>													
1961	2	4	2	6	1	0	1	1	4	2	4	11	38
1962	3	3	2	4	4	1	6	0	3	3	5	5	39
1963	4	7	6	5	3	10	6	3	1	4	4	4	57
1964	2	8	3	5	8	5	3	5	6	7	4	3	59
1965	4	0	4	4	7	7	5	4	2	11	2	7	57
1966	5	10	0	3	3	15	2	1	7	8	1	3	58
1967	1	1	1	0	5	9	1	5	11	1	6	0	41
1968	5	0	2	9	5	6	6	5	9	3	1	7	58
1969	5	3	3	6	10	2	3	11	3	9	2	7	64
1970	10	0	0	1	7	9	3	13	4	6	5	2	60
10 year mean	4.1	3.6	2.3	4.3	5.3	6.4	3.6	4.8	5.0	5.4	3.4	4.9	53.1
<u>Number of days with "thick fog" - visibility less than 220 yards (200 metres)</u>													
1961	2	3	2	0	1	0	1	0	0	2	1	2	14
1962	1	1	0	1	2	1	3	0	1	2	3	1	16
1963	0	0	1	1	1	5	3	2	1	2	2	2	20
1964	1	3	1	4	4	2	3	2	4	5	3	0	32
1965	2	0	3	1	3	2	0	0	0	7	2	1	21
1966	5	1	0	1	1	8	1	0	3	5	0	2	27
1967	0	1	0	0	1	5	1	1	3	0	4	0	16
1968	1	0	2	1	2	2	1	0	5	0	0	1	15
1969	1	1	1	2	0	0	0	3	1	4	1	2	16
1970	5	0	0	0	1	2	2	7	0	5	2	2	26
10 year mean	1.8	1.0	1.0	1.1	1.6	2.7	1.5	1.5	1.8	3.2	1.8	1.3	20.3
<u>Number of days with "dense fog" - visibility less than 55 yards (50 metres)</u>													
1961	0	0	0	0	0	0	0	0	0	1	0	0	1
1962	0	0	0	0	0	0	0	0	0	1	0	0	1
1963	0	0	0	0	0	1	0	0	0	1	1	1	4
1964	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	2	0	0	0	0	0	0	0	1	0	3
1966	0	0	0	0	0	1	0	0	0	0	0	0	1
1967	0	0	0	0	0	0	0	0	0	0	1	0	1
1968	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0	0	2	0	0	2
1970	0	0	0	0	0	0	0	0	0	0	0	0	0
10 year mean	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.5	0.3	0.1	1.3

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

TABLE 6C

Number of hours\* with "fog", "thick fog" and "dense fog"  
at Leuchars  
(10 years from 1961 to 1970)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
<u>Number of hours with "fog" - visibility less than 1100 yards (1000 metres)</u>													
1961	15	23	6	17	4	0	8	2	5	12	26	53	171
1962	12	13	3	20	15	4	37	0	16	34	15	22	191
1963	4	15	28	11	14	66	32	9	5	37	25	18	264
1964	12	42	14	34	63	20	13	13	49	42	41	7	350
1965	16	0	33	10	41	19	25	12	3	66	17	19	261
1966	26	36	0	13	11	117	8	1	39	39	2	9	301
1967	1	4	1	0	15	43	1	30	67	1	62	0	225
1968	36	0	6	32	49	22	18	22	61	5	1	16	268
1969	21	7	13	28	31	3	3	44	17	69	7	20	263
1970	62	0	0	1	25	32	22	70	17	52	27	7	315
10 year mean	20.5	14.0	10.4	16.6	26.8	32.6	16.7	20.3	27.9	35.7	22.3	17.1	260.9
<u>Number of hours with "thick fog" - visibility less than 220 yards (200 metres)</u>													
1961	3	8	3	0	1	0	1	0	0	8	5	6	35
1962	2	5	0	1	5	1	8	0	2	19	5	10	58
1963	0	0	6	2	2	20	3	4	1	13	8	9	68
1964	3	5	7	7	10	4	3	3	14	17	9	0	82
1965	5	0	21	5	4	4	0	0	0	21	11	1	72
1966	7	1	0	1	1	28	1	0	10	8	0	2	59
1967	0	2	0	0	1	9	1	3	18	0	15	0	49
1968	6	0	2	2	10	3	4	0	16	0	0	3	46
1969	1	1	1	7	0	0	0	5	1	19	1	5	41
1970	26	0	0	0	1	6	2	29	0	17	9	4	94
10 year mean	5.3	2.2	4.0	2.5	3.5	7.5	2.3	4.4	6.2	12.2	6.3	4.0	60.4
<u>Number of hours with "dense fog" - visibility less than 55 yards (50 metres)</u>													
1961	0	0	0	0	0	0	0	0	0	3	0	0	3
1962	0	0	0	0	0	0	0	0	0	4	0	0	4
1963	0	0	0	0	0	1	0	0	0	2	1	1	5
1964	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	3	0	0	0	0	0	0	0	1	0	4
1966	0	0	0	0	0	4	0	0	0	0	0	0	4
1967	0	0	0	0	0	0	0	0	0	0	1	0	1
1968	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0	0	4	0	0	4
1970	0	0	0	0	0	0	0	0	0	0	0	0	0
10 year mean	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.0	0.0	1.3	0.3	0.1	2.5

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

TABLE 6D

Number of mornings with fog (visibility less than 1100 yards (1000 metres))  
at 0900 hours GMT at stations in the Tayside region  
(10 years 1961 to 1970)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
<u>Montrose</u>													
1961	0	2	0	3	0	0	1	0	0	0	0	2	8
1962	0	1	0	1	1	0	1	1	2	1	0	0	8
1963	0	0	4	2	0	2	0	0	0	0	1	0	9
1964	1	3	1	0	3	0	1	1	1	1	0	0	12
1965	1	0	1	2	3	1	1	1	0	1	1	0	12
1966	1	1	0	1	1	6	0	0	2	0	0	0	12
1967	1	0	0	0	3	2	0	2	4	0	1	0	13
1968	0	0	0	2	3	0	0	0	1	0	1	1	8
1969	1	0	0	1	3	0	0	3	1	2	0	0	11
1970	4	0	0	0	2	0	1	2	1	4	2	1	17
10 year mean	0.9	0.7	0.6	1.2	1.9	1.1	0.5	1.0	1.2	0.9	0.6	0.4	11.0
<u>Arbroath</u>													
1961	1	1	0	4	0	0	2	0	1	0	0	2	11
1962	0	1	0	0	1	0	2	1	2	1	0	0	8
1963	0	0	3	4	0	3	2	0	1	1	2	0	16
1964	1	2	1	0	4	1	0	0	1	2	1	0	13
1965	1	0	1	2	3	2	2	1	0	3	2	1	18
1966	0	3	0	1	0	6	0	0	1	0	0	0	11
1967	1	0	0	0	2	5	1	2	2	0	3	0	16
1968	0	0	0	4	3	2	0	1	2	2	0	0	14
1969	2	0	0	1	1	1	0	3	1	2	0	0	11
1970	3	0	0	0	2	1	1	2	2	2	1	1	15
10 year mean	0.9	0.7	0.5	1.6	1.6	2.1	1.0	1.0	1.3	1.3	0.9	0.4	13.3
<u>Mylnefield</u>													
1961	0	0	1	0	0	0	0	0	0	0	2	4	7
1962	0	1	3	0	1	0	1	0	1	1	2	2	12
1963	0	0	2	3	0	0	0	0	0	1	1	1	8
1964	2	1	1	0	0	1	1	0	1	0	1	0	8
1965	2	0	3	0	2	2	0	0	0	3	1	1	14
1966	1	2	0	0	0	1	0	0	1	0	0	0	5
1967	0	1	0	0	0	0	0	1	3	0	4	0	9
1968	0	0	0	1	0	0	1	0	2	1	0	0	5
1969	0	0	1	1	2	0	0	1	1	3	0	0	9
1970	4	0	0	0	0	2	0	2	0	6	2	0	16
10 year mean	0.9	0.5	1.1	0.5	0.5	0.6	0.3	0.4	0.9	1.5	1.3	0.8	9.3

TABLE 6D (Contd)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
<u>Perth</u>													
1961	1	4	0	0	0	0	0	0	0	4	4	4	17
1962	1	1	2	0	0	0	0	0	0	3	5	4	16
1963	1	1	2	0	0	1	1	0	0	3	2	1	12
1964	2	3	1	0	0	0	0	1	1	3	2	0	13
1965	1	0	3	0	1	0	0	0	0	2	2	3	12
1966	3	1	0	0	0	0	0	0	0	1	1	1	7
1967	0	1	0	0	0	0	0	1	2	0	5	0	9
1968	0	0	0	0	0	0	0	0	1	2	0	1	4
1969	2	0	0	0	0	0	0	2	0	2	0	8	14
1970	2	0	1	0	1	0	1	3	0	0	2	3	13
10 year mean	1.3	1.1	0.9	0.0	0.2	0.1	0.2	0.7	0.4	2.0	2.3	2.5	11.7
<u>Leuchars</u>													
1961	1	2	0	1	0	0	0	0	0	0	1	4	9
1962	0	1	0	0	0	0	2	0	1	2	0	0	6
1963	0	0	1	1	0	0	3	0	0	2	2	1	10
1964	1	2	1	0	2	1	0	0	0	1	1	0	9
1965	2	0	3	0	2	1	1	1	0	2	2	0	14
1966	1	1	0	0	0	5	0	0	0	0	0	0	7
1967	0	0	0	0	0	0	0	1	3	0	4	0	8
1968	0	0	0	0	2	1	0	1	2	0	0	1	7
1969	1	1	1	1	0	0	0	1	1	3	1	1	11
1970	2	0	0	0	0	1	0	3	2	2	2	1	13
10 year mean	0.8	0.7	0.6	0.3	0.6	0.9	0.6	0.7	0.9	1.2	1.3	0.8	9.4

## 7. Snow

In common with the remainder of the British Isles, the incidence of snow falling and the persistence of snow cover in the Tayside region are two of the most variable of all the meteorological elements. For example, during the severe winter of 1962/63 there were 46 days on which snow or sleet fell at Leuchars compared with only 19 days of snowfall during the following winter of 1963/64.

In general, the Grampians give shelter from snow showers in northwesterly airstreams and much of the snow in the region falls as showers in unstable north-easterly airstreams.

The Meteorological Office at Leuchars is the only weather station in the region keeping a 24 hour watch on the weather, and is therefore, the only station for which complete records of snow falling at any time of the day or night are available. However, up to heights of about 200 feet, there is not much variation from place to place in the incidence of snowfall. Accordingly, the Leuchars figures of the number of days of snow or sleet falling can be taken as reasonably representative of most of the cities and towns in the region.

The number of days with snow falling increases fairly rapidly with increasing height above sea level and therefore the hills in the region will have a higher incidence of days with snow falling than Leuchars. No records of snowfall are available from the hills but as a good approximate rule, there is one day more per year with snow falling for each 50 feet of elevation above 200 feet up to an altitude of about 1,000 feet.

The numbers of days with snow or sleet falling at Leuchars are given in Table 7.

The numbers of days with snow lying on the ground at locations in the Tayside region are given in Tables 7A and 7B.

The numbers of days per winter with snow lying at specified depths at locations in the Tayside region are given in Table 7C.

It can be seen from Table 7B that, in general, the average number of days with snow lying decreases eastwards towards the coast.

Over low ground in the region, snow is not very troublesome and seldom causes serious traffic difficulties. This is particularly true of the coastal districts between Montrose and Buddon Ness and between Tayport and St Andrews. However, snow can be a nuisance to traffic on the steeper roads in Dundee and the outskirts of Perth.

As one might expect, snow cover is much more persistent inland and over the hills, especially on north and east facing slopes. For example, snow can be troublesome on the roads traversing the Sidlaws and the hills of the East Neuk of Fife (particularly the road between Cupar and Peat Inn) but in general, the roads skirt the higher ground and on most occasions there are always relatively snow-free alternative routes.

TABLE 7

Actual and average number of days with snow or sleet falling  
at Leuchars  
(25 years from 1946 to 1970)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
1946	1	4	5	0	0	0	0	0	0	0	1	3	14
1947	12	22	8	1	0	0	0	0	0	0	2	3	48
1948	6	3	0	2	1	0	0	0	0	1	0	4	17
1949	2	5	7	2	0	0	0	0	0	0	0	7	23
1950	5	6	1	1	0	0	0	0	0	0	0	9	22
1951	5	6	9	3	1	0	0	0	0	0	0	6	30
1952	12	6	5	2	0	0	0	0	0	0	1	7	33
1953	3	5	0	1	0	0	0	0	0	0	0	1	10
1954	8	10	4	1	0	0	0	0	0	0	0	5	28
1955	10	17	9	0	2	0	0	0	0	2	0	6	46
1956	8	15	3	1	0	0	0	0	0	0	3	6	36
1957	3	4	0	0	0	0	0	0	0	0	0	1	8
1958	7	10	16	2	0	0	0	0	0	0	0	4	39
1959	7	0	0	0	0	0	0	0	0	0	1	2	10
1960	8	10	4	0	0	0	0	0	0	0	0	1	23
1961	8	2	1	0	0	0	0	0	0	0	0	12	23
1962	1	8	5	3	0	0	0	0	0	0	3	9	29
1963	16	15	0	3	0	0	0	0	0	0	3	3	40
1964	2	5	6	0	0	0	0	0	0	0	1	7	21
1965	9	5	10	2	1	0	0	0	0	0	14	5	46
1966	7	12	5	9	0	0	0	0	0	0	3	8	44
1967	3	2	9	3	1	0	0	0	0	1	2	7	28
1968	10	11	5	6	2	0	0	0	0	1	2	8	45
1969	8	18	13	2	0	0	0	0	0	0	8	7	56
1970	10	13	12	7	0	0	0	0	0	1	3	5	51
25 year average	7	9	6	2	< 1	0	0	0	0	< 1	2	5	31

TABLE 7A

Actual and average number of days with snow lying on the ground  
 at 0900 hours GMT at Leuchars - altitude 34 feet  
 (25 years from 1946 to 1970)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
1946	1	1	2										4
1947	5	26	21								1	1	54
1948	4			1								1	6
1949			2										2
1950	4	1										9	14
1951	8	2										3	13
1952	8	2	2									6	18
1953	3	4											7
1954	1	2	1									2	6
1955	12	17	6									1	36
1956	3	14										1	18
1957	1												1
1958	3	8	5										16
1959	7												7
1960	6	9	1										16
1961	2	2										10	14
1962	5										1	6	12
1963	15	7										1	23
1964		2										3	5
1965	7	4	6								5	3	25
1966	7	10		1								2	20
1967		1										1	2
1968	2	3		1								1	7
1969	1	5										2	8
1970	3	4											7
25 year average	4	5	2	< 1	0	0	0	0	0	0	< 1	2	13

Note: A "day with snow lying" is counted when half or more of the ground surrounding the weather station is covered with snow at 0900 hours GMT.

TABLE 7B

Average number of days with snow lying on the ground at 0900 hours GMT  
at locations in the Tayside region

	<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 Total</u>
<u>Leuchars</u> (altitude 34 feet) - 25 years from 1946 to 1970	4	5	2	<1	0	0	0	0	0	0	<1	2	13
<u>Arbroath</u> (altitude 95 feet) - 25 years from 1946 to 1970	3	5	2	<1	0	0	0	0	0	0	<1	1	11
<u>Dundee</u> (altitude 147 feet) - 25 years from 1946 to 1970	5	7	3	<1	0	0	0	0	0	0	1	3	19
<u>Perth</u> (altitude 77 feet) - 25 years from 1946 to 1970	6	7	2	<1	0	0	0	0	0	0	<1	3	18
<u>Montrose</u> (altitude 186 feet) - 16 years from 1955 to 1970	6	6	2	<1	0	0	0	0	0	0	1	2	17
<u>Carnoustie</u> (altitude 29 feet) - 12 years from 1959 to 1970	4	4	<1	<1	0	0	0	0	0	0	1	3	12
<u>Mylnefield</u> (altitude 100 feet) - 17 years from 1954 to 1970	6	7	2	<1	0	0	0	0	0	0	<1	3	18
<u>Cupar</u> (altitude 82 feet) - 15 years from 1956 to 1970	5	5	1	<1	0	0	0	0	0	0	<1	3	14

Note: A "day with snow lying" is counted when half or more of the ground surrounding the weather station is covered with snow at 0900 hours GMT.

TABLE 7C

Number of days with snow lying at 0900 hours GMT at depths between specified limits at places in the Tayside Region

Depth - Inches.	0-1	2	3-4	5-6	7-8	9-12	13-16	Over 16	Total
MONTROSE - Altitude 186 feet					Maximum depth = 12 inches				
Winter of:									
1956-57	1								1
1957-58	17	4	2			1			24
1958-59	21								21
1959-60	12	5	1						18
1960-61	3								3
1961-62	4	1	3	5					13
1962-63	22	10	8						40
1963-64	7								7
1964-65	18	6	1		1				26
1965-66	18	2	1						21
1966-67	2								2
1967-68	14	3	1						18
1968-69	18	1	1						20
1969-70	7	1	1						9
1970-71	1								1
Total	165	33	19	5	1	1			224
% Total	73.6	14.7	8.5	2.2	0.5	0.5			100%
ARBROATH - Altitude 95 feet					Maximum depth = 9 inches				
Winter of:									
1956-57									0
1957-58	7	2	4			1			14
1958-59	4	2							6
1959-60	4	5	4						13
1960-61									0
1961-62	6	2	3	4					15
1962-63	24	5	3						32
1963-64	2	1							3
1964-65	4	4	4						12
1965-66	12								12
1966-67	2								2
1967-68	9								9
1968-69	2	2							4
1969-70	5	3							8
1970-71									0
Total	81	26	18	4		1			130
% Total	62.3	20.0	13.8	3.1		0.8			100%

TABLE 7C (Contd)

Depth - Inches	0-1	2	3-4	5-6	7-8	9-12	13-16	Over 16	Total
CARNOUSTIE - Altitude 29 feet					Maximum depth = 7 inches				
Winter of:									
1958-59	8								8
1959-60	10	1	3						14
1960-61	1								1
1961-62	10		5	1	2				18
1962-63	26	6	3						35
1963-64	8								8
1964-65	12	2							14
1965-66	13	4	1						18
1966-67	3								3
1967-68	12								12
1968-69	7	3	1						11
1969-70	4	1							5
1970-71	1								1
Total	115	17	13	1	2				148
% Total	77.7	11.5	8.8	0.7	1.3				100%
DUNDEE - Altitude 147 feet					Maximum depth = 8 inches				
Winter of									
1958-59	15								15
1959-60	17	1	1	2	1				22
1960-61	7		1						8
1961-62	6	3	5	2	5				21
1962-63	27	15	8						50
1963-64	12	1							13
1964-65	16	2							18
1965-66	40	5	1						46
1966-67	3								3
1967-68	15	1							16
1968-69	15	1							16
1969-70	12	1	1						14
1970-71		1							1
Total	185	31	17	4	6				243
% Total	76.1	12.8	7.0	1.6	2.5				100%

TABLE 7C (Contd)

Depth - Inches	0-1	2	3-4	5-6	7-8	9-12	13-16	Over 16	Total
MYLNEFIELD - Altitude 100 feet					Maximum depth = 5 inches				
Winter of:									
1958-59	4								4
1959-60	13	2	3	1					19
1960-61	8								8
1961-62	9	2	9	2					22
1962-63	35	6	1						42
1963-64	3	3							6
1964-65	14	2							16
1965-66	29	6	2						37
1966-67	2								2
1967-68	26								26
1968-69	11	1							12
1969-70	10	1							11
1970-71	1	1							2
Total	165	24	15	3					207
% Total	79.7	11.6	7.2	1.5					100%
PERTH - Altitude 77 feet					Maximum depth = 6 inches				
Winter of:									
1958-59									0
1959-60	15	2	2	1					20
1960-61	6	2	1						9
1961-62	12	3	2	1					18
1962-63	53	10	3						66
1963-64	4	1							5
1964-65	14	3							17
1965-66	30	7	4						41
1966-67	9								9
1967-68	24	4							28
1968-69	15								15
Total	182	32	12	2					228
% Total	79.8	14.0	5.3	0.9					100%

TABLE 7C (Contd)

Depth - Inches	0-1	2	3-4	5-6	7-8	9-12	13-16	Over 16	Total
LEUCHARS - Altitude 34 feet					Maximum depth - 9 inches				
Winter of:									
1956-57	2								2
1957-68	8	5	1	1		1			16
1958-59	7								7
1959-60	4	6	4	2					16
1960-61	2	1	1						4
1961-62	3	1	5	6					15
1962-63	7	19	3						29
1963-64	3								3
1964-65	9	4	7						20
1965-66	20	4	2						26
1966-67	3								3
1967-68	7								7
1968-69	7								7
1969-70	6	3							9
1970-71	1								1
Total	89	43	23	9		1			165
% Total	53.9	26.1	13.9	5.5		0.6			100%

## 8. Thunderstorms and Hail

In common with all the other major centres of population in Scotland, the Tayside region has a low incidence of thunderstorms and damaging hail. On the long term average, most cities and towns in the region have about 5 to 8 days per year with thunderstorms which is similar to the frequency in Edinburgh and Glasgow, but much less than in London and other places in central and southern England which have two to three times as many thunderstorms.

Thunderstorms have occurred at places in the region in all months of the year but have occurred most often in the months of May to August. As in most other parts of Scotland, thunderstorms during the summer months are rarely accompanied by true hail. Indeed, the frequency of reports of hail runs counter to the incidence of thunder. Hail is most commonly reported in April when the frequency of thunder is still low but the frequency of hail, although remaining significant, falls off in May whilst the thundery activity is increasing. Hail is often reported during the winter months from November to March but many of these reports are probably due to confusion between true hail which consists mainly of solid ice and "soft hail" or granular snow which is a much more common phenomenon on the east coast of Scotland during the winter months.

The number of days with thunderstorms at Leuchars are given in Table 8. Only a limited watch is kept on the weather at other stations in the region but the available records suggest that places on the coast like Montrose, Arbroath, Carnoustie and St Andrews have a frequency of thunderstorms similar to the average frequency of 5 days per year at Leuchars. There are indications of a slight increase in the frequency of thunderstorms westwards towards Perth where the annual average is probably nearer 8 days per year.

Records of thunderstorms are not available from the hillier areas of the region but thunderstorm clouds can often be seen building up over the higher ground, particularly over the hills near Perth, and the frequency of thunderstorms over the hilly ground may be higher than at the main centres of population.

TABLE 8

Actual and average number of days with thunderstorms  
at Leuchars  
(20 years from 1951 to 1970)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
1951	0	0	0	1	0	0	4	0	1	0	0	0	6
1952	0	0	0	0	2	0	0	2	0	0	0	1	5
1953	0	0	0	0	1	0	3	1	0	0	0	0	5
1954	0	0	0	0	4	1	0	0	1	2	0	0	8
1955	0	0	0	1	0	0	0	0	1	0	0	0	2
1956	0	0	1	0	0	0	2	1	1	0	0	0	5
1957	0	0	0	0	2	0	2	1	0	0	0	0	5
1958	0	0	0	0	0	2	1	2	2	0	0	0	7
1959	0	0	0	0	0	1	1	0	0	0	3	0	5
1960	0	0	0	0	1	1	2	2	0	1	0	0	7
1961	0	0	0	0	0	1	0	1	3	0	0	0	5
1962	0	0	0	1	1	0	1	0	0	0	0	0	3
1963	0	0	0	1	1	1	1	0	0	0	0	0	4
1964	0	0	0	0	0	2	1	0	0	0	0	0	3
1965	0	0	0	0	0	1	1	0	0	0	0	0	2
1966	0	0	0	0	1	0	1	0	0	0	0	0	2
1967	0	0	0	0	2	0	0	1	0	0	0	0	3
1968	0	0	0	0	0	1	2	0	0	0	0	0	3
1969	0	0	0	0	0	0	1	3	0	0	0	0	4
1970	0	0	0	0	2	3	2	0	1	0	1	0	9
20 year mean	0.0	0.0	0.1	0.2	0.8	0.7	1.3	0.7	0.5	0.1	0.2	0.1	4.7

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