

DUPLICATE

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THE CLIMATE OF GLASGOW

by

J.A.PLANT

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## THE CLIMATE OF GLASGOW

by J.A. Plant

Glasgow lies in the broad plain of the Clyde Basin but is almost completely surrounded by high ground. About 7 to 10 miles from the northern boundary of the city lie the Campsie Fells and Kilsyth Hills reaching an altitude of almost 1,900 feet. To the northwest lie the Dunbartonshire Hills with extensive areas of high ground exceeding 2,000 feet particularly near the Loch Lomond area. To the west and southwest of Glasgow are the hills of Renfrewshire and Ayrshire which reach a height of about 1,200 feet only 12 miles from the western boundary of the city while 10 miles to the south of the city are the high moorland areas around Corse and Ellrig, altitude 1,200 feet. The transition from flat to hilly country is less rapid to the east and southeast of Glasgow but nevertheless the ground rises to a height of 1,000 feet about 18 miles to the east of the city near the line of watershed between the catchments of the Clyde and Forth.

Near the city centre, the ground rises northwards from the Clyde in a series of short but quite steep slopes but otherwise much the greater part of the built-up area is flat and below an elevation of 200 feet and generally speaking, it is not until one approaches the perimeter of the city that slopes of any consequence are encountered.

Although Glasgow is about 23 miles inland from the sea area of the Firth of Clyde, the gaps in the high ground to the south-west and the Clyde waterway to the west allow easy access to westerly winds bringing the moderating influence of the sea.

The climate of Glasgow has a mild almost relaxing aspect which although impossible to evaluate from meteorological statistics alone is often readily apparent to a visitor from Edinburgh, Dundee, Aberdeen or some other place on the east coast of Scotland. The mildness is usually most noticeable in the spring and early summer when cold easterly winds from the North Sea often bring a touch of rawness to the weather on the east coast.

With an annual average rainfall of about 40 inches per year, Glasgow is wetter than Edinburgh (27 inches per year) and other places on the east coast. However, to restrict a comparison to the dry eastern coastal strip of Scotland could be misleading and it should be mentioned that Glasgow is drier than some towns near the Pennines in Lancashire and Yorkshire and other places near hills in the west and south-west of England. Moreover, an annual average rainfall of 40 inches is well below the average for Scotland as a whole.

Over the year, Glasgow has rather less sunshine than places on the east coast of Scotland, but the main losses in sunshine occur in autumn and winter, and there is not much difference in the duration of sunshine between, say, Glasgow and Edinburgh in the spring and summer months.

The separate aspects of the climate of Glasgow are discussed in more detail in the following paragraphs under the headings of Rainfall, Temperature, Sunshine, Winds, Fog, Snow, Thunderstorms, Relative Humidity and Barometric Pressure.

Perhaps it should be explained to the reader at this point that the Meteorological Office at 26, Palmerston Place, Edinburgh 12, and the Glasgow Weather Centre at 118, Waterloo Street, Glasgow, C.2, receive an ever increasing number of requests from members of the building profession and from students for the types of data contained in this memorandum. It is hoped that the data and accompanying text will be of interest to students and helpful to architects, engineers and building contractors who have work to do in the Glasgow area.



# 1. RAINFALL

Glasgow has an average annual rainfall ranging from about 39 inches in the eastern parts of the city to about 42 inches in the western suburbs, but it can be seen from the rainfall map at Figure 1 that there is a fairly rapid and appreciable increase in rainfall over the higher ground to the north, south and west of the city. The driest districts near Glasgow are the outlying towns of Uddingston, Motherwell and Wishaw to the south-east of the city with an average of about 34 inches per year. The wettest districts near Glasgow are parts of the Campsie Fells area to the north of the city with more than 70 inches per year, the higher Renfrewshire Hills to the west with more than 90 inches per year, and the Loch Lomond area to the north-west with more than 100 inches per year over the higher ground. Thus, in complete contrast to most other major cities in the British Isles, Glasgow is fortunate in that it has abundant resources of fresh water within reasonable distance.

Monthly and Annual Rainfall Averages for a number of places in the Glasgow Area are quoted in Tables 1 and 1A. These show that the period from the beginning of March to the end of June is usually the driest part of the year, and that October or January are usually the wettest months.

On the long term average, Glasgow has about 50 per cent more rainfall per year than Edinburgh, and it is worthy of mention that this increase is mainly due to the fact that when belts of rain from the Atlantic are moving eastwards across Scotland, the rate and duration of rainfall in Glasgow is higher than it is in Edinburgh i.e. in these circumstances, it rains for a longer period of time in Glasgow than it does in Edinburgh. As far as the number of days with rain in the average year are concerned, Glasgow has about the same frequency of days with rain as Edinburgh although it follows from what has already been said that on a day with rain in Glasgow it tends to be wetter for a longer period of time than on a day with rain in Edinburgh. The main exceptions to this general rule occur either during thundery weather or when Edinburgh is experiencing the prolonged heavy downpours of rain which often occur in east and south-east Scotland during the late summer and autumn in association with easterly winds from slow moving or stationary depressions in the North Sea.

## The Frequency of Dry Days in Glasgow

Table 1B gives, for each calendar date, the total number of "dry" days in Glasgow during a period of 50 years. These data have been extracted from 50 years (from 1915-1964) of daily rainfall records from the Coats Observatory, Paisley, which lies about 6 to 7 miles west of the centre of Glasgow. The occasions counted as "dry days" were the dates on which the 24 hour amounts of rainfall (including melted snow), from 09h GMT on one day to 09h GMT on the next day, were either 'Nil' or 'less than .005 inches'. It can be seen from Table 1B that over the 50 years considered, the months of March, April, May and June had the highest frequencies of dry days and that December and January had the lowest frequencies.

If running 7-day totals of the figures in Table 1B are prepared, it will be noted that over the 50 years considered, the 7-day period commencing 10th March had the highest frequency of dry days, viz. 208 dry days out of a maximum possible total of 7 days x 50 years = 350 days. The 7-day periods in each month with the highest frequency of dry days over the 50 years were:-

<u>7-day period commencing:</u>	<u>Total number of Dry Days out of a Possible</u> <u>Total of 350</u>
22nd January	= 130
16th February	= 166
10th March	= 208
27th and 28th April	= 205
24th May	= 203
24th June	= 182
30th July	= 180
31st July	= 181
1st August	= 180
27th September	= 153
8th October	= 151
12th November	= 150
17th December	= 128

/ While



While the 7-day values and the daily values in Table 1B do serve to highlight the periods of the year which usually have the highest frequency of dry days, the generally moderate to low frequencies and the large day to day variations in the numbers of occasions emphasise the uncertainty and shortcomings of this type of statistic as a guide to the probability of occurrence of a dry day or a dry period in any particular year in the future. For example, it can be seen from Table 1B that 1st January was dry on 14 occasions in the 50 years while 2nd January was dry on 24 occasions. However, the day to day incidence of dry days and days with rainfall is such that during a future period of 50 years, the position could be reversed with 1st January being drier more often than 2nd January.

Cumulative Frequencies of Daily Rainfall in inches showing the numbers of days in the 35 years from 1931 to 1965 on which specified 24 hour amounts of rain fell at Glasgow Green are given in Table 1C.

Maximum Daily Rainfalls recorded at Glasgow Green during the 65 years from 1902 to 1966 are given in Table 1D.

#### Intensities of Rainfall for Sewer and Culvert Design

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

Table 1E gives two sets of frequencies of the numbers of days in 10 years with specified amounts of rain falling in specified times. The first set of frequencies in Column 'A' of the Table are empirical frequencies calculated from actual recordings made at Renfrew and Abbotsinch airports while the second set of frequencies in Column 'B' of the Table have been calculated from the well known Bilham formula for rainfall intensities.

Table 1F provides a more comprehensive set of rainfall intensities all of which have been calculated from the Bilham formula.

There are very few long-period records of measurements of rainfall intensities available from places in Scotland, and therefore drainage engineers make fairly wide use of the Bilham formula. However, it can be seen from Table 1E that for durations up to about 2 hours, the frequencies obtained from the Bilham formula are too high when related to Glasgow, particularly when the Bilham frequencies are compared with the empirical frequencies derived from the longer periods of actual records, and experience suggests that for durations up to about 2 hours, the frequencies obtained from the Bilham formula could be halved when applied to Glasgow, i.e. a frequency of "1 day in 5 years" obtained from Table 1F would become "1 day in 10 years". Alternatively, for durations of up to about 2 hours, a 20 per cent reduction could be made to the amounts quoted in Table 1F to relate the Bilham intensities to sewer and culvert design purposes in the Glasgow area.

The following paragraphs on the subject of driving rain are largely an abstract of a paper by H.C. Shellard and R.E. Lacy<sup>(5)</sup>.

#### Driving Rain

When rain is carried along at an angle to the vertical by wind, so that it impinges on vertical surfaces, some of it will be absorbed if the surface is porous, or driven into cracks between units which are impervious. Damage to buildings, to their decorations and even to their contents from rainwater which is driven on to a wall in this manner is of common occurrence. Not only does the rainwater absorbed by the structure cause direct damage, but also by increasing the thermal conductivity of the materials it tends to lower the temperature at the inner face and so increase the risk of condensation there. Greater heat-losses because of the higher thermal conductivity either reduce the comfort of the occupants or increase costs because the losses must be made good by burning more fuel.

/ Such



Such wind-driven rain is called "driving rain" and it is useful to have some measure of its severity. Measurements from raingauges set into the walls of buildings have been made in Glasgow by the Building Research Station, Ministry of Technology. These measurements show that the amount of rain driven on to a wall is directly proportional to the product of the rainfall on the ground and the wind speed during the rain. Wind speeds during periods of rainfall are not usually recorded separately but a convenient and satisfactory index of driving rain can be obtained by taking the product of the annual rainfall in millimetres and the average wind speed in metres per second divided by 1,000, thus giving an index in  $\text{m}^2/\text{sec}$ . The overall picture is not distorted by this expedient because the available evidence indicates an almost constant relationship between the annual average wind speed and the average wind speed during rain.

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

With an index of  $6.3 \text{ m}^2/\text{sec}$ . (calculated from data for Renfrew Airport), it can be seen that Glasgow lies almost in the "severe" zone, and the city has in fact a higher index of driving rain than any other city of comparable size in the British Isles. Croydon Airport near London for example, has a relatively low annual index of  $4.7 \text{ m}^2/\text{sec}$ . while Holyhead on the exposed western promontory of Anglesey has a high annual index of  $7.7 \text{ m}^2/\text{sec}$ .

An indication of the amount of run-off water to be accommodated, measurements have shown that in a place with a driving-rain index of  $7 \text{ m}^2/\text{sec}$ ., a run-off of 1 gallon per  $100 \text{ ft}^2$  per minute from a vertical wall can be expected about once a year.

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

<u>NE.</u>	<u>East</u>	<u>SE.</u>	<u>South</u>	<u>SW.</u>	<u>West</u>	<u>NW.</u>	<u>North</u>	<u>Total</u>
9	10	5	15	34	22	4	1	100%

Thus, as a general rule, it would appear that north-facing walls in Glasgow escape the worst effects of driving rain. On the other hand, it would seem desirable to pay special attention to making west-facing walls weather-tight particularly west-facing walls of multi-storey buildings which are more exposed to the wind than their general surroundings.

#### Rain as a Factor interrupting Outdoor Building Work in Glasgow

Tables 1G to 1I give certain data which may be helpful in assessing the probable amount of time in which rainfall may hamper or interrupt outdoor building work in the Glasgow area. There is practically no experimental evidence on this subject, but in consultation with the Building Research Station, Ministry of Technology, it has been decided that the lower limit of precipitation contributing to time lost in the building industry through inclement weather should be set at a rate of 0.5 millimetres per hour which corresponds to the lower limit of the Meteorological Office classification of 'moderate' rainfall i.e. rain falling fast enough to form puddles rapidly and to accumulate in a raingauge at a rate between 0.5 mm and 4 mm per hour.

Table 1G which has been prepared from hourly measurements of rainfall intensities recorded at Renfrew Airport, 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 07h and 17h GMT in each month during the 10 years from 1956 to 1965. The monthly totals quoted in Table 1G have been obtained by adding up the duration of rain falling at a rate of 0.5 mm/hr or more in each hour between 07h and 17h on each

/ day



day of the month. For example, rain falling at a rate of 0.5 mm/hr for 36 minutes during one hour would contribute a value of 0.6 hours to the total duration. The following example will serve to illustrate the rather serious shortcomings of the figures presented in Table 1G.

Consider, for instance, a single period of ten hours between 07h and 17h with intermittent rain, most of it quite light but increasing to a rate of 0.5 mm/hr for say a period of 12 minutes in each of the 10 hours. The total duration of rain at a rate of 0.5 mm/hr throughout the whole ten hour period would be 10 times 12 minutes (or 10 times 0.2 hours) = 2 hours, whereas the actual amount of working time lost during this particular period might be the whole period of ten hours. Similarly, if rain fell at a rate of 0.5 mm/hr for a single period of 30 minutes, it would be reasonable to assume that with certain types of outdoor building work, the actual working time lost because of the rain might be at least one hour or even longer. Thus, it will be realised that in the majority of cases, the duration figures quoted in Table 1G underestimate, perhaps grossly underestimate, the probable amount of time lost on outdoor work. However, the duration figures in Table 1G do provide an indication of the extreme lower limit of the working time likely to be lost because of rain.

When consulting the first of the two tables of Table 1H giving the number of days with rain falling at a rate of 0.5 mm/hr or more between the hours of 07h and 17h GMT, it should be emphasised that these figures should not be taken to mean that rain has fallen continuously at a rate of 0.5 mm/hr throughout the whole period of 10 hours on each day. On the contrary, the monthly total numbers of days include days on which rain has fallen at a rate of 0.5 mm/hr for a period as short as six minutes on one day. Similarly, the totals in the second table of Table 1H include "hours" when rain has fallen at a rate of 0.5 mm/hr for a period as short as six minutes within one hour. Thus in contrast to the figures given in Table 1G, the figures given in Table 1H tend to overestimate the probable amount of time lost on outdoor building work although the figures in Table 1H undoubtedly provide a safer and perhaps more realistic guide for planning purposes than the figures in Table 1G.

Polythene shelters to cover the building site, or part of the site, obviate loss of working time due to inclement weather, and a study of the data in Tables 1G and 1H with a possible interpolation between the two sets of figures, may help building contractors to decide for particular jobs whether it is an economic proposition to use these shelters. On the other hand, perhaps it should be stressed that while the figures in Tables 1G and 1H provide a guide to the duration of rain falling at the critical rate of 0.5 millimetres per hour or more during the working 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 in Glasgow could flood a building site (especially at the excavation stage) bringing work to a standstill for several days, but such a downpour might only contribute a value of, say, one or two extra hours with rain falling at a rate of 0.5 mm/hr or more. Clearly, a heavy downpour of rain outside the ten hour period from 07h to 17h GMT could bring about a similar stoppage.

Table 1I gives the number of days on which rain fell at Renfrew Airport between the hours of 07h and 17h in each month during the 10 years from 1956 to 1965. Days on which only a few spots of rain fell in a few minutes have been counted in arriving at the monthly totals. Similarly, in the second table of Table 1I, hours with only a few spots of rain falling in a few minutes within the hour have been included in the monthly totals. It is thought that the figures in Table 1I may be of particular interest to contractors who are faced with unusual types of building work which are especially prone to interruption by rainfall, or to contractors who are more interested in simple frequencies of rainfall rather than durations or rates of rainfall.



## 2. TEMPERATURE

In winter, temperatures in Glasgow are comparable with those of London and other places in the south of England. The reasons for this is that westerly winds are the most frequent winds in winter and have a long track over the sea, the air in contact with the sea thus tending to take up the sea surface temperature. Sea temperatures along the western seaboard of the British Isles and the English Channel are higher than the land surface temperatures in winter, and thus temperatures tend to decrease inland with increasing distance from the west and south coasts of the British Isles with the isotherms of mean winter temperature running in a broadly northwest to southeast direction over the country.

The winters in Glasgow are no more severe than they are in the south of England. Indeed, Glasgow usually escapes the worst effects of very severe winters (e.g. the winters of 1946/47 and 1962/63) which are characterised by bitterly cold easterly winds from the Continent affecting east and south-east England much more than Glasgow. However, because of the high latitude of Glasgow and the onset of cold easterly winds from the North Sea, the rise of temperature at the end of winter is much slower than it is in the south. Consequently, the winters last longer in Glasgow than they do in the south, and spring is later and cooler than in the south. In summer and early autumn the effect of latitude on the heat received from the sun is the dominant factor, and temperatures in Glasgow are several degrees lower than in the south of England.

The temperature regime within Glasgow and the surrounding area is complex. Generally speaking, day temperatures are highest on the lower ground, particularly in the more densely built up areas sheltered from the wind. However, at night time and particularly on winter nights with calm weather and clear skies, parts of Glasgow act as a "sink" for the air which has been cooled by contact with the ground in the high, peat or grass covered moorland areas surrounding the city. Being relatively dense (i.e. heavier), the cold air drains down the slopes surrounding Glasgow, and stagnates over flatter ground or in depressions and hollows. Thus, if the urban warming influence (discussed later) did not exist, most of the low lying ground on which Glasgow stands could perhaps be described as a large scale "frost hollow". On a much more limited scale, a similar drainage of cold air takes place over the extensive areas of low-lying, gently sloping parkland within the city.

It follows from what has been said that the parts of Glasgow and the surrounding area most prone to frost and low night temperatures are low-lying places near the foot of slopes, particularly near the more pronounced slopes on the perimeter of the city or near the areas of parkland within the city where the gravitational flow of cold air formed over the grass covered surface may be dammed by trees or buildings.

Renfrew Airport, which lies in a shallow depression at the foot of sloping ground, is a good example of a low-lying place in the Glasgow area subject to the "frost hollow" effect, and it is worthy of note that Renfrew Airport records lower temperatures and has a much higher incidence of frost than the nearby station at Paisley which is at a higher elevation than the Airport and in a different environment.

In windy, cloudy weather, the surface of the ground cools less rapidly at night and the air near the ground is too disturbed for the "frost hollow" effect to develop.

The temperature regime within the city is further complicated by the "heat island" effect which large built-up areas create at night. This effect is the result of a combination of a number of factors including the heat released in artificially heating the buildings, the effect of pollution haze and tall buildings in cutting down the loss of outward radiation at night, the general reduction in wind speed etc. Some of the most densely built-up areas in Glasgow are in shallow depressions or on low-lying ground at the foot of slopes, and here the "frost hollow" and "heat island" effects will tend to counteract each other. Unfortunately, little is known about the total effect on temperatures in the city, but it is probable that the urban warming influence is considerably less than in London.

/ Renfrew



Renfrew and Abbotsinch airports lie quite close to the Clyde, and one might expect the waters of the river to have a warming influence in winter and a cooling influence in summer. However, there is no clear evidence that the river does have an effect on the temperatures recorded at the airports, and this may be due to the narrowness of the Clyde in the built-up area of Glasgow.

It should perhaps be explained at this point that air ("shade") temperatures are read from thermometers exposed at a height of four feet above ground level, and an "air frost" occurs when the temperature at four feet falls to 32°F or below\*. However, at night-time and particularly on clear, calm nights, the air in close contact with the ground is nearly always cooled to below the temperature at four feet. Consequently, the incidence of frost at the surface of the ground is much higher than the incidence of "air frost". It is difficult to provide representative statistics of frost at the surface of the ground as conditions will vary considerably over quite short distances from place to place depending on the composition of the surface (e.g. grass, bare soil, tarmacadam or concrete) and whether a particular site lies in a sheltered place or is exposed to the wind. Owing to its excellent insulating characteristics, a grass covered surface will normally have a higher frequency of frosts than the other surfaces mentioned because it seals off the only source of heat during the night, i.e. the soil. The average number of days with grass minimum temperatures below freezing point at Renfrew Airport (recorded by a thermometer lying one or two inches above a short grass covered surface freely exposed to the sky) was 96 per year during the 10 years from 1956 to 1965 compared with 59 days with air frost per year at the same site. At a higher and more sheltered grass covered site in Springburn Park, the average number of days per year with grass minimum temperatures below freezing point was 108 compared with 64 days of air frost per year at the same time. Clearly the winter months of December, January and February will normally have the highest frequency of frosts at the surface of the ground, but sheltered grass covered sites in Glasgow could have grass minimum temperatures below freezing point in any month of the year.

In dealing with problems involving heat loss, whether it is related to human comfort, heating of buildings or frost penetration, it is necessary to consider the combined effect of temperature and wind. As a general rule, the heat loss will be greatest in the higher windier outskirts of Glasgow or in the upper storeys of high blocks of flats which are more exposed to the wind than their general surroundings. The effect of wind on frost intensity is illustrated by the following table which is used by the Meteorological Office to define their descriptions of frost.

Term	Corresponding to air temperature °F	
	Wind Speed less than 11 mph (10 knots)	Wind Speed more than 11mph (10 knots)
Slight frost	32°-27°	32°-31°
Moderate frost	26°-21°	30°-28°
Severe frost	20°-11°	27°-23°
Very severe frost	Below 11°	Below 23°

Averages and Extremes of Air Temperature for several places in the Glasgow area are given in Tables 2, 2A and 2B. The standard period for temperature averages in current use in the Meteorological Office is the 30 years from 1931 to 1960. The averages quoted for Renfrew Airport and Paisley are actual averages over this period of 30 years but the averages quoted for the other

/ places

\* Since 1st January 1963, a day with air frost has been defined as a day on which the minimum air temperature falls to below 32.0°F.



places have been estimated from shorter period or broken periods of records. The temperatures quoted in the Tables for Renfrew Airport and Springburn Park should provide a reasonably reliable guide for planning purposes to the temperatures at places at similar elevations in Glasgow. Similarly, the temperatures quoted for Coatbridge and Thorntonhall should be reasonably representative of the temperatures experienced at similar elevations in the higher suburbs and outlying towns near Glasgow. Although orthodox instruments and methods are used at Paisley for recording temperatures, the site is rather sheltered by nearby buildings to the north and east and this may account in part for the relatively high temperatures and low incidence of frost when the Paisley figures are compared with other places in the Glasgow area. The Burgh of Paisley covers a wide area, and although the Paisley temperature and frost figures quoted in the Tables are no doubt representative of similar "warm" sites in the Burgh, it is considered that the figures quoted for Renfrew Airport will provide a more comprehensive basis for general planning or design purposes in the Paisley area.

The Percentage Amount of Time with Air Temperatures below Certain Limits at Renfrew Airport is given in Table 2C.

The Numbers of Days with Maximum Air Temperatures exceeding 60°F, 65°F, 70°F, 75°F and 80°F at Renfrew Airport are given in Table 2D.

The Actual and Average Numbers of Days with Air Frost are given for certain places in the Glasgow area in Tables 2E and 2F, and the average and extreme dates of occurrence of the first and last frosts in Table 2G. A note is also included of the longest period in the 20 years from 1946 to 1965 with air temperatures continuously below freezing point at Renfrew Airport and Springburn Park.

#### Temperature as a Factor interrupting Outdoor Building Work in Glasgow

Clearly, outdoor building work will be seriously hampered or have to cease when temperatures are somewhere near or below freezing point, but it is difficult to decide a precise threshold temperature because this will obviously depend on the type of building work and other factors. However, it would seem reasonable to assume that figures showing the numbers of days and hours with temperatures below, say, 34°F and 36°F would provide a closer guide for estimating the building time likely to be lost through low temperatures than figures showing the number of days and hours with temperatures below freezing point.

Tables 2H and 2I have been prepared from records of hourly readings of air temperature made at Renfrew Airport between 07h and 17h Greenwich Mean Time (08h and 18h British Summer Time) on each day during the 10 years from 1956 to 1965. Owing to the convention formerly in use in the Meteorological Office whereby tenths of a degree Fahrenheit were rounded off and recorded in the records to the nearest whole degree, "below 33.6°F" and "below 35.6°F" are the nearest precise values of temperature available from the records to the suggested thresholds of "below 34°F" and "below 36°F" respectively.

The Tables giving the total numbers of days in each month with hourly readings of air temperature less than 33.6°F and 35.6°F include days on which only one hourly reading of air temperature was below 33.6°F or 35.6°F, and therefore the figures in these Tables should not necessarily be taken to mean that these are days on which the air temperature was continuously below 33.6°F or 35.6°F throughout the whole period of ten hours between 07h and 17h. On the contrary, during the 10 years considered, there were many more days with two or three hourly readings of air temperature below 33.6°F or 35.6°F than there were with ten hourly readings below these levels. It should be mentioned that the figures in these Tables slightly underestimate the true number of days on which the air temperature fell to below 33.6°F or 35.6°F because on several days the air temperature would have fallen to below these levels for a short time during the 60 minutes between the routine hourly readings, although the hourly readings themselves might have been above 33.6°F or 35.6°F.

/ The



The Tables showing the total number of hours during the ten hour period between 07h and 17h GMT with air temperatures below 33.6°F and 35.6°F have been determined by counting up the number of hourly readings below these limits between 07h and 17h on each day during the 10 years from 1956 to 1965.

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

Averages and Extremes of Earth Temperatures at depths of 1 foot and 4 feet are given for Paisley in Table 2J. The sheltered, rather enclosed site at Paisley is the only place in the Glasgow area for which long term records of earth temperatures are available. Perhaps it should be stated that if there is appreciable shading from direct sunshine at a sheltered site, the ground which is shaded absorbs less heat and so may suffer a reduction in earth temperature. On the other hand, a shaded site will also tend to lose less heat by radiation; the ground would also retain moisture for a longer period of time than a more open site, and the thermal capacity of the soil would be increased. The net result of this is that the Paisley values of earth temperature should be reasonably representative of sheltered sites in the Glasgow area, but sites with a more open exposure will almost certainly record higher earth temperatures during the summer and lower earth temperatures during the winter.

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

### 3. SUNSHINE

Averages of sunshine duration for Renfrew, Paisley and Springburn Park are given in Table 3. The sites of the sunshine recorders at all three of these stations have free horizons with no obstructing hills, buildings or trees to cut off the sunshine. Nevertheless, the sunshine duration at all three sites is reduced to a varying degree by atmospheric pollution from domestic and industrial chimneys particularly during the winter months when more coal is being burnt for heating purposes. Although Renfrew, Paisley and Springburn Park all lie near to the fringe of the main smoke-producing parts of the city, it can be seen from Table 3 that Springburn Park has considerably less sunshine than either Renfrew or Paisley. The reason for this is that Renfrew and Paisley lie more to the windward (i.e. westward) of the city, while Springburn Park to the northeast of the city lies more in the path of the pollution haze carried inland by the prevailing west to south-west winds.

There is a clear indication that the smokeless zones established in Glasgow during recent years have led to a significant increase in the average sunshine duration. For example, the average annual duration of sunshine at Renfrew over the 30 years ending in 1960 is 50 hours more than an annual average for Renfrew over the 15 years ending in 1935 and about 40 hours more than an annual average over the 30 years ending in 1950.

Clearly, if atmospheric pollution was completely eliminated from the air above Glasgow, then there would be a considerable increase in sunshine duration particularly over the parts of the city worst affected by smoke-soiled air. Places like Troon on the Ayrshire coast to the south-west of Glasgow have an average annual sunshine duration of about 1,380 hours per year compared with the average annual duration of 1,243 hours at Renfrew and 1,148 hours at Springburn Park. Because of the high ground surrounding Glasgow and the tendency for cloud to form inland during the day, the incidence of cloud cover over the city is almost certainly higher than over the Ayrshire coast near Troon but nevertheless, in the complete absence of atmospheric pollution, Glasgow's sunshine duration might increase to something like 1,300 hours per year.

/ In



In fairness to Glasgow, perhaps it should be emphasised that all major cities in the British Isles suffer from the effects of atmospheric pollution. For example, it is interesting to note that the central London districts of Kingsway and Regents Park have an annual average sunshine duration of about 1,355 hours per year while places like Croydon and Kew on the outskirts have about 1,515 hours per year.

The path of the sun across the sky depends on the latitude and the time of year. Figure 2 is a solar chart for Glasgow (latitude 56°N) which shows the elevation and azimuth of the sun at various times of day, for the solstices, equinoxes and for certain intermediate dates. For a given site the various obstructions can be plotted on the chart and their effect in cutting off the sun's radiation at various times can then be evaluated. In winter for example, a hill on the southern outskirts of Glasgow with an elevation greater than  $10\frac{1}{2}$  degrees could cut-off practically all the sunshine.

#### 4. WINDS

There are four main gaps in the high ground surrounding Glasgow through which the winds have a relatively unobstructed passage into the city. For example, westerly winds from the Atlantic and the sea area of the Firth of Clyde find easy access into the city up the estuary of the Clyde waterway between Greenock and Glasgow, while winds from the south-west are channelled into the city through the valley which stretches between Dalry in Ayrshire and Paisley. Similarly, easterly winds from the North Sea penetrate into Glasgow along the valley south of the Kilsyth Hills and Campsie Fells i.e. roughly along the line between Falkirk and Glasgow, while winds from the south-east find their way into the city along the Clyde valley between Lanark and Glasgow.

Local increases in wind speed are a fairly common feature of valleys which are orientated along a direction from which strong winds blow, and therefore it is to be expected that exposed places on the perimeter of Glasgow near to the exits of the gaps in the high ground are appreciably windier than the more densely built-up parts of the city.

It is difficult to generalise about the winds in the built-up area of any city as the winds near the ground tend to follow the directions of the streets, being channelled up or down the streets between the buildings on either side and giving rise to gustiness at street intersections and corners. The buildings act as wind breaks so reducing the mean speed of strong winds, and in the more densely built-up areas of a city the mean hourly speeds may be of the order of 10 mph lower than in the more exposed outskirts. However, although buildings tend to reduce the mean wind speed, the "rough" surface of a built-up area increases the gustiness and the maximum gust speeds may well approximate to those experienced at an open site.

The arrangements of building in a town may cause channelling effects similar to those in a valley, and in this connection it is important to note that the main streets in Glasgow run for unusually long distances particularly in the west to east direction. This, coupled with the fact that the Clyde waterway also provides a relatively unhindered passage into the city, adds support to the contention that strong westerly winds are able to bring something like their full effect into some places in the heart of the city. At this point, it is worthy of mention that on a day with strong westerly winds, the maximum mean hourly wind speeds and gusts recorded at a height of 40 feet above ground level at the relatively "open" site at Renfrew Airport, are very similar to the maximum speeds recorded by an instrument sited 40 feet above the roof of the six storeys high Weather Centre Building at 118 Waterloo Street in central Glasgow.

At an open level site in Glasgow, the average wind speed near the ground is about 10 mph, i.e. similar to the average wind speed in London and Birmingham but appreciably less than the average speed in Edinburgh and Dundee. However, an average value always tends to mask the extremes, and in the case of Glasgow it is necessary to consider the incidence of very light winds and very strong winds.

/ As



As far as light winds are concerned, it is important to note that the city is extremely well sheltered by high ground to winds from a northerly point, and when winds from the north are blowing, winds in the city are likely to be calm or very light for fairly long periods of time particularly during the winter months.

With regard to strong winds, it is interesting to note that during the ten years from 1956 to 1965, Renfrew (Glasgow) Airport had a total of 45 days with gale over the 10 years, compared with a total of 119 days with gale at Turnhouse (Edinburgh) Airport over the same 10 years. However, it should not be concluded from this that the strength of the winds in Glasgow is a factor of secondary importance, because, when a gale does occur in Glasgow, the average speeds recorded during the gale are unusually high when Glasgow is compared with major cities in England. Even more important is the high incidence of strong gusts of wind caused by the roughness of the terrain to the south and west of the city, and the very high speeds reached during the gusts is perhaps the most remarkable single feature of the wind regime in Glasgow.

The following paragraphs dealing with the estimation of extreme wind speeds for building design purposes are largely abstracts from papers by H.C. Shellard<sup>(3)</sup> <sup>(4)</sup>.

#### Extreme 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) and highest gusts recorded in each year over a long period of years at the fairly open level site at Renfrew Airport yields the following results:-

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

<u>10 years</u>	<u>20 years</u>	<u>50 years</u>	<u>100 years</u>
50 mph	53 mph	58 mph	61 mph

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

<u>10 years</u>	<u>20 years</u>	<u>50 years</u>	<u>100 years</u>
93 mph	100 mph	108 mph	115 mph

#### Estimation of Maximum Speeds averaged over short periods of time

The Current British Code of Practice concerned with the calculation of wind loads on buildings requires the basic design wind speed to be the highest expected wind speed averaged over one minute, and it is likely that the revised Code will specify the use of an average over a shorter period, probably 15 seconds, as a basic speed for the design of whole structures, with an even shorter period, probably 3 seconds, for the design of certain unclad structures or of individual members of a building. However, the records from standard anemographs have too close a time scale for mean speeds to be measured over periods of one minute or less, and the readily available statistics are limited to means over one hour and details of the highest gusts. The highest speeds averaged over periods of 1 minute and 15 seconds will clearly lie somewhere between the highest hourly mean speed and the highest gust, while the highest 3 second mean will approximate to the highest gust speed, since the gusts that are fully recorded by an anemograph have durations of 3 seconds or more.

Until more evidence is available from open-scale recordings of strong winds in urban and city exposures, it is suggested that the estimation of maximum speeds over periods between one hour and a few seconds should be related to the roughness of the terrain as reflected in the ratio of the

/ maximum



maximum gust to the maximum hourly speed. It can be seen from the extreme speeds quoted at "A" and "B" above that the ratio of the maximum gust to the maximum hourly speed at a height of 33 feet above the ground at Renfrew Airport has the high value of about 1.9, i.e. the maximum gust speed is about 190 per cent of the maximum hourly speed. Suggested increases which should be applied to the hourly mean speeds quoted at 'A' above to obtain the probable value of the maximum wind speed averaged over periods of time ranging from 10 minutes to 10 seconds are given below:

<u>Average Wind Speed over:</u>	<u>Suggested Increases for Ratio of 1.9</u>
10 minutes	- increase speeds at "A" above by 6 per cent
1 minute	- " " " " " " 28 " "
30 seconds	- " " " " " " 39 " "
15 seconds	- " " " " " " 52 " "
10 seconds	- " " " " " " 60 " "

Although the ratio of the maximum gust to the maximum hourly speed at 33 feet above the ground has the high value of 1.9, it can be seen from the speeds quoted at "C" and "D" in the following paragraphs that the ratio of the maximum gust speed to the maximum hourly speed gradually decreases with increasing height above the ground. Suggested factors for estimating maximum speeds over short periods of time "t" from maximum hourly speeds for ratios less than 1.9 are given below.

<u>Ratio of Maximum Gust to Maximum Hourly Speed</u>	<u>10 minutes</u>	<u>1 minute</u>	<u>"t" = 30 seconds</u>	<u>15 seconds</u>	<u>10 seconds</u>
1.8	1.06	1.27	1.37	1.48	1.55
1.7	1.06	1.25	1.34	1.44	1.50
1.6	1.06	1.23	1.30	1.38	1.43
1.5	1.05	1.20	1.26	1.33	1.37
1.4	1.05	1.17	1.22	1.27	1.30

Thus, for example, with a ratio of maximum gust to maximum hourly speed of 1.7, the probable value of the maximum wind speed averaged over one minute would be 125 per cent of the maximum hourly speed.

#### Corrections to Extreme Wind Speeds for Heights in excess of 33 feet above ground level

In the Meteorological Office, average wind speeds near the ground are often related to a standard height of 33 feet (10 metres) above the ground and it will be noticed that the extreme speeds quoted at "A" and "B" above refer to this height. The most satisfactory method of estimating extreme wind speeds at heights in excess of 33 feet above ground level is by use of the following power laws:-

For speeds meaned over one hour: 
$$V_H = V_{33} \left( \frac{H}{33} \right)^{0.17}$$

For gust speeds: 
$$V_H = V_{33} \left( \frac{H}{33} \right)^{0.085}$$

/ where:



where:

- $V_H$  = the hourly mean speed or gust speed in mph at the required height H
- $V_{33}$  = the extreme hourly mean speed or gust speed in mph at 33 feet above the ground (quoted at "A" and "B" above)
- H = the required height in feet.

Applying these formulae to the extreme speeds quoted for Renfrew Airport at "A" and "B" above, the following estimates of the extreme hourly mean speeds and maximum gusts are obtained for heights ranging from 50 feet to 400 feet above ground level.

- C. Maximum Hourly Mean Wind Speeds at specified heights above the ground likely to be exceeded only once in the stated number of years:

	<u>10 years</u>	<u>20 years</u>	<u>50 years</u>	<u>100 years</u>
At 50 feet	54 mph	57 mph	62 mph	65 mph
At 100 feet	60 mph	64 mph	70 mph	74 mph
At 150 feet	65 mph	69 mph	75 mph	79 mph
At 200 feet	68 mph	72 mph	79 mph	83 mph
At 250 feet	71 mph	75 mph	82 mph	86 mph
At 300 feet	73 mph	77 mph	84 mph	89 mph
At 350 feet	75 mph	79 mph	87 mph	91 mph
At 400 feet	76 mph	81 mph	89 mph	93 mph

- D. Maximum Gust Speeds at specified heights above the ground likely to be exceeded only once in the stated number of years:

	<u>10 years</u>	<u>20 years</u>	<u>50 years</u>	<u>100 years</u>
At 50 feet	96 mph	104 mph	112 mph	119 mph
At 100 feet	102 mph	110 mph	119 mph	126 mph
At 150 feet	106 mph	114 mph	123 mph	131 mph
At 200 feet	108 mph	117 mph	126 mph	134 mph
At 250 feet	111 mph	119 mph	128 mph	137 mph
At 300 feet	112 mph	121 mph	130 mph	139 mph
At 350 feet	114 mph	122 mph	132 mph	141 mph
At 400 feet	115 mph	124 mph	134 mph	142 mph

The extreme speeds quoted at "A", "B", "C" and "D" above should give a reasonably close guide to the extreme speeds likely to be experienced at low-lying, open and level sites in the Glasgow area. However, special care should be taken when using these speeds for the design of buildings or building components where there are unusual features either of exposure and local topography or of the structure itself. In such cases, advice may be sought from the Meteorological Office.

/ Terms



Terms used by the Meteorological Office for describing the wind strength

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

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 limits shown in the above table.

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

Most gales in Glasgow blow from directions in the quadrant between south and west but easterly gales, although much less frequent, are not uncommon. Gales can occur in Glasgow in any month of the year but January usually has the highest frequency and July and August the lowest.

The Actual and Average Numbers of Days of Gales at Renfrew (Glasgow) Airport in the 10 years from 1956 to 1965 are given in Table 4.

The Numbers of Days and Hours with Gusts to 39 mph or more and 55 mph or more at Renfrew Airport during the 10 years from 1956 to 1965 are given in Tables 4A and 4B.

Annual and Monthly Frequencies of Wind Direction and Velocity for Renfrew Airport are given in Tables 4C and 4D. These show that in the "average" year, almost 45 per cent of all winds blow from the quadrant between south and west, and that the prevailing wind direction lies in the sector between south-west and west. The high frequency of winds from the sector between east and north-east is also worthy of note particularly in the spring months of March, April and May when easterly winds are often more frequent than winds from a westerly point.

High Winds as a Factor interrupting Outdoor Building Work in Glasgow

Strong winds often lead to hazardous working conditions on building sites particularly at sites where men are working on ladders or have precarious hand and footholds above ground level. Perhaps equally dangerous are the risks to workmen who are handling materials which are likely to be snatched off or blown about by the wind.

With the increasing use of tower cranes in recent years, the incidence of strong winds has become an even more important factor affecting the time lost in building work, because when strong winds are blowing, the tower cranes have to cease operating, the hoisting of building materials is stopped and nearly all work may be brought to a standstill.

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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 factors including the exposure of the building site, e.g. whether it is sheltered from the wind by nearby buildings, the height above ground level at which men are working, the type of work, the materials being used etc. Similar considerations would have to be taken into account in trying to assess the probable amount of time in which the use of a tower crane would be restricted or have to cease.

During a gale (average wind speed near the ground of 39 mph or more with frequent gusts to 50 mph or more) tower cranes cannot operate and probably most other types of outdoor building work would be brought to a standstill. However, a gale represents extreme wind conditions and there is no doubt that high gusts of wind of say 40 mph or more associated with average speeds considerably less than 39 mph could also lead to dangerous working conditions and would also seriously restrict the use of tower cranes.

Statistics showing the incidence of gusts of 40 mph or more in each hour throughout the working day are not readily available. However, statistics of hourly mean wind speeds recorded at Renfrew (Glasgow) Airport throughout each period of 24 hours are available, and a study of the Renfrew records of hourly mean speeds and gusts reveals that gusts of 40 mph or more first start to occur when the hourly mean wind speed reaches the level of about 20 mph and that gusts of 40 mph become quite frequent with hourly mean speeds of 25 mph or more. Accordingly, in view of the gusty nature of the winds in Glasgow and the surrounding area, statistics showing the incidence 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 4E gives the total number of days on which the wind speed averaged over a period of not less than one hour between 07h and 17h GMT has reached a value of 25 mph or more at Renfrew Airport during the 10 years from 1956 to 1965. Table 4E also gives the total number of hours between 07h and 17h GMT in which the hourly mean wind speed has reached 25 mph or more at Renfrew Airport during the same 10 year period. It is considered that the values given in Table 4E (with a possible reference to the values in Tables 4A and 4B) should provide a reasonably good guide for planning purposes to the probable amount of time in which outdoor work or the use of tower cranes might be hampered or have to cease at an exposed place in Glasgow.

It should be borne in mind when consulting Table 4E that the hourly mean wind speeds of 25 mph or more at Renfrew Airport are recorded at a height of 40 feet above ground level and that considerably higher speeds would be experienced at heights in excess of 40 feet above ground level, e.g. on exposed multi-storey buildings or high up on tower cranes. For example, using the power law corrections for height mentioned earlier, an hourly mean wind speed of 25 mph or more with gusts to 40 mph or more at a height of 40 feet above ground level would become something like 30 mph or more with gusts to 45 mph or more at a height of 150 feet above the ground at an exposed site in Glasgow.

## 5. FOG

In winter, the downhill drainage of cold air (previously discussed in the section dealing with Temperature) developed over the grass and peat-covered slopes and moorlands surrounding Glasgow often produces an extensive pool of cold air over the city particularly when winds are light or calm. This results in a smoke-trapping inversion of temperature up to a height of several hundred feet above ground level. The polluted air cannot escape upwards into the atmosphere because of the overlying warmer air, and the lateral escape of the polluted air at ground level is hindered by the narrowness of the gaps in the high ground surrounding the city.

Smoke fogs are the curse of all industrial areas and Glasgow is certainly no exception to the rule. However, the area affected by smoke and fog is fairly limited when Glasgow is compared with the Midlands of England and the London area, and the occurrence of really dense fogs is not so frequent.

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At this point it should perhaps be explained that a fog is said to occur when the visibility falls to below 1,100 yards. A fog becomes "thick" when the visibility falls to less than 220 yards and "dense" when the visibility falls to less than 55 yards.

Fogs with visibilities between about 500 and 1,100 yards hamper the movements of aircraft at Glasgow Airport but have little effect on the normal life of the city. However, when visibility falls to around the 500 yards mark it is beginning to have a serious effect on the movement of larger ships in the Clyde though still allowing the free movement of road traffic in the city. When visibility falls to less than 220 yards, the movement of even small vessels in the Clyde is virtually stopped and the flow of road traffic is slowed down. With dense fogs of visibility less than 55 yards, the movement of road traffic is very seriously impeded especially at night time.

Fog can be polluted, and from a health point of view, a polluted fog can be very damaging to the respiratory system, particularly the more highly polluted thick and dense fogs of the winter months.

On more than 90 per cent of occasions, thick or dense fogs in Glasgow occur when there is either no wind or very light winds (speeds less than 2 mph) from the sector between east and north-east.

Almost three quarters of all thick fogs in Glasgow occur with low air temperatures between 25 and 40 degrees Fahrenheit. This confirms the considerable effect of smoke on the development of thick fogs, the fuel used for heating in cold weather making a substantial contribution to fog density. Domestic heating habits are almost certainly reflected in the difference between the frequencies of thick and dense fogs. For example, when air temperatures are between 35 and 39 degrees Fahrenheit, only one fog in four becomes dense but with temperatures around freezing point one fog in two becomes dense.

During the spring and summer, thick fogs in Glasgow are infrequent and do not occur unless the relative humidity is 100 per cent or thereabouts. However, in winter, thick fogs occur quite often when the relative humidity is well below 100 per cent. For example, during the months of December, January and February, something like one third of all fogs become thick with humidities less than 95 per cent, and visibilities of the order of 100 to 200 yards have been known to occur in Central Glasgow with relative humidities as low as 75 per cent.

The months of November, December and January have much the highest frequency of fogs and the occurrence of a fog in the months of May, June and July is a comparatively rare event. Fogs in the spring, summer and autumn are most likely to occur around dawn but the diurnal variation in the incidence of winter fogs is much less marked and these fogs can become thick at any time of the day. However, there is one curious local feature which is difficult to account for, in that there is a fairly well marked tendency for winter fogs in Glasgow to thicken around midday, while in other major cities in the British Isles the tendency is for the fogs to thicken up around the time of the morning and evening rush hours.

There is a distinct lack of visibility records in foggy weather from places in and around Glasgow, but the available evidence suggests that over most of the city and the outlying suburbs and industrial towns there is not a great deal of difference from place to place in the frequency of days with visibilities less than 1,100 yards. However, the distribution of thick and dense fogs appears to be almost entirely controlled by the pattern of smoke pollution which is borne out by the fact previously mentioned that visibilities as low as 100 yards can occur in central Glasgow with relative humidities as low as 75 per cent. The very sparse data available suggest that the areas most prone to thick and dense fogs are the lowest lying places in the Glasgow area, the worst areas being usually either very near to the Clyde or to the south of the Clyde in the Paisley, Renfrew and southern Glasgow districts.

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The ground on which Glasgow now stands must always have had a fairly high frequency of days with poor visibility long before the city was established but there is no doubt at all that the thick and dense fogs which now afflict the city are largely "man-made". It is too early to say what effect the smokeless zones are having on visibility in Glasgow but there certainly seems to have been some improvement in very recent years, particularly in the centre of the city.

Percentage frequencies of occurrence of visibilities less than 1,100 yards according to month and hour are given in Table 5.

The variations of poor visibilities with wind direction are given in Table 5A.

The number of days with "Fog", "Thick Fog" and "Dense Fog" are given in Table 5B.

The number of hours with "Thick" and "Dense" Fogs are given in Table 5C.

## 6. SNOW

In Glasgow, as elsewhere in the British Isles, the incidence of snow falling and the persistence of snow cover are two of the most variable of all the meteorological elements. For example, during the severe winter of 1946/47 there were 47 mornings with snow lying on the ground at Renfrew Airport compared with only four mornings during the following winter of 1947/48.

Considering its high latitude and distance from the west coast, Glasgow is remarkably snow-free. At Renfrew Airport, there are on average, about 26 days per year with snow or sleet falling. The highest number of days in a year during the 20 years from 1946 to 1965 with snow or sleet falling is 42 days during 1951, and the lowest number of days in a year is 9 days during 1953. Most of the days with snow falling occur in January and February but snow can fall on low ground in Glasgow as late as May or as early as October, although snow falling in May or October seldom lies on the ground for any length of time.

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

Whether snow will lie, after it has fallen, in sufficient depth to cause difficulty to transport, depends on a number of complex factors but a greater height above sea level and a north or east facing aspect of the surface will certainly increase the number of days with snow lying. Even slight falls of snow on the short but steep gradients near the centre of Glasgow and the slopes surrounding the city can seriously impede the smooth flow of traffic, and the persistence of snow cover on the roads traversing the high ground surrounding Glasgow can be a nuisance.

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

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It is interesting to note that on average, snow falls on low ground in Glasgow on about one day less per winter than in Edinburgh. On the other hand, a comparison of the number of mornings with snow lying at Renfrew (Glasgow) Airport and Turnhouse (Edinburgh) Airport over the ten winters from 1955/1956 to 1964/1965 reveals that Turnhouse Airport had about twice as many mornings with snow lying during this period. It should also be mentioned that the variation in snow cover between Glasgow and Edinburgh in a particular winter can be considerable. For example, during the severe winter of 1962/63, there were only 10 mornings with snow lying on the ground at Renfrew Airport compared with 39 mornings at Turnhouse Airport. This variation was largely due to the fact that the largest falls of snow during the winter of 1962/63 were associated with winds from a south-east rather than an easterly direction, and Glasgow is well sheltered by the Southern Uplands to winds from the south-east. Easterly or north-easterly winds can bring fairly heavy falls of snow to Glasgow but fortunately the weather situations giving rise to snow bearing winds from these directions are rare.

There are very few reasonably long period records of snow cover from places on the outskirts of Glasgow but there is no doubt that the higher districts on the perimeter of the city, particularly the suburbs and outlying towns on the eastern side of Glasgow, are affected by snow much more than Renfrew Airport and the city itself. For example, the station at Coatbridge, which lies at an elevation of 256 feet only about 8 miles east of Glasgow, had 40 mornings with snow lying on the ground during the winter of 1962/63 compared with only 10 mornings with snow lying at Renfrew Airport.

It should be noted that in the Meteorological Office, a "day with snow lying" is counted only when half or more of the ground surrounding the weather station is covered with snow at 09h GMT, and the depth of snow is only measured on these occasions. The depths of snow measured at 09h GMT relate to the uniform undrifted depth.

The Actual and Average Numbers of Days with Snow or Sleet Falling at Renfrew Airport are given in Table 6.

The Numbers of Mornings per Winter with Snow Lying at Specified Depths are given in Table 6A for Renfrew Airport, Barrhead, Coatbridge and Carnwath. Carnwath lies at an altitude of 706 feet about 30 miles south-east of Glasgow by rail, but is the nearest "high level" station on the eastern side of Glasgow for which records of snow cover and depths are available. However, there are several areas at altitudes of 500 to 700 feet on the eastern side of Glasgow much nearer to the city than Carnwath, and it is thought that the Carnwath records in Table 6A should provide a more reliable guide to the snow coverage and depths in these areas than the records quoted for the relatively low lying stations at Renfrew, Barrhead and Coatbridge.

The Maximum Depths of Snow during the periods for which records are available are also quoted in Table 6A. It should be borne in mind when consulting the maximum depths given in Table 6A that all the records relate to a fairly short period of years. Moreover, the very few stations in the Glasgow area for which records of snow depths are available are by no means representative of the widely varying types of site at which buildings may be erected. From general meteorological considerations, one would expect that the maximum "undrifted" depth of snow likely to accumulate in Glasgow would be of the order of 12 inches and as an approximate guide for planning purposes, one foot of snow would be a more reasonable maximum value to adopt than the actual maximum depths quoted in Table 6A.

Monthly Frequencies of Snow Depths at Renfrew Airport and Carnwath are given in Table 6B.

#### Water Yield from Snow

At the present time, there is a distinct lack of records providing the actual water equivalents of sample depths of melted snow. However, as one would expect, the available evidence indicates that the water yield from "wet" snow falling in temperatures above freezing point is considerably higher than

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the water yield from an equivalent depth of "dry" snow falling in temperatures below freezing point. In fact there is a steady increase with temperature in the water yield per inch of snow and a sharp increase around freezing point.

The most commonly occurring water yield from samples of melted snow is one inch of water from about 12 inches of snow and until further evidence becomes available, it is suggested that this modal yield be used for general planning purposes. However, it should be emphasised that the suggested yield of one inch of water from 12 inches of snow should only be taken as a very approximate guide because one inch of water has been obtained by melting depths of snow as low as 5 inches and as high as 35 inches.

## 7. THUNDERSTORMS

In common with all the other major centres of population in Scotland, Glasgow has a low incidence of thunderstorms and damaging hail. During the 10 years from 1956 to 1965, Glasgow Airport (Renfrew) had an average of 8 days per year with thunderstorms compared with 7 days per year at Turnhouse (Edinburgh) Airport, 14 days per year at Birmingham Airport (Elmdon) and 16 days per year at London Airport (Heathrow). Thunderstorms can occur in Glasgow in any month of the year but are more likely to occur during the months of May to September and least likely to occur in February and March.

There are no detailed records of the incidence of thunderstorms over the high ground surrounding Glasgow but there is little doubt that the frequency of thunderstorms over the hills and high moorland areas on the outskirts of the city is appreciably higher than in the city itself.

The actual and average numbers of days with thunderstorms at Renfrew Airport during the 10 years from 1956 to 1965 are given in Table 7.

## 8. RELATIVE HUMIDITY

In the Glasgow area as elsewhere in the British Isles, the relative humidity reaches 90 per cent or thereabouts on most nights of the year. As a good general rule, the highest values of relative humidity occur in association with the lowest air temperatures of the day, i.e. usually around dawn, while the lowest values of relative humidity occur in association with the highest air temperatures 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 in that relative humidities are higher for a longer period of time during the winter months. Conversely, one might reasonably expect that relative humidities in Glasgow would be lower for a longer period of time in the summer months, but this is not the case, and it is worthy of note that relative humidities are in fact lower for a longer period of time in the spring months of April, May and June, no doubt because of the fairly high incidence of "dry" easterly winds and relatively low rainfall in the spring.

During the summer in Glasgow, high values of relative humidity are seldom associated with high values of air temperature, and therefore "muggy" days with warm damp air are rare. During the winter months, the wind speeds on days with high relative humidities and low air temperatures are usually light, and consequently the days with cold damp air are seldom unduly "raw".

When averaged over a long period of time, there is no significant difference in relative humidity from place to place in the Glasgow area although considerable differences could exist at a particular time of day depending on the local weather conditions prevailing at that time. It is considered therefore that the averages of relative humidity and values of wet bulb temperature for Renfrew Airport given in the Tables listed below should provide a close guide for planning or design purposes to the humidity regime in Glasgow.

Average Values of Relative Humidity and Corresponding Air Temperatures at certain times of the day are given in Table 8.

/ The



The Percentage Amounts of Time with Wet Bulb Temperatures below certain limits are given in Table 8A.

The Absolute Highest Wet Bulb Temperatures and the Highest Wet Bulb Temperatures associated with Relative Humidities of 100 per cent are given in Table 8B.

## 9. BAROMETRIC PRESSURE

Maps of average barometric pressure corrected to mean sea level show that pressure increases fairly uniformly from north to south over the British Isles. For example, the annual average mean sea level pressure at Lerwick in the Shetlands at 09h is 1010 millibars, at Aberdeen 1012 millibars, at Glasgow 1012.8 millibars, in Birmingham 1015 millibars and in Southampton 1016 millibars. However, although average barometric pressures in Scotland are lower than in England, the range of pressure in Scotland is greater than in England and it is interesting to note that both the highest and lowest pressures ever recorded in the British Isles (1054.7 millibars and 925.5 millibars respectively) were both recorded in Scotland.

Monthly averages of mean sea level barometric pressure at 09h (in millibars and inches) for Renfrew (Glasgow) Airport are given in Table 9.

The highest and lowest mean sea level pressures known to have been recorded at meteorological stations in the British Isles making readings of pressure at one or more fixed hours a day are given in Table 9A. It is possible that pressures outside these limits have occurred at other times or at other places not recording pressures, but Table 9A should give a good indication of the range of values within which pressure in Glasgow may be expected to lie in any particular month.

### Large Changes of Barometric Pressure in Short Periods of Time

The maximum rates (in millibars per hour) at which pressure is likely to change in the Glasgow area are as follows:

<u>Period</u>	<u>1</u> <u>hour</u>	<u>3</u> <u>hours</u>	<u>6</u> <u>hours</u>	<u>9</u> <u>hours</u>	<u>12</u> <u>hours</u>	<u>24</u> <u>hours</u>	<u>36</u> <u>hours</u>	<u>48</u> <u>hours</u>	<u>72</u> <u>hours</u>
Maximum Rate in mb/hour	8.0	5.5	4.5	3.9	3.3	2.2	1.6	1.3	1.0

It should perhaps be emphasised that large pressure changes can in some circumstances occur in very short periods of time. For example, at Croydon on 27th June 1947 during a violent squall accompanied by a thunderstorm and heavy rain, the pressure rose 7 millibars within a few minutes and then fell 5 millibars.

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TABLE 1

MONTHLY AND ANNUAL AVERAGES OF RAINFALL (INCHES) 1916-1950 FOR PLACES IN THE GLASGOW AREA

Station	Ht. (Ft)	N.G.R.	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
Townhill Filters, Hamilton	430	NS (26) 694546	4.49	2.84	2.39	2.21	2.62	2.36	2.91	3.65	3.59	4.41	3.83	3.94	39.24
Airdrie, Broom- knoll St.	402	NS (26) 762653	3.91	2.57	2.17	2.11	2.54	2.44	3.22	3.67	3.50	3.96	3.42	3.24	36.75
Tollcross Park	84	NS (26) 639638	4.26	2.84	2.43	2.31	2.68	2.56	3.17	3.71	3.48	4.19	3.70	3.69	39.02
Alexandra Park	141	NS (26) 617658	4.16	2.80	2.50	2.27	2.73	2.66	3.23	3.66	3.63	4.26	3.66	3.62	39.18
Gartloch Hospi- tal	291	NS (26) 673670	4.29	2.91	2.40	2.31	2.72	2.66	3.32	3.93	3.66	4.28	3.76	3.67	39.91
Ruchill Park	228	NS (26) 578684	4.07	2.77	2.37	2.24	2.58	2.50	3.18	3.56	3.46	4.28	3.62	3.67	38.30
Glasgow, Elder Park	25	NS (26) 543658	4.66	3.13	2.58	2.40	2.71	2.63	3.30	3.69	3.67	4.62	4.04	4.14	41.57
Victoria Park	30	NS (26) 543673	4.20	2.84	2.37	2.22	2.59	2.49	3.21	3.59	3.42	4.41	3.75	3.72	38.81
Renfrew	26	NS (26) 508662	4.66	3.19	2.51	2.32	2.63	2.41	3.10	3.33	3.57	4.70	4.12	4.19	40.73
Pollok House	50	NS (26) 549619	4.37	2.94	2.51	2.18	2.56	2.42	3.04	3.51	3.67	4.56	4.00	3.98	39.74
Waulk Glen	297	NS (26) 522578	5.92	4.04	3.12	2.89	2.97	2.88	3.54	3.96	4.41	5.54	4.94	5.32	49.53
Paisley	106	NS (26) 478642	5.21	3.47	2.80	2.48	2.80	2.57	3.26	3.58	3.85	5.12	4.46	4.62	44.22
Parkhill Filters	242	NS (26) 353736	6.27	4.16	3.24	3.18	2.98	2.93	3.42	3.93	4.38	6.13	5.62	5.73	51.97



TABLE 1A

MONTHLY AND ANNUAL AVERAGES OF RAINFALL (INCHES) 1916-1950 ESTIMATED FOR SHORT TERM STATIONS IN THE GLASGOW AREA

Station	Ht. (Ft)	N.G.R.	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct.	Nov	Dec	Year
Motherwell, Elvan St.	175	NS (26) 748570	3.93	2.55	2.09	2.02	2.33	2.23	2.83	3.40	3.25	3.93	3.50	3.33	35.39
Wishaw, Coronation St.	510	NS (26) 810552	3.71	2.43	1.96	1.96	2.26	2.13	2.77	3.24	3.14	3.75	3.27	3.14	33.76
Whifflet Park	295	NS (26) 740637	3.96	2.65	2.11	2.11	2.47	2.29	3.02	3.49	3.42	3.96	3.53	3.34	36.35
Coatbridge	256	NS (26) 708646	3.78	2.58	2.09	2.01	2.40	2.23	3.04	3.43	3.29	3.82	3.43	3.25	35.35
Rutherglen, Kingsknowe Drive	100	NS (26) 603608	4.75	3.15	2.68	2.55	2.85	2.68	3.41	3.89	3.89	4.71	4.27	4.36	43.19
Mugdock Res.	320	NS (26) 558755	5.50	3.82	3.16	3.01	3.31	3.16	4.13	4.74	4.69	5.64	4.89	4.89	50.94
Glasgow, Springburn	351	NS (26) 610685	4.22	2.87	2.47	2.31	2.71	2.59	3.31	3.71	3.59	4.46	3.79	3.82	39.85
Glasgow Green	35	NS (26) 599645	4.32	2.92	2.41	2.22	2.53	2.41	3.11	3.50	3.50	4.32	3.77	3.89	38.90
Glasgow, Botanic Gds.	131	NS (26) 568675	4.36	3.01	2.49	2.33	2.69	2.49	3.17	3.61	3.69	4.39	3.93	3.93	40.09
Kilmacolm	243	NS (26) 358691	7.25	4.77	3.86	3.74	3.50	3.50	4.16	4.77	5.31	6.88	6.10	6.52	60.36
Ranfurly	290	NS (26) 389652	7.23	5.10	3.98	3.73	3.61	3.61	4.48	4.98	5.48	7.10	6.29	6.66	62.25
Thorntonhall	453	NS (26) 590555	5.16	3.46	2.86	2.67	2.95	2.81	3.55	4.06	4.15	5.07	4.66	4.70	46.10
Linn Park	164	NS (26) 582592	4.71	3.23	2.60	2.43	2.69	2.56	3.27	3.69	3.73	4.57	4.24	4.24	41.96
Neilston Filters	561	NS (26) 475564	6.67	4.65	3.61	3.32	3.56	3.32	4.36	4.76	5.05	6.42	5.86	5.81	57.39
Barrhead	97	NS (26) 511601	5.29	3.55	2.91	2.64	2.87	2.69	3.46	3.78	3.96	5.05	4.60	4.73	45.53
Thornly Park School	195	NS (26) 487613	5.92	3.95	3.29	2.98	3.18	2.98	3.90	4.31	4.52	5.70	5.24	5.39	51.36
Stanely Res.	190	NS (26) 469616	5.90	3.93	3.18	2.93	3.13	2.93	3.78	4.19	4.39	5.65	5.10	5.35	50.46
Dumbarton S. Wks.	11	NS (26) 407745	5.44	3.60	2.87	2.73	2.82	2.73	3.19	4.07	3.97	5.27	4.53	4.99	46.21



TABLE 1B

TOTAL NUMBER OF "DRY" DAYS DURING A PERIOD OF 50 YEARS (1915 TO 1964)  
 AT THE COAT'S OBSERVATORY, PAISLEY  
 ("DRY" = 24 HOUR RAINFALL AMOUNT OF 'NIL' OR LESS THAN .005 INCHES)

Date	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
1st	14	15	27	23	25	23	24	27	15	21	14	14	
2nd	24	19	27	22	30	27	23	24	19	21	12	17	
3rd	17	18	18	24	29	25	23	29	21	20	16	23	
4th	20	17	20	18	27	28	27	26	25	18	17	18	
5th	16	19	19	28	23	26	23	25	23	21	15	16	
6th	13	16	25	20	23	25	20	26	16	25	21	15	
7th	17	15	27	21	20	22	18	23	21	15	23	14	
8th	12	15	29	20	26	27	25	15	20	21	16	15	
9th	16	19	25	26	27	22	25	20	23	20	17	15	
10th	17	18	29	25	30	25	23	19	19	23	22	16	
11th	16	21	32	23	25	24	27	19	19	24	16	19	
12th	15	23	26	23	25	27	20	22	20	18	22	18	
13th	21	19	33	14	17	28	18	23	16	20	19	13	
14th	17	21	31	20	23	24	19	17	20	25	24	15	
15th	20	21	29	24	26	24	24	14	22	20	18	13	
16th	21	28	28	28	26	23	19	18	19	14	22	18	
17th	16	25	24	25	23	24	20	16	17	17	22	23	
18th	15	27	23	24	24	21	17	19	20	21	23	15	
19th	14	21	21	26	23	25	22	20	16	15	16	16	
20th	15	21	24	26	20	20	21	17	19	19	20	19	
21st	15	19	22	25	27	24	23	18	20	19	18	19	
22nd	20	24	23	24	25	25	25	22	19	14	18	16	
23rd	21	22	24	23	26	26	29	20	14	16	18	20	
24th	20	22	22	25	31	25	23	17	19	20	19	13	
25th	18	20	26	22	27	24	20	23	20	21	20	16	
26th	17	18	28	24	21	27	21	20	19	20	22	12	
27th	18	21	29	27	33	23	17	19	24	22	17	14	
28th	16	22	25	34	28	29	22	20	24	23	14	16	
29th	16	8*	17	34	32	25	21	21	22	19	19	11	
30th	14		18	26	31	29	25	21	21	19	17	16	
31st	13		22		25		24	18		20		20	
Total	524	575	773	724	798	747	688	638	592	611	557	505	7732
Total ÷ 50	10.5	11.5	15.5	14.5	16.0	15.0	13.8	12.8	11.8	12.2	11.1	10.1	
Date in each month which was dry on most occasions	2nd	16th	13th	28th) 29th)	27th	28th) 30th)	23rd	3rd	4th	6th) 14th)	14th	3rd) 17th)	

\*8 occasions on 29th February in 13 leap years.

Example:- 15th January was dry on 20 occasions in the 50 years from 1915 to 1964



TABLE 1C

CUMULATIVE FREQUENCIES OF DAILY RAINFALL IN INCHES (35 YEARS FROM 1931 TO 1965)  
AT GLASGOW GREEN

Daily Totals (inches)	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	All Months
3.05						1							1
2.30						1							1
2.20						1	1						2
2.10						1	1	1					3
2.00						1	1	1					3
1.90	1					2	1	1			1		6
1.80	1					2	1	1			1		6
1.70	1					2	1	1	1		1		8
1.60	1					2	1	1	2	1	1		9
1.50	1					2	2	2	2	2	1	1	13
1.40	1					2	3	2	3	4	1	2	18
1.30	2			1		3	4	3	4	5	2	2	26
1.20	2			1		4	5	5	6	6	3	4	36
1.10	6	2		1		4	8	6	7	6	4	4	48
1.00	6	2		3	1	4	8	6	10	13	6	7	66
0.90	10	4	2	3	4	4	9	14	13	16	12	9	100
0.80	22	9	3	4	7	7	16	23	21	22	19	14	167
0.70	35	15	8	9	10	8	21	28	35	30	28	27	254
0.60	44	22	17	13	20	16	33	36	50	51	38	39	379
0.50	61	32	29	23	28	28	49	54	70	67	58	54	553
0.40	98	48	47	41	48	54	77	81	106	107	93	91	891
0.30	167	86	79	88	85	86	134	130	146	159	143	156	1459
0.20	241	153	150	143	164	161	209	203	228	244	227	256	2379
0.10	331	301	281	270	269	231	336	327	369	374	364	402	3975
0.04	513	435	410	428	400	415	469	496	503	512	510	552	5643
0.005	640	566	525	564	512	545	611	621	624	627	649	700	7184
* ≤ 0.004	445	423	560	486	573	505	474	464	426	458	401	385	5600
Total No. of days	1085	989	1085	1050	1085	1050	1085	1085	1050	1085	1050	1085	12784

\*Including rainless days

Example:-

The entry at 0.20 inch or more under January (viz. 241) is the total number of days in January in the 35 years from 1931 to 1965 with falls of 0.20 inch or more.



TABLE 1D

MAXIMUM DAILY RAINFALLS IN INCHES AT GLASGOW GREEN (65 YEARS FROM 1902 TO 1966)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>
Maximum Daily Fall	2.40	1.85	1.25	1.31	1.08	3.05	2.24	2.36	1.77	2.50	1.93	1.58
Year of Occurrence	1903	1903	1906	1941	1922	1935	1938	1920	1948	1907	1944	1953

Example:-

The daily fall of 2.40 inches which occurred in January 1903 is the highest daily fall recorded at Glasgow Green in any January during the period from 1902 to 1966.



TABLE 1E

INTENSITIES OF RAINFALL IN THE GLASGOW AREA

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

	A. <u>Empirical</u> <u>Frequency</u> (number of days in 10 years)	B. <u>Bilham</u> <u>Frequency</u> (number of days in 10 years)	C. <u>Period of Record</u> <u>Used for Calculation</u> <u>of A.</u>
<u>Amount of 0.2 inches falling within:</u>			
6 minutes or less	5.5	8.9	22 years
15 " " "	11.8	22.3	22 years
<u>Amount of 0.4 inches falling within:</u>			
15 minutes or less	2.5	3.7	40 years
30 " " "	3.7	7.3	40 years
60 " " "	6.0	14.6	40 years
<u>Amount of 0.6 inches falling within:</u>			
15 minutes or less	0.4	1.1	28 years
30 " " "	1.1	2.2	28 years
1 hour " "	1.5	4.4	28 years
2 hours " "	2.9	8.8	28 years
<u>Amount of 0.8 inches falling within:</u>			
30 minutes or less	0.7	0.9	28 years
1 hour " "	0.7	1.8	28 years
2 hours " "	1.5	3.6	28 years
<u>Amount of 1.0 inches falling within:</u>			
1 hour or less	0.5	0.9	40 years
2 hours or less	1.0	1.8	40 years
5 " " "	3.0	4.5	30 years

Notes

- The empirical frequencies quoted in column "A" above have been calculated from intensities of rainfall recorded at Renfrew and Abbotsinch Airports during the 40 years period between 1925 and 1965. Owing to changes in the classification of rainfall intensities, certain data are not available for the whole period of 40 years and the actual period of record used for the calculation of the empirical frequency is given in column "C".
- The frequencies quoted in column "B" above have been calculated from the well known Bilham formula:-

$$\log n = 0.952 + \log t - 3.55 \log (r + 0.1)$$

where:-

n = number of days in 10 years

t = time in hours

r = rainfall in inches



TABLE 1F

## COMPUTED AMOUNTS OF RAIN FALLING IN STATED TIMES FROM BILHAM'S FORMULA

	5 mins. or less	10 mins. or less	15 mins. or less	20 mins. or less	30 mins. or less	45 mins. or less	1 hour or less	2 hours or less	3 hours or less	4 hours or less	5 hours or less	6 hours or less	9 hours or less	12 hours or less	18 hours or less	24 hours or less
1 day per annum	.18	.23	.28	.31	.36	.41	.46	.58	.66	.72	.77	.82	.93	1.02	1.16	1.26
1 day per 2 yrs.	.24	.31	.36	.40	.46	.52	.58	.72	.82	.90	.96	1.04	1.15	1.26	1.43	1.56
1 day per 5 yrs.	.33	.43	.49	.55	.62	.71	.78	.98	1.09	1.19	1.28	1.35	1.53	1.66	1.88	2.04
1 day per 10 yrs.	.43	.54	.62	.68	.77	.88	.97	1.20	1.35	1.47	1.57	1.66	1.87	2.04	2.31	2.51
1 day per 20 yrs.	.54	.68	.78	.85	.97	1.10	1.20	1.47	1.66	1.81	1.93	2.04	2.30	2.51	2.82	3.07
1 day per 40 yrs.	.68	.85	.97	1.06	1.19	1.35	1.48	1.82	2.04	2.22	2.37	2.50	2.82	3.07	3.45	3.75
1 day per 160 yrs.	1.06	1.31	1.49	1.61	1.82	2.06	2.24	2.73	3.07	3.34	3.56	3.75	4.22	4.58	5.15	5.60

The above values were computed from the formula  $\log n = 0.0952 + \log t - 3.55 \log (r + 0.1)$

where  $t$  = time in hours

$r$  = rainfall in inches

$n$  = number of occurrences in 10 years



TABLE 1G

TOTAL DURATION IN HOURS AND TENTHS OF RAIN FALLING AT A RATE OF 0.5 MILLIMETRES  
OR MORE PER HOUR BETWEEN THE HOURS OF 07H AND 17H GREENWICH MEAN TIME  
(09H AND 18H BRITISH SUMMER TIME) IN EACH MONTH AND YEAR DURING  
THE 10 YEARS FROM 1956 TO 1965 AT RENFREW AIRPORT

<u>Year</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year Total</u>
<u>Total Duration in Hours and Tenths</u>													
1956	24.6	10.6	13.2	9.2	11.0	22.5	29.6	32.6	27.5	17.0	5.7	38.2	241.7
1957	30.6	22.4	19.4	4.4	23.2	10.0	9.6	21.2	28.0	19.7	12.6	23.4	224.5
1958	34.1	33.6	8.8	9.1	19.8	7.8	25.5	18.3	10.7	15.3	14.2	33.1	230.3
1959	8.8	17.2	19.1	12.9	4.0	13.6	26.2	1.4	10.0	19.2	27.2	61.7	221.3
1960	33.9	22.0	16.3	8.1	18.7	8.4	25.0	13.8	20.6	15.0	27.2	18.5	227.5
1961	27.6	38.9	6.7	24.3	18.8	8.5	13.4	30.7	26.1	29.2	17.3	27.0	268.5
1962	45.8	19.0	11.6	26.3	5.7	5.9	7.5	29.4	21.7	8.0	11.4	22.5	214.8
1963	8.5	4.9	31.4	13.3	27.3	14.7	17.5	24.6	11.3	28.4	36.8	12.0	230.7
1964	14.6	9.5	8.6	15.4	23.2	15.6	18.3	27.2	31.5	16.6	26.1	33.6	240.2
1965	37.6	7.2	11.5	16.2	21.8	14.6	24.5	22.4	22.9	31.3	12.4	41.9	264.3
10 years total	266.1	185.3	146.6	139.2	173.5	121.6	197.1	221.6	210.3	199.7	190.9	311.9	2363.8
10 years mean	26.6	18.5	14.7	13.9	17.3	12.2	19.7	22.2	21.0	20.0	19.1	31.2	236.4



TABLE 1H

NUMBER OF DAYS WITH RAIN FALLING AT A RATE OF 0.5 MILLIMETRES OR MORE PER HOUR  
BETWEEN THE HOURS OF 07H AND 17H GREENWICH MEAN TIME (08H AND 18H  
BRITISH SUMMER TIME) IN EACH MONTH AND YEAR DURING THE 10 YEARS  
PERIOD FROM 1956 TO 1965 AT RENFREW AIRPORT

<u>Year</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year Total</u>
<u>Number of Days</u>													
1956	14	7	5	9	13	9	13	18	13	13	5	16	135
1957	14	9	14	8	13	6	8	15	16	10	10	13	136
1958	12	13	6	8	10	8	8	12	10	11	8	19	125
1959	7	7	13	11	7	12	12	3	4	10	18	22	126
1960	12	13	8	8	6	8	18	12	9	10	15	16	135
1961	15	15	11	12	10	10	9	12	17	16	11	12	150
1962	20	13	3	11	8	7	3	16	10	5	9	12	117
1963	4	4	16	13	14	10	10	12	13	14	17	7	134
1964	7	9	5	16	16	10	11	11	15	10	12	14	136
1965	14	2	10	14	12	15	11	16	15	11	7	18	145
10 years total	119	92	91	110	109	95	103	127	122	110	112	149	1339
10 years mean	11.9	9.2	9.1	11.0	10.9	9.5	10.3	12.7	12.2	11.0	11.2	14.9	133.9

NUMBER OF HOURS WITH RAIN FALLING AT A RATE OF 0.5 MILLIMETRES OR MORE PER HOUR  
BETWEEN THE HOURS OF 07H AND 17H GREENWICH MEAN TIME (08H AND 18H  
BRITISH SUMMER TIME) IN EACH MONTH AND YEAR DURING THE 10 YEARS  
PERIOD FROM 1956 TO 1965 AT RENFREW AIRPORT

<u>Year</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year Total</u>
<u>Number of Hours</u>													
1956	43	19	20	19	26	37	43	59	41	41	19	61	428
1957	57	34	33	13	43	19	19	43	53	37	28	47	426
1958	55	53	14	19	32	16	37	32	25	28	25	64	400
1959	21	24	41	24	11	27	36	3	14	39	53	82	375
1960	47	35	23	21	27	19	48	25	26	24	47	48	390
1961	58	58	17	40	36	18	26	42	45	54	35	48	477
1962	75	42	14	40	17	13	8	51	31	21	24	43	379
1963	10	7	49	25	44	24	36	43	24	43	53	24	382
1964	22	23	16	41	56	23	29	39	52	24	49	57	431
1965	64	9	17	37	32	31	32	43	35	49	26	70	445
10 years total	452	304	244	279	324	227	314	380	346	360	359	544	4133
10 years mean	45.2	30.4	24.4	27.9	32.4	22.7	31.4	38.0	34.6	36.0	35.9	54.4	413.3

NOTE: The numbers of days and numbers of hours quoted in the above tables should not be taken to mean that rain has fallen continuously at a rate of 0.5 millimetres or more per hour throughout the day between 07h and 17h or continuously at the same rate throughout an hour during this period. For example, the above tables include days and hours when rain fell at a rate of 0.5 millimetres or more per hour for only a few minutes.



TABLE 1I

NUMBER OF DAYS WITH RAIN (ANY AMOUNT) BETWEEN THE HOURS OF 07H AND 17H GREENWICH  
MEAN TIME (08H AND 18H BRITISH SUMMER TIME) IN EACH MONTH AND YEAR DURING THE  
10 YEARS PERIOD FROM 1956 TO 1965 AT RENFREW AIRPORT

<u>Year</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year Total</u>
<u>Number of Days</u>													
1956	23	16	15	16	21	15	22	21	18	21	13	22	223
1957	21	13	22	14	17	9	20	21	19	23	19	19	217
1958	16	20	18	13	21	13	15	21	17	22	16	22	214
1959	13	12	20	22	10	21	17	14	6	15	26	27	203
1960	17	20	14	18	11	15	27	23	15	21	22	22	225
1961	19	20	21	21	13	17	16	24	22	20	19	18	230
1962	23	21	14	17	22	16	11	22	15	15	21	22	219
1963	14	12	21	21	21	19	18	20	21	20	23	13	223
1964	19	18	15	23	22	19	20	19	22	19	17	21	234
1965	19	13	21	23	21	19	20	19	24	16	18	23	236
10 years total	184	165	181	188	179	163	186	204	179	192	194	209	2224
10 years average	18.4	16.5	18.1	18.8	17.9	16.3	18.6	20.4	17.9	19.2	19.4	20.9	222.4

NUMBER OF HOURS WITH RAIN (ANY AMOUNT) BETWEEN THE HOURS OF 07H AND 18H GREENWICH  
MEAN TIME (08H AND 18H BRITISH SUMMER TIME) IN EACH MONTH AND YEAR DURING THE  
10 YEARS PERIOD FROM 1956 TO 1965 AT RENFREW AIRPORT

<u>Year</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year Total</u>
<u>Number of Hours</u>													
1956	121	85	74	65	88	87	116	116	97	116	57	147	1169
1957	112	75	128	53	89	45	81	117	115	115	99	131	1160
1958	123	111	86	77	98	73	86	94	67	108	65	117	1105
1959	54	75	116	101	33	109	94	49	37	92	128	149	1037
1960	79	80	77	85	52	74	135	83	69	102	110	103	1049
1961	102	115	101	108	65	72	93	116	107	105	87	109	1180
1962	148	134	56	74	73	69	48	140	76	59	103	121	1101
1963	51	52	112	117	120	86	92	108	92	115	123	57	1125
1964	95	107	77	126	113	79	100	114	115	93	120	134	1273
1965	127	43	107	109	104	103	102	89	111	104	79	153	1231
10 years total	1012	877	934	915	835	797	947	1026	886	1009	971	1221	11,430
10 years average	101.2	87.7	93.4	91.5	83.5	79.7	94.7	102.6	88.6	100.9	97.1	122.1	1143.0

Note: The numbers of days and numbers of hours quoted in the above tables should not be taken to mean that rain has fallen continuously throughout the day between 07h and 17h or continuously throughout an hour during this period. On the contrary, on the great majority of days and in most hours considered, the rainfall was not continuous. Indeed, it should be realised when consulting the above tables that the totals include days and hours when only a few spots of rain fell in a few minutes.



TABLE 2

AVERAGES OF DAILY MAXIMUM, MINIMUM AND MEAN TEMPERATURE IN DEGREES  
FAHRENHEIT FOR TEMPERATURE RECORDING STATIONS IN THE GLASGOW AREA  
(30 YEARS PERIOD 1931 to 1960)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
<u>RENFREW/ABBOTSINCH AIRPORTS - altitude 26 feet</u>													
Maximum	41.8	43.8	48.1	53.4	59.6	64.5	66.3	65.8	61.5	54.7	47.9	43.9	54.3
Minimum	33.4	34.1	36.1	38.8	43.0	48.4	51.9	51.4	47.9	43.3	38.2	36.0	41.9
Mean	37.6	39.0	42.1	46.1	51.3	56.4	59.1	58.6	54.7	49.0	43.1	40.0	48.1
<u>PAISLEY - altitude 106 feet</u>													
Maximum	42.5	44.2	48.5	54.0	60.3	65.2	67.1	66.1	61.5	54.8	48.4	44.8	54.8
Minimum	34.0	34.8	37.4	40.3	44.7	49.8	53.3	53.1	49.7	44.9	39.3	36.6	43.2
Mean	38.3	39.5	42.9	47.1	52.5	57.5	60.2	59.6	55.6	49.9	43.9	40.7	49.0
<u>BARRHEAD - altitude 97 feet</u>													
Maximum	41.9	43.6	47.7	52.5	58.8	63.4	65.4	65.1	61.0	54.3	47.7	44.3	53.8
Minimum	31.6	32.2	34.9	38.0	41.9	47.3	51.3	50.8	46.9	42.1	36.7	34.2	40.7
Mean	36.7	37.9	41.3	45.3	50.3	55.3	58.3	57.9	53.9	48.2	42.2	39.3	47.3
<u>THORNTONHALL near BUSBY - altitude 453 feet</u>													
Maximum	40.9	42.3	46.3	50.9	57.3	62.1	63.8	63.5	59.2	53.2	46.8	43.3	52.5
Minimum	31.4	31.7	34.1	36.9	40.7	46.4	50.0	49.8	46.6	41.7	36.7	33.9	40.0
Mean	36.1	37.0	40.2	43.9	49.0	54.3	56.9	56.7	52.9	47.5	41.7	38.6	46.2
<u>SPRINGBURN PARK - altitude 351 feet</u>													
Maximum	40.8	42.9	47.2	52.9	59.7	64.6	66.4	65.6	61.0	53.6	46.6	43.0	53.7
Minimum	31.6	32.3	34.8	38.3	42.5	47.9	51.3	50.8	47.0	42.2	36.8	34.3	40.8
Mean	36.2	37.6	41.0	45.6	51.1	56.3	58.9	58.2	54.0	47.9	41.7	38.7	47.3
<u>COATBRIDGE - altitude 256 feet</u>													
Maximum	41.5	43.6	47.7	52.6	59.1	63.7	65.7	65.1	61.0	54.4	47.3	43.9	53.8
Minimum	31.7	32.5	35.1	38.6	42.0	47.2	51.0	50.7	47.2	42.4	36.8	34.0	40.8
Mean	36.6	38.1	41.4	45.6	50.5	55.5	58.3	57.9	54.1	48.4	42.1	38.9	47.3



TABLE 2A

AVERAGES OF THE HIGHEST AND LOWEST TEMPERATURES IN EACH MONTH IN DEGREES  
FAHRENHEIT AT TEMPERATURE RECORDING STATIONS IN THE GLASGOW AREA

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
<u>RENFREW/ABBOTSINCH AIRPORTS</u> (altitude 26 feet) 30 years from 1936-1965													
Average of the Highest each month	52	52	59	63	72	77	75	75	70	63	56	53	80*
Average of the Lowest each month	17	21	24	28	32	39	42	40	35	30	25	20	14**
<u>PAISLEY</u> (altitude 106 feet) 30 years from 1936-1965													
Average of the Highest each month	51	52	59	64	73	77	76	76	70	63	56	53	80*
Average of the Lowest each month	22	24	27	31	35	42	45	44	40	34	28	24	19**
<u>BARRHEAD</u> (altitude 97 feet) 10 years from 1956-1965													
Average of the Highest each month	52	52	57	62	70	74	73	73	69	64	56	53	77*
Average of the Lowest each month	17	18	24	27	32	37	40	38	35	31	24	19	13**
<u>THORNTONHALL</u> (altitude 453 feet) 14 years from 1952-1965													
Average of the Highest each month	50	51	56	61	70	73	72	72	68	62	55	51	76*
Average of the Lowest each month	17	18	23	27	32	37	41	40	36	30	24	20	14**
<u>SPRINGBURN PARK</u> (altitude 351 feet) 28 years from 1938-1965													
Average of the Highest each month	50	51	58	63	73	78	76	75	70	63	55	52	80*
Average of the Lowest each month	19	21	25	30	33	40	43	42	37	32	26	23	16**
<u>COATBRIDGE</u> (altitude 256 feet) 14 years from 1952-1965													
Average of the Highest each month	51	52	57	63	72	75	74	75	71	64	55	53	79*
Average of the Lowest each month	18	19	24	29	33	38	42	40	37	31	25	21	14**

\* = 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 GLASGOW AREA

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year*
<u>RENFREW/ABBOTSINCH AIRPORTS</u> (altitude 26 feet) 45 years from 1921 to 1965													
Absolute Highest in each month	56	57	70	71	79	86	84	85	80	75	62	58	86
Absolute Lowest in each month	0	5	7	19	23	29	35	33	25	17	16	12	0
<u>PAISLEY</u> (altitude 106 feet) 52 years from 1914 to 1965													
Absolute Highest in each month	56	57	69	73	80	86	86	84	77	73	62	57	86
Absolute Lowest in each month	8	14	14	20	29	36	39	36	32	24	10	15	8
<u>BARRHEAD</u> (altitude 97 feet) 10 years from 1956 to 1965													
Absolute Highest in each month	56	56	65	65	75	81	81	79	77	73	58	54	81
Absolute Lowest in each month	7	11	8	24	27	32	34	33	30	27	20	15	7
<u>THORNTONHALL</u> (altitude 453 feet) 37 years from 1914 to 1936 and from 1952 to 1965													
Absolute Highest in each month	56	55	66	69	77	81	84	83	76	73	60	55	84
Absolute Lowest in each month	8	11	12	11	23	28	36	34	27	19	6	11	6
<u>SPRINGBURN PARK</u> (altitude 351 feet) 34 years from 1914 to 1919 and from 1938 to 1965													
Absolute Highest in each month	55	56	71	71	80	88	86	86	79	75	60	56	88
Absolute Lowest in each month	6	9	8	19	29	35	37	37	29	26	11	15	6
<u>COATBRIDGE</u> (altitude 256 feet) 14 years from 1952 to 1965													
Absolute Highest in each month	56	58	67	68	77	83	83	86	79	75	58	56	86
Absolute Lowest in each month	8	10	13	26	28	35	36	34	30	26	15	12	8

\* The entries in this column are the absolute highest and lowest temperatures during the whole period.



TABLE 2C

PERCENTAGE AMOUNT OF TIME WITH AIR ("SHADE") TEMPERATURES BELOW CERTAIN  
LIMITS - DEGREES FAHRENHEIT AT RENFREW (GLASGOW) AIRPORT  
(10 YEARS 1946 TO 1955)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
	%	%	%	%	%	%	%	%	%	%	%	%	%
32°F or below	17.9	17.7	9.7	1.6	0.2	0.0	0.0	0.0	0.1	1.9	7.7	13.5	5.7
34°F or below	26.6	27.5	14.7	3.3	0.4	0.0	0.0	0.0	0.2	3.4	10.6	20.5	8.8
36°F or below	37.3	39.0	22.9	5.7	1.2	0.1	0.0	0.0	0.4	5.5	15.4	27.3	12.7
38°F or below	49.8	51.8	32.3	10.3	2.6	0.1	0.1	0.0	0.8	8.1	20.7	37.3	17.6
40°F or below	60.0	62.8	43.1	17.7	5.2	0.2	0.1	0.1	1.2	11.1	27.6	48.3	22.9
42°F or below	69.2	71.8	54.7	26.8	9.3	0.7	0.1	0.3	2.2	15.5	37.0	59.6	28.7
44°F or below	76.6	79.8	65.7	37.9	14.7	1.9	0.3	0.5	4.2	21.7	46.7	68.0	34.6
46°F or below	85.0	86.1	75.7	50.3	22.7	4.3	1.0	1.7	6.9	30.4	58.7	77.6	41.5
48°F or below	91.3	91.6	84.7	64.4	34.3	9.0	2.4	3.5	11.0	42.0	73.1	86.3	49.3
50°F or below	97.3	96.2	91.7	76.1	47.9	18.2	4.7	6.3	19.3	53.8	85.4	92.9	75.3
52°F or below	99.7	99.5	96.1	85.8	59.1	30.0	10.4	11.9	30.8	65.5	93.3	97.7	64.8
54°F or below	99.9	99.9	97.9	91.8	69.1	42.6	21.2	22.5	46.6	76.0	96.5	99.5	71.8
56°F or below	100.0	100.0	98.7	95.4	77.1	55.7	34.1	36.3	62.8	84.1	98.6	99.9	78.4
58°F or below			99.3	97.3	83.4	68.4	48.7	50.3	76.9	90.0	99.8	100.0	84.4
60°F or below			99.5	98.5	88.3	78.2	63.8	65.1	86.9	95.7	100.0		89.6
62°F or below			99.6	99.4	92.5	85.4	75.4	77.7	93.4	98.9			93.5
64°F or below			99.7	99.8	95.1	89.7	83.4	85.7	97.2	99.9			95.9
66°F or below			99.8	99.9	96.8	92.8	88.8	90.9	98.8	100.0			97.3
68°F or below			99.9	99.9	98.2	94.7	92.5	94.1	99.3				98.2
70°F or below			100.0	100.0	98.8	96.7	94.9	96.3	99.7				98.8
72°F or below					99.5	97.9	96.8	97.7	99.9				99.3
74°F or below					99.7	98.8	98.1	98.5	99.9				99.6
76°F or below					99.9	99.3	98.9	99.1	99.9				99.8
78°F or below					100.0	99.7	99.5	99.4	100.0				99.9
80°F or below						99.8	99.7	99.5					99.9
82°F or below						99.9	99.9	99.7					99.9
84°F or below						99.9	100.0	99.9					99.9
86°F or below						100.0		100.0					100.0



TABLE 2D

NUMBER OF DAYS WITH MAXIMUM AIR TEMPERATURES EXCEEDING CERTAIN LIMITS  
AT RENTFLEW AIRPORT (15 YEARS FROM 1951 TO 1965)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year Total
<u>EXCEEDING 60°F</u>													
1951					8	24	29	26	22	9			118
1952				7	16	15	28	26	10				102
1953				3	20	24	28	28	21	3			127
1954				1	16	18	22	27	11	2			97
1955				5	10	21	27	31	20	5			119
1956			1		11	17	27	19	17	3			95
1957			2	3	9	27	30	26	8	1			106
1958				2	6	21	28	30	26	1			114
1959				2	20	23	30	30	22	14			141
1960				5	20	28	31	30	13	2			129
1961					17	29	29	28	25	8			136
1962				8	10	22	26	25	9	4			104
1963				2	6	24	25	26	15				98
1964				2	12	20	27	27	21	4			113
1965			2	2	11	28	21	26	15	2			107
15 year average			<1	3	13	23	27	27	17	4			114
<u>EXCEEDING 65°F</u>													
1951					1	11	16	8	4				40
1952					7	7	18	13					45
1953					7	15	10	17	4				53
1954					6	4	3	6	4				23
1955				1	4	7	27	29	7				75
1956					3	8	12	2	7				32
1957			1		7	15	17	10					50
1958				1	1	9	15	11	15				52
1959				1	14	11	23	22	14	6			91
1960					10	17	16	16	3				62
1961					1	3	8	8	8				28
1962				3	1	9	9	5	1				28
1963					3	12	11	6	4				36
1964					7	9	13	10	6				45
1965					3	9	7	8	1				28
15 year average			<1	<1	5	10	14	11	5	<1			46



TABLE 2D (cont.)

NUMBER OF DAYS WITH MAXIMUM AIR TEMPERATURES EXCEEDING CERTAIN LIMITS  
AT RENFREW AIRPORT (15 YEARS FROM 1951 TO 1965)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year Total
<u>EXCEEDING 70°F</u>													
1951						4		1					5
1952					3		10						13
1953					4	11	1	4	3				23
1954					1	2		1					4
1955					3	3	22	14	1				43
1956					2	5	4		1				12
1957					2	9	2	6					19
1958					1	1	7		5				14
1959					7	4	6	9	8	2			36
1960					2	11		3					16
1961								2	1				3
1962						3	2						5
1963						7	5	2					14
1964					4	1	1	3	2				11
1965					2	2		3					7
15 year average					2	4	4	3	1	<1			15
<u>EXCEEDING 75°F</u>													
1951						1							1
1952					3		1						4
1953						2	1	1					4
1954													0
1955							13	4	1				18
1956					2	2							4
1957						4	1	2					7
1958							3		1				4
1959					2		1	2	2				7
1960						7		1					8
1961								1					1
1962							1						1
1963						2	2	1					5
1964													0
1965								1					1
15 year average					<1	1	2	1	<1				4



TABLE 2D (cont.)

NUMBER OF DAYS WITH MAXIMUM AIR TEMPERATURES EXCEEDING CERTAIN LIMITS  
AT REHIMEN AIRPORT (15 YEARS FROM 1951 TO 1965)

EXCEEDING 80°F

There were 11 days during the 15 year period from 1951 to 1965 on which maximum temperatures exceeded 80°F viz:-

8th July 1955	=	81°F
12th " "	=	82°F
13th " "	=	82°F
26th " "	=	82°F
27th " "	=	82°F
23rd August 1955	=	84°F
24th " "	=	85°F
25th " "	=	82°F
15th June 1957	=	84°F
16th " "	=	83°F
4th July 1958	=	82°F



TABLE 2E

NUMBERS OF DAYS OF AIR FROST (MINIMUM AIR TEMPERATURE 32° F OR LESS)  
 AT RENFREW AIRPORT, SPRINGBURN PARK AND THORNTONHALL  
 (10 YEARS FROM 1956 TO 1965)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year Total
<u>RENFREW AIRPORT - Altitude 26 feet</u>													
1956	17	19	5	8	1	0	0	0	0	3	7	5	65
1957	10	10	0	4	2	0	0	0	1	0	7	10	44
1958	13	12	17	5	2	0	0	0	0	2	5	13	69
1959	25	10	4	3	1	0	0	0	0	0	3	6	52
1960	16	18	2	2	0	0	0	0	0	2	8	15	63
1961	13	4	0	3	0	0	0	0	0	0	10	23	53
1962	8	5	14	4	0	0	0	0	0	1	11	16	59
1963	21	24	7	2	0	0	0	0	0	0	8	14	76
1964	8	7	6	1	0	0	0	0	1	3	6	10	42
1965	16	17	9	3	0	0	0	0	0	2	16	10	73
10 year total	147	126	64	35	6	0	0	0	2	13	81	122	596
<u>SPRINGBURN PARK - Altitude 351 feet</u>													
1956	18	21	9	9	0	0	0	0	0	3	11	6	77
1957	9	13	0	1	1	0	0	0	0	0	5	11	40
1958	16	16	19	6	0	0	0	0	0	0	2	11	70
1959	26	12	0	0	0	0	0	0	0	0	3	3	44
1960	14	20	4	1	0	0	0	0	0	0	5	18	62
1961	16	4	3	3	0	0	0	0	0	0	8	21	55
1962	9	10	19	7	0	0	0	0	0	1	11	18	75
1963	26	27	7	1	0	0	0	0	0	0	8	12	81
1964	8	9	7	1	0	0	0	0	0	0	5	13	43
1965	19	18	18	2	0	0	0	0	0	0	18	13	88
10 year total	161	150	86	31	1	0	0	0	0	4	76	126	635
<u>THORNTONHALL - Altitude 453 feet</u>													
1956	19	21	10	14	2	0	0	0	0	3	9	5	83
1957	14	17	0	6	3	0	0	0	0	0	7	12	59
1958	18	17	24	10	4	0	0	0	0	1	5	17	96
1959	26	13	5	6	2	0	0	0	0	1	8	8	69
1960	23	21	9	2	1	0	0	0	1	1	9	18	85
1961	18	5	1	3	1	0	0	0	0	0	11	22	61
1962	9	11	19	6	2	0	0	0	0	2	12	19	80
1963	29	27	10	4	0	0	0	0	0	1	8	14	93
1964	11	10	14	2	0	0	0	0	0	2	7	12	58
1965	15	18	14	3	2	0	0	0	0	1	16	11	80
10 year total	182	160	106	56	17	0	0	0	1	12	92	138	764



TABLE 2F

AVERAGE NUMBER OF DAYS OF AIR FROST (MINIMUM AIR TEMPERATURE 32°F OR LESS)  
AT TEMPERATURE RECORDING STATIONS IN  
THE GLASGOW AREA (10 YEARS 1956 TO 1965)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
<u>RENFREW AIRPORT</u> - altitude 26 feet													
	15	13	6	3	1	0	0	0	<1	1	8	12	59
<u>PAISLEY</u> - altitude 106 feet													
	13	12	5	1	<1	0	0	0	0	0	5	10	46
<u>BARRHEAD</u> - altitude 97 feet													
	16	14	8	5	1	<1	0	0	<1	1	8	13	66
<u>THORNTONHALL</u> - altitude 453 feet													
	18	16	11	6	2	0	0	0	<1	1	9	14	77
<u>SPRINGBURN PARK</u> - altitude 351 feet													
	16	15	9	3	<1	0	0	0	0	<1	8	13	64
<u>COATBRIDGE</u> - altitude 256 feet													
	16	14	7	4	1	0	0	0	0	1	9	13	65

Longest periods of continuous frost at RENFREW AIRPORT and SPRINGBURN PARK  
during the 20 years from 1946 to 1965

#### RENFREW AIRPORT

Air temperatures at Renfrew Airport were continuously below freezing point during the 4½ day period from 21h on 4th February 1947 to 09h on 9th February 1947.

#### SPRINGBURN PARK

Air temperatures at Springburn Park were continuously below freezing point during the 5 day period from 09h on 22nd January 1952 to 09h on 27th January 1952.



TABLE 2G

AVERAGE AND EXTREME DATES OF FIRST AND LAST AIR FROSTS AT TEMPERATURE RECORDING STATIONS IN THE GLASGOW AREA DURING THE 10 YEARS FROM 1956 TO 1965

		<u>Average Date of First Air Frost</u>	<u>Average Date of Last Air Frost</u>
Renfrew Airport	=	20th October	27th April
Paisley	=	9th November	3rd April
Barrhead	=	23rd October	5th May
Thortonhall	=	22nd October	8th May
Springburn Park	=	4th November	11th April
Coatbridge	=	29th October	24th April

		<u>Earliest Date of First Air Frost</u>	<u>Latest Date of Last Air Frost</u>
Renfrew Airport	=	21st September	19th May
Paisley	=	1st November	26th May
Barrhead	=	21st September	7th June
Thorntonhall	=	21st September	27th May
Springburn Park	=	24th October	6th May
Coatbridge	=	12th October	19th May



TABLE 2H

TOTAL NUMBER OF DAYS IN EACH MONTH WITH AN HOURLY AIR TEMPERATURE READING  
OF LESS THAN 33.6° F BETWEEN 07H AND 17H GREENWICH MEAN TIME

AT RENFREW AIRPORT  
(10 YEARS 1956 TO 1965)

<u>Year</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year Total</u>
1956	14	16	2	5	0	0	0	0	0	1	5	2	45
1957	7	11	0	0	0	0	0	0	1	0	3	6	28
1958	12	11	13	5	0	0	0	0	0	1	2	8	52
1959	21	9	3	0	0	0	0	0	0	0	2	4	39
1960	10	16	2	0	0	0	0	0	0	1	3	13	45
1961	8	3	0	3	0	0	0	0	0	0	7	18	39
1962	6	4	12	3	0	0	0	0	0	0	8	12	45
1963	21	22	6	1	0	0	0	0	0	0	7	10	67
1964	7	6	4	1	0	0	0	0	1	1	5	8	33
1965	13	12	9	1	0	0	0	0	0	1	11	8	55
10-year mean	11.9	11.0	5.1	1.9	0.0	0.0	0.0	0.0	0.2	0.5	5.3	8.9	44.8

TOTAL NUMBER OF HOURS BETWEEN 07H AND 17H GREENWICH MEAN TIME IN EACH MONTH  
WITH AIR TEMPERATURES LESS THAN 33.6° F AT RENFREW AIRPORT  
(10 YEARS 1956 TO 1965)

<u>Year</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year Total</u>
1956	76	84	6	6	0	0	0	0	0	4	17	11	204
1957	31	31	0	0	0	0	0	0	1	0	9	47	119
1958	93	57	34	7	0	0	0	0	0	1	8	51	251
1959	140	59	4	0	0	0	0	0	0	0	5	21	229
1960	44	77	6	0	0	0	0	0	0	1	14	84	226
1961	40	6	0	5	0	0	0	0	0	0	31	138	220
1962	44	17	38	3	0	0	0	0	0	0	43	74	219
1963	120	118	19	1	0	0	0	0	0	0	36	51	345
1964	39	23	10	1	0	0	0	0	1	1	32	43	150
1965	68	52	40	1	0	0	0	0	0	2	38	41	242
10-year mean	69.5	52.4	15.7	2.4	0.0	0.0	0.0	0.0	0.2	0.9	23.3	56.1	220.5



TABLE 2I

TOTAL NUMBER OF DAYS IN EACH MONTH WITH AN HOURLY AIR TEMPERATURE READING  
OF LESS THAN 35.6° F BETWEEN 07H AND 17H GREENWICH MEAN TIME

AT RENFREW AIRPORT  
(10 YEARS 1956 TO 1965)

<u>Year</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year Total</u>
1956	17	22	9	8	0	0	0	0	0	3	12	3	74
1957	9	15	0	1	0	0	0	0	1	0	4	9	39
1958	14	13	19	6	0	0	0	0	0	2	5	10	69
1959	25	11	4	1	0	0	0	0	0	0	3	5	49
1960	18	19	2	2	0	0	0	0	1	2	4	17	65
1961	9	3	2	4	0	0	0	0	0	2	10	21	51
1962	9	8	18	5	0	0	0	0	0	1	11	18	70
1963	26	28	9	1	0	0	0	0	0	0	7	12	83
1964	7	10	12	1	0	0	0	0	1	3	7	13	54
1965	17	17	15	2	0	0	0	0	0	4	13	10	78
10-year mean	15.1	14.6	9.0	3.1	0.0	0.0	0.0	0.0	0.3	1.7	7.6	11.8	63.2

TOTAL NUMBER OF HOURS BETWEEN 07H AND 17H GREENWICH MEAN TIME IN EACH MONTH  
WITH AIR TEMPERATURES LESS THAN 35.6° F AT RENFREW AIRPORT  
(10 YEARS 1956 TO 1965)

<u>Year</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year Total</u>
1956	103	125	18	10	0	0	0	0	0	7	34	23	320
1957	39	58	0	1	0	0	0	0	1	0	13	63	175
1958	106	85	64	13	0	0	0	0	0	4	17	74	363
1959	180	78	8	1	0	0	0	0	0	0	7	24	298
1960	86	104	9	2	0	0	0	0	1	2	21	106	331
1961	58	13	3	8	0	0	0	0	0	2	40	182	306
1962	53	37	56	8	0	0	0	0	0	2	67	98	321
1963	197	167	30	2	0	0	0	0	0	0	45	65	506
1964	53	49	30	1	0	0	0	0	1	3	38	69	244
1965	103	72	70	3	0	0	0	0	0	6	64	64	382
10-year mean	97.8	78.8	28.8	4.9	0.0	0.0	0.0	0.0	0.3	2.6	34.6	76.8	324.6



TABLE 2J

AVERAGES AND EXTREMES OF EARTH TEMPERATURE READINGS IN DEGREES FAHRENHEIT MADE  
ONCE-DAILY AT 09H GMT FROM THERMOMETERS EXPOSED AT DEPTHS OF ONE FOOT  
AND FOUR FEET UNDER A SHORT GRASS SURFACE AT THE COATS OBSERVATORY,  
PAISLEY - ALTITUDE 106 FEET

(Soil: Dark Garden Loam above Boulder Clay)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year</u>
	<u>AT ONE FOOT</u>												
Monthly Mean of Daily Readings	38.3	38.5	41.4	46.6	52.5	58.3	61.2	60.4	56.1	50.4	44.1	40.6	48.9
Highest Monthly Mean of Daily Readings	42.1	41.7	46.2	49.1	55.0	61.9	64.6	63.1	58.6	53.2	46.9	44.2	64.6
Lowest Monthly Mean of Daily Readings	34.3	34.7	33.8	43.3	49.3	55.2	59.0	56.8	53.4	47.3	41.4	35.8	33.8
Absolute Highest Daily Reading	46.0	46.0	48.9	53.1	60.1	65.1	68.4	68.2	62.1	57.2	52.0	48.0	68.4
Absolute Lowest Daily Reading	34.0	33.1	32.0	38.1	43.0	49.5	55.0	55.0	46.9	37.9	35.2	34.3	32.0

AT FOUR FEET

Monthly Mean of Daily Readings	44.1	43.0	43.3	45.3	48.7	52.5	55.6	56.7	55.9	53.2	49.5	46.2	49.5
Highest Monthly Mean of Daily Readings	45.9	44.6	45.1	47.3	50.2	54.0	57.7	58.6	57.4	55.2	51.1	48.6	58.6
Lowest Monthly Mean of Daily Readings	42.3	41.0	39.9	42.6	46.2	50.5	54.1	55.0	53.4	51.4	47.7	43.7	39.9
Absolute Highest Daily Reading	46.9	45.1	46.2	48.7	52.2	55.9	58.5	59.2	58.5	56.1	52.9	49.8	59.2
Absolute Lowest Daily Reading	40.3	39.7	39.4	40.3	44.1	48.0	52.0	54.0	52.2	47.8	44.1	41.0	39.4

Notes

1. The "Monthly Means of Daily Readings" are monthly means of readings taken on each day during the 30 years from 1931 to 1960.
2. The "Highest and Lowest Monthly Means of Daily Readings" relate to the single January, February, March, April etc. during the 30 years from 1931 to 1960 which has the highest or lowest monthly mean of daily readings.
3. The "Absolute Highest and Lowest Daily Readings" are the absolute highest and lowest daily readings recorded during the 40 years from 1921 to 1960.



TABLE 2K

TABLE FOR CONVERTING DEGREES FAHRENHEIT TO DEGREES CENTIGRADE

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



TABLE 3

AVERAGES OF SUNSHINE DURATION IN HOURS - MONTHLY TOTALS AND DAILY MEANS  
OVER 30 YEAR PERIOD FROM 1931 TO 1960 AT PLACES IN THE GLASGOW AREA

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
<u>RENFREW/ABBOTSINCH AIRPORTS</u> - altitude 20 feet plus 10 feet													
Monthly Total	35	60	91	142	185	183	159	137	111	72	42	26	1,243
Daily Mean	1.12	2.11	2.94	4.72	5.97	6.09	5.14	4.43	3.69	2.34	1.41	0.83	3.40
<u>PAISLEY</u> - altitude 106 feet plus 45 feet													
Monthly Total	31	57	87	139	181	178	157	137	112	72	40	23	1,214
Daily Mean	1.01	2.00	2.80	4.63	5.82	5.94	5.07	4.43	3.74	2.32	1.33	0.73	3.32
<u>SPRINGBURN PARK</u> - altitude 351 feet plus 79 feet													
Monthly Total	31	58	82	128	177	175	151	125	97	68	36	20	1,148
Daily Mean	0.99	2.07	2.63	4.25	5.72	5.84	4.88	4.05	3.25	2.19	1.19	0.63	3.14

Note: The altitude in feet above mean sea level of the sites to which the above averages refer is given as the sum of two figures, the first representing the height of the ground above mean sea level and the second the height of the recording instrument above the ground.

TABLE 4

NUMBER OF DAYS WITH GALES AT RENFREW AIRPORT  
(10 YEARS 1956 TO 1965)

<u>Year</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year Total</u>
<u>Number of Days with Gales - Average wind speed near the ground 39 mph or more</u>													
1956	0	0	0	0	0	0	0	0	0	0	0	3	3
1957	6	2	0	0	0	0	0	0	0	0	0	2	10
1958	2	0	0	0	0	0	0	0	0	0	0	0	2
1959	1	2	0	1	0	0	0	0	0	0	1	2	7
1960	0	0	0	1	0	1	0	0	0	0	0	0	2
1961	2	1	0	0	0	0	0	0	1	1	0	0	5
1962	3	3	0	0	1	2	0	0	0	0	0	3	12
1963	1	0	0	0	0	0	0	0	0	0	0	0	1
1964	0	0	0	0	0	0	0	0	1	0	0	0	1
1965	1	0	0	0	0	0	0	0	0	0	1	0	2
10-year mean	1.6	0.8	0.0	0.2	0.1	0.3	0.0	0.0	0.2	0.1	0.2	1.0	4.5



TABLE 4A

NUMBER OF DAYS AND HOURS WITH GUSTS TO 39 MPH OR MORE AT RENFREW AIRPORT  
(10 YEARS 1956 TO 1965)

		<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year</u>
1956	Days	6	4	10	3	12	4	6	2	4	13	7	18	89
	Hours	65	26	68	16	57	26	45	20	19	50	62	145	599
1957	Days	18	6	8	2	5	1	1	6	9	9	5	14	84
	Hours	155	42	42	12	11	3	12	36	34	52	21	106	526
1958	Days	8	8	6	10	7	2	3	2	3	9	1	9	68
	Hours	50	34	48	30	51	10	9	12	18	36	1	50	349
1959	Days	3	9	2	9	4	5	3	5	0	6	9	13	68
	Hours	16	63	2	48	15	47	8	43	0	32	50	90	414
1960	Days	4	8	5	7	4	2	0	1	2	2	4	9	48
	Hours	16	34	30	65	35	10	0	1	5	4	30	41	271
1961	Days	6	13	10	0	3	6	4	5	4	10	6	3	70
	Hours	34	49	49	0	22	24	23	17	21	71	21	20	351
1962	Days	18	14	1	7	4	9	1	10	3	6	1	11	85
	Hours	129	106	4	35	35	54	1	50	27	33	1	81	556
1963	Days	2	2	6	5	7	0	0	2	7	11	6	7	55
	Hours	22	24	36	40	30	0	0	6	41	38	46	21	304
1964	Days	9	4	5	4	11	2	6	1	6	3	9	9	69
	Hours	47	33	21	7	43	5	33	4	18	8	38	33	290
1965	Days	9	3	4	6	2	6	0	3	2	5	7	4	51
	Hours	39	23	11	11	8	27	0	12	4	42	47	5	229
10-year means	Days	8.3	7.1	5.7	5.3	5.9	3.7	2.4	3.7	4.0	7.4	5.5	9.7	68.7
	Hours	57.3	43.4	31.1	26.4	30.7	20.6	13.1	20.1	18.7	36.6	31.7	59.2	388.9



TABLE 4B

NUMBER OF DAYS AND HOURS WITH GUSTS TO 55 MPH OR MORE AT RENFREW AIRPORT  
(10 YEARS 1956 TO 1965)

		<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year</u>
1956	Days	2	1	2	0	0	1	0	1	0	1	1	5	14
	Hours	8	1	4	0	0	1	0	2	0	1	3	24	44
1957	Days	8	3	0	0	0	0	0	0	0	1	1	2	15
	Hours	22	16	0	0	0	0	0	0	0	1	3	4	46
1958	Days	4	0	1	0	1	0	0	0	0	1	0	3	10
	Hours	9	0	1	0	1	0	0	0	0	1	0	4	16
1959	Days	1	2	0	1	0	0	0	1	0	1	4	7	17
	Hours	4	3	0	2	0	0	0	1	0	1	7	13	31
1960	Days	1	0	0	2	0	1	0	0	0	0	1	1	6
	Hours	1	0	0	15	0	1	0	0	0	0	5	1	23
1961	Days	2	1	2	0	1	1	0	0	1	3	0	1	12
	Hours	14	3	2	0	1	1	0	0	9	10	0	2	42
1962	Days	7	5	0	1	1	2	0	1	2	0	0	3	22
	Hours	21	42	0	1	10	6	0	3	6	0	0	13	102
1963	Days	1	1	2	0	0	0	0	0	1	0	1	1	7
	Hours	9	1	2	0	0	0	0	0	5	0	1	1	19
1964	Days	2	2	0	0	3	0	1	0	1	0	0	1	10
	Hours	2	3	0	0	4	0	1	0	1	0	0	1	12
1965	Days	4	1	0	0	1	0	0	1	0	0	1	0	8
	Hours	4	1	0	0	1	0	0	1	0	0	2	0	9
10-year means	Days	3.2	1.6	0.7	0.4	0.7	0.5	0.1	0.4	0.5	0.7	0.9	2.4	12.1
	Hours	9.4	7.0	0.9	1.8	1.7	0.9	0.1	0.7	2.1	1.4	2.1	6.3	34.4



TABLE 4C

ANNUAL PERCENTAGE FREQUENCY OF WIND DIRECTION AND VELOCITY AT  
RENFREW AIRPORT (10 YEARS 1956-1965)

Mean Wind Speed (mph)	Wind Directions in Degrees (true)												All Directions
	350- 10	20- 40	50- 70	80- 100	110- 130	140- 160	170- 190	200- 220	230- 250	260- 280	290- 310	320- 340	
0	-	-	-	-	-	-	-	-	-	-	-	-	18.1%
1- 3	0.2	0.4	0.7	0.4	0.2	0.2	0.3	0.3	0.7	1.0	0.4	0.2	5.0%
4- 7	0.4	1.0	3.0	2.0	0.9	0.8	1.2	1.2	2.7	3.6	1.4	0.5	18.7%
8-12	0.5	0.8	4.3	3.0	1.0	0.9	1.6	2.4	4.4	4.0	2.1	0.5	25.5%
13-18	0.2	0.4	3.6	2.8	0.8	0.6	1.5	3.7	4.6	3.7	2.0	0.2	24.1%
19-24	0+	0+	0.5	0.6	0.1	0.1	0.3	1.5	1.4	0.9	0.4	0+	5.8%
25-31		0+	0.1	0.2	0+	0+	0.2	0.7	0.5	0.3	0.1	0+	2.1%
32-38			0+	0.1	0+	0+	0.1	0.2	0.1	0.1	0+	0+	0.6%
39-46				0+	0+	0+	0+	0.1	0+	0+	0+	0+	0.1%
47-54							0+	0+	0+				0.4%
55-63								0+					0.4%
Total	1.3	2.6	12.2	9.1	3.0	2.6	5.2	10.1	14.4	13.6	6.4	1.4	100.0%

Notes

- The above frequencies have been computed from values of wind directions and speed averaged over each hour during the 10 years from 1956 to 1965.
- Wind directions are measured in degrees from True North and relate to the direction from which the wind is blowing. For example:
 

Direction	360 degrees	=	wind blowing from North
"	090	"	" " " East
"	180	"	" " " South
"	270	"	" " " West
- Adding the columns of the above table vertically gives the percentage amount of time in the year with winds from the stated directions.
- Adding the columns of the above table horizontally gives the percentage amount of time in the year with winds in the stated speed ranges.



TABLE 4D

MONTHLY PERCENTAGE FREQUENCIES OF WIND DIRECTION AND VELOCITY AT  
RENFREW AIRPORT (10 YEARS 1956-1965)

	Wind Directions in Degrees (true)												
Mean Wind Speed	350- 10	20- 40	50- 70	80- 100	110- 130	140- 160	170- 190	200- 220	230- 250	260- 280	290- 310	320- 340	All Directions
<u>JANUARY</u>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	30.3%
4-12 mph	1.0	1.6	5.0	4.0	1.7	1.4	1.8	2.7	6.4	8.6	2.8	0.9	37.9%
13-24 mph	0.2	0.5	3.4	2.3	0.9	1.1	1.6	6.1	5.0	3.9	1.5	0.1	26.6%
25-38 mph				0.1	0.2	0.1	0.3	2.1	0.9	0.6	0.3	0.1	4.7%
39 mph or more				0+	0+	0+	0+	0.3	0.1	0.1		0+	0.5%
Total	1.2	2.1	8.4	6.4	2.8	2.6	3.7	11.2	12.4	13.2	4.6	1.1	100.0%
<u>FEBRUARY</u>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	25.2%
4-12 mph	1.5	2.4	6.9	4.3	2.2	2.0	2.6	2.6	4.9	7.2	2.9	1.3	40.8%
13-24 mph	0.4	0.8	5.0	4.0	0.7	0.8	2.6	5.2	4.8	3.6	1.7	0.1	29.7%
25-38 mph			0.1	0.3	0.1	0+	0.3	1.2	0.8	0.6	0.5	0+	3.9%
39 mph or more							0+	0.2	0+	0.1	0.1		0.4%
Total	1.9	3.2	12.0	8.6	3.0	2.8	5.5	9.2	10.5	11.5	5.2	1.4	100.0%
<u>MARCH</u>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	16.6%
4-12 mph	0.8	2.3	9.1	7.9	3.4	2.3	2.5	2.9	3.5	3.3	1.9	0.8	40.7%
13-24 mph	0.2	0.3	7.5	9.4	3.7	1.4	2.5	4.4	5.0	3.2	1.6	0.2	39.4%
25-38 mph			0.2	1.1	0.1		0.1	0.6	0.6	0.5	0.1		3.3%
39 mph													0.0%
Total	1.0	2.6	16.8	18.4	7.2	3.7	5.1	7.9	9.1	7.0	3.6	1.0	100.0%
<u>APRIL</u>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	20.9%
4-12 mph	1.1	1.7	8.1	5.4	1.8	1.4	2.2	3.3	7.1	6.9	3.9	1.3	44.2%
13-24 mph	0.5	0.4	4.0	4.2	0.9	1.0	1.8	4.7	6.2	5.0	3.4	0.3	32.4%
25-38 mph			0.1	0.2	0+	0.1	0.2	0.7	0.6	0.4	0.2		2.5%
39 mph or more								0+					0+
Total	1.6	2.1	12.2	9.8	2.7	2.5	4.2	8.7	13.9	12.3	7.5	1.6	100.0%
<u>MAY</u>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	17.8%
4-12 mph	0.9	1.6	9.5	6.0	1.5	1.2	2.4	3.2	6.3	6.7	4.6	1.1	45.0%
13-24 mph	0.1	0.3	5.7	4.1	0.6	0.4	2.2	4.6	6.2	6.0	3.8	0.3	34.3%
25-38 mph			0.6	0.3			0.3	0.6	0.6	0.4	0.1		2.9%
39 mph or more										0+			0+
Total	1.0	1.9	15.8	10.4	2.1	1.6	4.9	8.4	13.1	13.1	8.5	1.4	100.0%
<u>JUNE</u>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	17.1%
4-12 mph	0.8	2.4	7.1	4.7	1.6	1.2	2.2	4.0	8.2	9.1	4.6	0.9	46.8%
13-24 mph	0.2	0.4	4.3	2.6	0.8	0.3	1.8	5.2	7.9	6.7	4.0	0.2	34.4%
25-38 mph			0.1	0+			0.1	0.6	0.6	0.2	0+		1.6%
39 mph or more							0+	0+	0.1				0.1%
Total	1.0	2.8	11.5	7.3	2.4	1.5	4.1	9.8	16.8	16.0	8.6	1.1	100.0%



TABLE 4D (Contd.)

	Wind Directions in Degrees (true)												
Mean Wind Speed	350- 10	20- 40	50- 70	80- 100	110- 130	140- 160	170- 190	200- 220	230- 250	260- 280	290- 310	320- 340	All Directions
<u>JULY</u>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	18.8%
4-12 mph	0.6	1.5	7.4	6.0	1.5	0.9	1.8	3.7	9.4	11.5	6.0	0.9	51.2%
13-24 mph	0.1	0.2	3.4	3.5	0.2	0.3	1.1	4.5	6.3	6.2	2.9	0.2	28.9%
25-38 mph			0.1	0+			0.1	0.2	0.5	0.1	0.1		1.1%
39 mph or more													0.0%
Total	0.7	1.7	10.9	9.5	1.7	1.2	3.0	8.4	16.2	17.8	9.0	1.1	100.0%
<u>AUGUST</u>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	21.8%
4-12 mph	0.6	1.8	7.7	4.5	1.4	1.3	2.6	3.9	9.0	10.4	5.1	0.8	49.1%
13-24 mph	0.1	0.4	2.5	1.3	0.4	0.3	1.2	4.2	5.8	7.5	3.5	0.3	27.5%
25-38 mph				0+		0+	0.1	0.5	0.5	0.4	0.1	0+	1.6%
39 mph or more													0.0%
Total	0.7	2.2	10.2	5.8	1.8	1.6	3.9	8.6	15.3	18.3	8.7	1.1	100.0%
<u>SEPTEMBER</u>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	26.1%
4-12 mph	0.7	1.6	6.9	4.8	1.6	2.0	4.3	4.3	7.6	7.8	3.7	0.8	46.1%
13-24 mph	0+	0.5	3.4	2.5	0.6	0.6	2.3	5.5	4.7	3.7	2.2	0.1	26.1%
25-38 mph			0+	0.1	0.1	0+	0.2	0.7	0.2	0.2	0+		1.5%
39 mph or more							0.1	0.1					0.2%
Total	0.7	2.1	10.3	7.4	2.3	2.6	6.9	10.6	12.5	11.7	5.9	0.9	100.0%
<u>OCTOBER</u>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	21.9%
4-12 mph	0.8	1.4	7.6	4.3	2.0	2.2	3.2	5.5	8.9	7.6	2.1	0.9	46.5%
13-24 mph	0.3	0.2	3.8	2.0	0.2	0.3	1.4	7.1	7.4	4.2	1.5	0.5	28.9%
25-38 mph		0+	0.1	0.1	0+	0+	0.1	1.6	0.6	0.1	0.1	0+	2.7%
39 mph or more							0+						0+
Total	1.1	1.6	11.5	6.4	2.2	2.5	4.7	14.2	16.9	11.9	3.7	1.4	100.0%
<u>NOVEMBER</u>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	29.9%
4-12 mph	1.2	2.0	7.4	4.6	2.1	2.4	3.2	2.6	7.4	7.0	2.7	1.0	43.6%
13-24 mph	0.4	0.7	3.5	2.5	1.1	1.0	2.1	3.1	5.1	2.8	1.2	0.2	23.7%
25-38 mph		0+	0.4	0.3	0+	0.1	0.3	0.7	0.6	0.3	0.1	0+	2.8%
39 mph or more							0+		0+	0+			0+
Total	1.6	2.7	11.3	7.4	3.2	3.5	5.6	6.4	13.1	10.1	4.0	1.2	100.0%
<u>DECEMBER</u>													
Under 4 mph	-	-	-	-	-	-	-	-	-	-	-	-	29.3%
4-12 mph	0.5	1.9	5.6	3.5	1.9	2.3	3.6	3.4	5.4	5.4	2.2	0.7	36.4%
13-24 mph	0.1	0.5	3.0	2.7	1.3	0.9	2.1	7.0	6.8	3.4	1.2	0.1	29.1%
25-38 mph			0.2	0.6	0.1		0.4	2.0	0.8	0.6	0.2	0+	4.9%
39 mph or more				0+			0.1	0.1	0+		0.1		0.3%
Total	0.6	2.4	8.8	6.8	3.3	3.2	6.2	12.5	13.0	9.4	3.7	0.8	100.0%



TABLE 4E

NUMBER OF DAYS ON WHICH THE WIND SPEED AVERAGED OVER AT LEAST ONE HOUR  
BETWEEN 07H AND 17H GMT REACHED 25 MPH OR MORE  
AT RENFREW AIRPORT  
(10 YEARS 1956 TO 1965)

<u>Year</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year Total</u>
1956	4	1	5	1	6	3	6	1	2	2	3	9	43
1957	9	2	2	1	2	0	1	2	2	3	1	6	31
1958	5	4	4	4	4	1	1	1	2	2	1	4	33
1959	1	7	0	4	2	5	1	3	0	4	4	5	36
1960	1	3	3	4	2	1	0	0	1	1	3	1	20
1961	4	3	5	0	1	1	2	1	2	5	1	2	27
1962	11	8	0	5	2	2	0	7	2	4	0	5	46
1963	1	2	3	5	3	1	0	2	2	4	2	1	26
1964	2	1	3	2	6	0	2	1	2	0	3	2	24
1965	4	2	3	0	1	3	0	1	1	2	5	1	23
10-year mean	4.2	3.3	2.8	2.6	2.9	1.7	1.3	1.9	1.6	2.7	2.3	3.6	30.9

NUMBER OF HOURS BETWEEN 07H AND 17H GMT WITH HOURLY MEAN WIND SPEEDS  
OF 25 MPH OR MORE AT RENFREW AIRPORT  
(10 YEARS 1956 TO 1965)

<u>Year</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year Total</u>
1956	23	1	30	5	13	8	8	7	8	3	11	31	148
1957	44	7	8	7	3	0	6	5	10	13	4	26	133
1958	14	11	22	11	26	1	5	3	3	6	1	11	114
1959	5	36	0	10	11	19	1	16	0	10	17	37	162
1960	2	11	16	25	18	6	0	0	4	2	15	7	106
1961	18	8	18	0	7	4	7	3	7	23	1	4	100
1962	51	39	0	15	17	8	0	18	13	9	0	22	192
1963	10	11	17	21	6	1	0	5	10	9	11	6	107
1964	13	1	17	5	27	0	12	2	5	0	14	4	100
1965	13	6	9	0	3	8	0	6	3	11	19	1	79
10-year mean	19.3	13.1	13.7	9.9	13.1	5.5	3.9	6.5	6.3	8.6	9.3	14.9	124.1
10-year mean expressed as percentage of average work- ing day	%	%	%	%	%	%	%	%	%	%	%	%	%
	6.2	4.6	4.4	3.3	4.2	1.8	1.3	2.1	2.1	2.8	3.1	4.8	3.4



TABLE 5

PERCENTAGE FREQUENCY OF OCCURRENCE OF VISIBILITIES LESS THAN  
1,100 YARDS ACCORDING TO MONTH AND HOUR  
AT RENFREW AIRPORT

Time GMT	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
	%	%	%	%	%	%	%	%	%	%	%	%	%
00h midnight	16.8	5.7	3.2	0.7	0.0	0.0	0.0	0.6	0.7	7.1	15.3	16.1	5.5
01h	19.3	5.7	4.5	0.7	0.0	0.7	0.0	0.6	1.3	7.7	13.3	14.8	5.7
02h	18.1	6.4	5.2	0.7	0.0	0.0	0.0	0.6	2.0	5.8	12.7	11.0	5.2
03h	16.8	5.0	5.2	0.0	0.0	0.0	0.0	1.9	2.7	5.2	12.7	9.7	4.9
04h	16.8	3.5	5.8	0.0	0.0	0.0	0.0	0.6	2.7	5.8	12.0	7.1	4.5
05h	14.2	2.8	4.5	2.0	0.0	0.0	0.6	1.3	4.0	7.1	11.3	8.4	4.7
06h	16.8	4.3	3.9	0.7	0.0	1.3	0.0	3.2	4.0	11.0	12.7	12.9	5.9
07h	12.9	4.3	5.8	0.0	0.0	0.0	0.0	1.9	4.7	11.0	10.0	7.1	4.8
08h	12.3	9.9	5.2	0.0	0.0	0.0	0.0	1.3	1.3	11.6	12.0	7.7	5.1
09h	17.4	9.9	7.7	0.7	0.0	0.0	0.0	0.0	0.0	12.9	14.7	12.9	6.3
10h	20.0	11.3	4.5	0.7	0.0	0.0	0.0	0.0	0.0	10.3	15.3	15.5	6.5
11h	22.6	9.9	3.9	1.3	0.0	0.7	0.0	0.0	0.0	7.1	16.0	20.6	6.8
12h noon	19.3	8.5	1.9	0.0	0.0	0.0	0.0	0.0	1.3	2.6	16.7	18.1	5.7
13h	16.8	9.2	0.6	0.7	0.0	0.0	0.0	0.6	0.7	2.6	12.7	16.8	5.0
14h	14.2	7.1	1.3	0.7	0.0	0.0	0.0	0.0	0.0	1.9	10.7	15.5	4.3
15h	15.5	2.8	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.6	10.0	16.8	3.9
16h	14.2	2.8	1.3	0.0	0.0	0.0	0.0	0.0	0.0	1.9	10.0	18.1	4.1
17h	12.9	4.3	0.6	0.0	0.6	0.0	0.0	0.0	0.0	5.2	12.7	13.5	4.2
18h	12.9	4.3	2.6	0.0	0.0	0.0	0.0	0.0	0.0	5.2	10.0	15.5	4.2
19h	16.1	7.1	1.9	1.3	0.0	0.0	0.0	0.6	0.0	3.2	12.7	14.8	4.8
20h	18.1	5.7	3.2	1.3	0.0	0.0	0.0	0.0	0.0	4.5	14.0	14.8	5.1
21h	18.7	6.4	2.6	0.7	0.0	0.0	0.0	0.0	0.0	5.2	12.0	16.1	5.1
22h	17.4	9.2	1.9	0.7	0.0	0.0	0.0	0.0	0.0	5.8	14.7	17.4	5.6
23h	16.1	6.4	3.2	0.7	0.0	0.0	0.0	0.0	0.7	6.5	16.0	16.8	5.5

Percentage Amount of Total Time in each month with  
 Visibilities less than 1,100 yards at  
 RENFREW AIRPORT

%	%	%	%	%	%	%	%	%	%	%	%	%	%
16.5	6.3	3.4	0.5	<0.1	0.1	<0.1	0.6	1.1	6.1	12.9	14.1	5.1	

Note: The above frequencies have been computed from hourly observations of visibility made during the 5 year period from 1961 to 1965.



TABLE 5A

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

Visibility Wind Direction (degrees)	<u>Winter Half-Year</u> Percentage Probability			<u>Summer Half-Year</u> Percentage Probability		
	Less than 440 yards	Less than 1100 yards	Less than 2200 yards	Less than 440 yards	Less than 1100 yards	Less than 2200 yards
350-010	0.3	2.0	5.5	0.0	0.0	0.4
020-040	1.1	6.0	16.9	0.0	0.2	2.5
050-070	0.6	4.0	20.9	0.0	0.3	4.9
080-100	0.4	2.6	15.8	< 0.1	0.2	3.0
110-130	0.4	3.0	10.2	0.0	0.2	3.0
140-160	0.5	1.9	6.2	0.0	0.2	0.5
170-190	0.5	1.1	2.5	0.0	0.0	< 0.1
200-220	0.1	0.2	0.9	0.0	0.0	0.1
230-250	0.1	0.5	1.9	0.0	< 0.1	0.2
260-280	0.3	1.3	4.3	0.0	< 0.1	0.1
290-310	0.2	0.4	2.6	0.0	< 0.1	0.2
320-340	0.0	1.2	5.5	0.0	0.3	0.3
Calms	0.1	17.4	16.3	0.8	2.0	7.1

\* Results derived from hourly observations during the 5 years from 1961 to 1965.



TABLE 5B

NUMBER OF DAYS WITH "FOG", "THICK FOG" AND "DENSE FOG" AT ANY TIME OF DAY\* AT  
RENFREW AIRPORT DURING 10 YEAR PERIOD FROM 1956 TO 1965

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year</u>
<u>Number of Days with "Fog" - Visibility less than 1,100 yards</u>													
1956	16	12	3	3	0	1	0	6	7	9	10	6	73
1957	11	10	6	2	1	0	2	1	5	5	10	12	65
1958	10	7	5	1	1	4	1	3	6	4	22	16	80
1959	18	12	10	3	1	3	0	0	6	3	9	12	77
1960	15	15	1	1	2	1	1	1	4	10	15	19	85
1961	13	7	2	3	0	0	0	2	7	9	14	21	78
1962	10	5	9	4	0	0	0	2	3	3	12	13	61
1963	14	13	9	2	0	2	0	3	1	4	11	11	71
1964	13	3	4	2	1	1	1	1	4	14	10	9	63
1965	12	11	6	1	0	0	0	2	1	11	5	9	58
10-year mean	13.2	9.5	5.5	2.2	0.6	1.3	0.5	2.1	4.4	7.2	11.8	12.8	71.1

<u>Number of Days with "Thick Fog" - Visibility less than 220 yards</u>													
1956	3	1	1	0	0	0	0	2	0	2	3	0	12
1957	2	1	1	0	0	0	1	0	0	1	1	6	13
1958	3	0	0	0	0	0	0	0	1	1	5	7	17
1959	12	5	0	0	0	1	0	0	1	1	2	5	27
1960	2	5	0	0	1	0	0	0	0	0	5	7	20
1961	6	0	2	0	0	0	0	1	1	2	7	11	30
1962	6	1	0	0	0	0	0	0	2	1	3	4	17
1963	4	1	3	0	0	0	0	1	0	3	7	3	22
1964	3	0	3	1	0	0	0	1	3	2	6	1	20
1965	3	4	0	0	0	0	0	1	0	6	2	1	17
10-year mean	4.4	1.8	1.0	0.1	0.1	0.1	0.1	0.6	0.8	1.9	4.1	4.5	19.5

<u>Number of Days with "Dense Fog" - Visibility less than 55 yards</u>													
1956	1	0	0	0	0	0	0	0	0	0	1	0	2
1957	0	0	0	0	0	0	0	0	0	0	0	2	2
1958	1	0	0	0	0	0	0	0	0	1	2	2	6
1959	5	4	0	0	0	0	0	0	0	0	0	5	14
1960	2	4	0	0	0	0	0	0	0	0	2	5	13
1961	4	0	1	0	0	0	0	0	0	2	3	4	14
1962	4	1	0	0	0	0	0	0	0	0	2	4	11
1963	2	0	1	0	0	0	0	0	0	1	5	2	11
1964	3	0	0	0	0	0	0	0	0	0	5	0	8
1965	1	2	0	0	0	0	0	1	0	2	2	0	8
10-year mean	2.3	1.1	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.6	2.2	2.4	8.9

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



TABLE 5C

NUMBER OF HOURS\* WITH "THICK" AND "DENSE" FOGS AT RENFREW AIRPORT  
(10 YEARS 1956 TO 1965)

<u>Year</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year Total</u>
<u>Number of Hours with "Thick Fog" - Visibility less than 220 yards</u>													
1956	17	3	3	0	0	0	0	4	0	10	12	0	49
1957	7	2	1	0	0	0	1	0	0	1	1	25	38
1958	24	0	0	0	0	0	0	0	4	9	29	55	121
1959	97	77	0	0	0	1	0	0	2	1	4	41	223
1960	15	43	0	0	1	0	0	0	0	0	14	82	155
1961	41	0	10	0	0	0	0	1	1	14	52	81	200
1962	62	9	0	0	0	0	0	0	4	3	17	36	131
1963	22	2	7	0	0	0	0	1	0	12	54	17	115
1964	32	0	7	1	0	0	0	2	5	11	64	2	124
1965	25	13	0	0	0	0	0	2	0	17	14	1	72
10-year mean	34.2	14.9	2.8	0.1	0.1	0.1	0.1	1.0	1.6	7.8	26.1	34.0	122.8
<u>Number of Hours with "Dense Fog" - Visibility less than 55 yards</u>													
1956	2	0	0	0	0	0	0	0	0	0	3	0	5
1957	0	0	0	0	0	0	0	0	0	0	0	5	5
1958	9	0	0	0	0	0	0	0	0	1	3	24	37
1959	41	42	0	0	0	0	0	0	0	0	0	33	116
1960	9	15	0	0	0	0	0	0	0	0	9	22	55
1961	15	0	2	0	0	0	0	0	0	7	18	41	83
1962	29	7	0	0	0	0	0	0	0	0	7	25	68
1963	7	0	1	0	0	0	0	0	0	3	20	9	40
1964	17	0	0	0	0	0	0	0	0	0	46	0	63
1965	12	5	0	0	0	0	0	1	0	2	8	0	28
10-year mean	14.1	6.9	0.3	0.0	0.0	0.0	0.0	0.1	0.0	1.3	11.4	15.9	50.0

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



TABLE 6

NUMBER OF DAYS WITH SNOW OR SLEET FALLING AT ANY TIME OF DAY AT  
RENFREW (GLASGOW) AIRPORT  
(20 YEARS FROM 1946 TO 1965)

<u>Year</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year Total</u>
1946	3		5									1	9
1947	8	16	8	2								2	36
1948	4	5								1		3	13
1949	4	5	5							1	1	7	23
1950	5	7	2	2							1	10	27
1951	9	11	11	4	1							6	42
1952	15	5	3								1	8	32
1953	1	5	1	2									9
1954	8	11	3	1							1	2	26
1955	9	12	6									4	31
1956	11	12	3								1	6	33
1957	6	4	1									2	13
1958	9	9	9	2								4	33
1959	8			1							4	2	15
1960	5	11	2									7	25
1961	8	3	1	1							2	9	24
1962	3	14	8	5							4	8	42
1963	12	12		2							2	4	32
1964	2	6	5								3	7	23
1965	10	2	8	3							11	3	37
20-year total	140	150	81	25	1	0	0	0	0	2	31	95	525
20-year average	7	7	4	1	<1	0	0	0	0	<1	2	5	26



TABLE 6A

NUMBER OF DAYS WITH SNOW LYING AT 09H GMT AT DEPTHS  
BETWEEN SPECIFIED LIMITS

RENFREW AIRPORT - Altitude 26 feet							Maximum Depth = $4\frac{1}{2}$ inches
Depth - Inches	0-1	2	3-4	5-6	7-8	9-12	Total
Winter of:							
1952-53	4	1					5
1953-54	1	7	4				12
1954-55	8	5	4				17
1955-56	8						8
1956-57		1					1
1957-58	2		9				11
1958-59	7						7
1959-60	4	2		1			7
1960-61							0
1961-62	10						10
1962-63	8		2				10
1963-64	1	1					2
1964-65	4	3	1				8
1965-66	5	1	2				8
Total	62	21	22	1			106
% Total	58.5	19.8	20.8	0.9			100%

BARRHEAD - Altitude 97 feet							Maximum Depth = 9 inches
Depth - Inches	0-1	2	3-4	5-6	7-8	9-12	Total
Winter of:							
1956-57	1		1				2
1957-58	7	4	4				15
1958-59	8						8
1959-60	7	1	1			1	10
1960-61							0
1961-62	8	3					11
1962-63	3	1	1				5
1963-64	3		1				4
1964-65	8	2	1				11
1965-66	11	2	1		1		15
Total	56	13	10	0	1	1	81
% Total	69.2	16.1	12.3	0.0	1.2	1.2	100%



TABLE 6A (cont.)

NUMBER OF DAYS WITH SNOW LYING AT 09H GMT AT DEPTHS  
BETWEEN SPECIFIED LIMITS

COATBRIDGE - Altitude 256 feet				Maximum Depth = 8 inches			
Depth - Inches	0-1	2	3-4	5-6	7-8	9-12	Total
Winter of:							
1956-57	1						1
1957-58	7	3	2	1			13
1958-59	1						1
1959-60	6	2	2	2			12
1960-61							0
1961-62		3					3
1962-63	19	3	3	8	7		40
1963-64			3				3
1964-65	6	2	4				12
1965-66	13	4	3				20
Total	53	17	17	11	7		105
% Total	50.5	16.2	16.2	10.4	6.7		100%

CARNWATH - Altitude 706 feet				Maximum Depth = 12 inches			
Depth - Inches	0-1	2	3-4	5-6	7-8	9-12	Total
Winter of:							
1953-54	16	1	1				18
1954-55	31	4	11				46
1955-56	33	3	2				38
1956-57	12						12
1957-58	16	6	4				26
1958-59	24	4					28
1959-60	11	5	1	5	1		23
1960-61	8						8
1961-62	26	6	2				34
1962-63	13	13	40	19			85
1963-64	13		1				14
1964-65	15	14	4		1	1	35
1965-66	18	4	6	1			29
Total	236	60	72	25	2	1	396
% Total	59.6	15.1	18.2	6.3	0.5	0.3	100%



TABLE 6B

RENFREW AIRPORT - Altitude 26 feet

MONTHLY FREQUENCIES FOR EACH YEAR DURING THE 15 YEARS FROM 1952 TO 1966 OF DAYS WITH SNOW LYING AT 09H GMT  
AT DEPTHS BETWEEN THE SPECIFIED LIMITS

DEPTH (Inches)	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	Total
<b>NOVEMBER</b>																
0-1											1			4	1	6
2																
3-4																
5-6																
7-8																
9-12																
TOTAL	0	0	0	0	0	0	0	0	0	0	1	0	0	4	1	6
<b>DECEMBER</b>																
0-1	2			2						5		1	2	1	1	14
2	1										2					1
3-4																
5-6																
7-8																
9-12																
TOTAL	3	0	0	2	0	0	0	0	0	5	2	1	2	2	1	18
<b>JANUARY</b>																
0-1				5	5		1	7	3		4	1		1		27
2				4												7
3-4			3	3			5									11
5-6																
7-8																
9-12																
TOTAL	0	0	6	12	5	0	6	7	3	0	4	1	0	1	0	45
<b>FEBRUARY</b>																
0-1		2		2	1		1		1		1	6			1	14
2				1		1			2							8
3-4			3				4								1	5
5-6																
7-8																
9-12																1
TOTAL	0	2	3	3	1	1	5	0	4	0	1	6	0	0	2	28



TABLE 6B (cont.)

RENFREW AIRPORT

DEPTH (Inches)	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	Total
MARCH																
0-1			1	1										1		3
2			1											3		5
3-4			1	1									1	1		3
5-6																
7-8																
9-12																
TOTAL	0	0	3	2	0	0	0	0	0	0	0	0	1	5	0	11
APRIL																
All Depths	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



TABLE 6B (cont.)

CARNWATH - Altitude 706 feet

MONTHLY FREQUENCIES FOR EACH YEAR DURING THE 14 YEARS FROM 1953 TO 1966 OF DAYS WITH SNOW LYING AT 09H GMT  
AT DEPTHS BETWEEN THE SPECIFIED LIMITS

DEPTH (Inches)	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	Total
NOVEMBER															
0-1				2	1		1		2	2	3	1	4	3	19
2										6			2		2
3-4													3		9
5-6													1		1
7-8															
9-12															
TOTAL	0	0	0	2	1	0	1	0	2	8	3	1	10	3	31
DECEMBER															
0-1		4	8	3		5		1	7	9	5	4	4	2	52
2			1						3	1		1	2	1	8
3-4										1			2		3
5-6										1			1		2
7-8															
9-12															
TOTAL	0	4	9	3	0	5	0	1	10	11	5	5	9	3	65
JANUARY															
0-1		3	11	14	5	7	19	2	4	1			4	5	75
2			1	1		1	4	2		3	12		5		29
3-4			3			1				1	10		1		16
5-6								2			9				11
7-8															
9-12															
TOTAL	0	3	15	15	5	9	23	6	4	5	31	0	10	5	131
FEBRUARY															
0-1	5	9	8	10	2	1		7	3	5		5	1	5	61
2			3	1		4		3					5		16
3-4			7	2		3		1		1	19	1			34
5-6								3			9				12
7-8								1							1
9-12															
TOTAL	5	9	18	13	2	8	0	15	3	6	28	6	6	5	124



TABLE 6B (cont.)

CARINWATH

DEPTH (Inches)	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	Total
MARCH															
0-1		4	8			6		1		7	1		5		32
2		1				1					1		3		6
3-4		1									1		3		9
5-6		1	1								4				
7-8													1		1
9-12													1		1
TOTAL	0	6	9	0	0	7	0	1	0	7	6	0	13	0	49
APRIL															
0-1				1		1				4	1				7
2															
3-4															
5-6															
7-8															
9-12															
TOTAL	0	0	0	1	0	1	0	0	0	4	1	0	0	0	7



TABLE 7

ACTUAL AND AVERAGE NUMBERS OF DAYS WITH THUNDERSTORMS AT RENFREW  
(GLASGOW) AIRPORT  
(10 YEARS 1956 TO 1965)

<u>Year</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Year Total</u>
1956	0	0	1	0	0	0	1	0	2	1	1	2	8
1957	0	0	0	1	2	0	3	0	0	0	0	0	6
1958	0	0	0	0	0	0	2	1	4	0	0	0	7
1959	0	0	0	1	4	0	1	1	0	0	1	0	8
1960	0	0	0	0	3	2	1	3	0	0	0	2	11
1961	0	1	0	1	1	0	0	0	3	1	1	0	8
1962	1	0	0	0	0	0	0	0	1	2	0	0	4
1963	0	0	0	0	0	1	1	1	2	0	0	0	5
1964	1	0	0	1	1	2	0	3	1	0	0	0	9
1965	2	0	0	0	2	2	1	1	0	1	1	1	11
10-year mean	0.4	0.1	0.1	0.4	1.3	0.7	1.0	1.0	1.3	0.5	0.4	0.5	7.7



TABLE 8

AVERAGE VALUES OF RELATIVE HUMIDITY AND DRY BULB TEMPERATURE AT 03H, 09H,  
15H AND 21H, GMT AT RENFREW AIRPORT  
(10 YEARS FROM 1956 TO 1965)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
<u>At 03h GMT</u>													
Average Relative Humidity per cent	88	87	87	87	88	89	89	91	91	90	89	88	89%
Average Dry Bulb Temperature °F	36.3	36.8	39.4	42.1	46.0	50.9	53.1	53.0	51.0	47.9	41.6	38.2	44.7°F
<u>At 09h GMT</u>													
Average Relative Humidity per cent	89	86	84	78	75	75	79	82	85	87	89	89	83%
Average Dry Bulb Temperature °F	36.2	37.0	40.9	46.2	51.7	56.7	57.9	57.2	54.4	49.6	41.9	38.5	47.3°F
<u>At 15h GMT</u>													
Average Relative Humidity per cent	82	76	71	65	63	64	68	70	72	77	81	84	73%
Average Dry Bulb Temperature °F	40.0	42.2	46.7	52.0	57.6	62.2	62.6	62.2	59.6	54.0	46.0	41.1	52.2°F
<u>At 21h GMT</u>													
Average Relative Humidity per cent	87	84	83	80	78	77	81	84	86	87	88	87	84%
Average Dry Bulb Temperature °F	37.2	38.4	41.8	45.8	50.9	56.0	57.2	56.2	53.8	49.5	42.7	39.1	47.4°F



TABLE 8A

PERCENTAGE AMOUNT OF TIME WITH WET BULB TEMPERATURES BELOW CERTAIN LIMITS- DEGREES FAHRENHEITAT RENFREW AIRPORT (10 YEARS 1946 TO 1955)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
	%	%	%	%	%	%	%	%	%	%	%	%	%
32°F or below	22.9	25.5	13.5	2.3	0.2	0.0	0.0	0.0	0.1	2.3	9.0	17.0	7.8
34°F or below	33.5	37.1	21.5	4.8	0.8	0.0	0.0	0.0	0.3	4.3	12.9	25.2	11.7
36°F or below	46.6	50.7	31.1	10.6	2.2	0.0	0.0	0.0	0.6	6.6	18.3	33.5	16.6
38°F or below	57.4	62.0	42.9	18.0	4.8	0.1	0.0	0.0	1.1	9.8	25.3	45.3	22.1
40°F or below	67.1	71.6	54.9	29.8	9.5	0.5	0.1	0.1	1.9	14.2	34.5	58.0	28.4
42°F or below	75.3	79.3	66.7	42.6	16.8	1.7	0.1	0.4	3.6	20.6	44.8	66.4	34.7
44°F or below	83.4	86.1	77.9	57.8	26.6	4.5	0.5	0.9	6.7	30.2	57.1	75.5	42.1
46°F or below	89.2	91.6	87.1	72.1	39.7	9.6	1.6	2.7	11.6	43.1	70.9	84.3	50.1
48°F or below	94.9	95.7	93.9	84.5	55.7	21.1	5.0	5.4	19.8	56.1	83.6	91.1	58.7
50°F or below	99.1	99.0	97.5	92.9	70.0	37.5	11.6	10.9	32.8	67.5	92.0	96.5	67.1
52°F or below	99.8	100.0	98.9	97.1	81.3	53.7	25.1	23.9	50.8	77.2	95.9	98.9	75.0
54°F or below	100.0		99.6	98.9	89.4	69.3	43.5	43.3	67.4	86.4	97.9	99.8	82.8
56°F or below			99.7	99.6	94.2	81.5	62.7	61.9	82.9	92.9	99.5	100.0	89.5
58°F or below			100.0	100.0	97.7	90.1	77.5	77.5	92.1	96.7	100.0		94.2
60°F or below					99.2	94.8	87.9	88.9	97.0	99.7			97.2
62°F or below					99.8	97.2	93.6	94.3	99.1	100.0			98.6
64°F or below					99.9	98.7	97.1	97.6	99.7				99.4
66°F or below					100.0	99.6	98.9	99.2	99.9				99.8
68°F or below						99.9	99.4	99.7	100.0				99.9
70°F or below						99.9	99.7	99.8					99.9
72°F or below						99.9	99.8	99.9					99.9
74°F or below						100.0	100.0	100.0					100.0



TABLE 8B

ABSOLUTE HIGHEST VALUES OF WET BULB TEMPERATURE AND HIGHEST VALUES OF  
WET BULB TEMPERATURE ASSOCIATED WITH RELATIVE HUMIDITIES OF  
100 PER CENT EXTRACTED FROM HOURLY READINGS OF WET BULB  
TEMPERATURE MADE AT RENFREW AIRPORT DURING THE  
10 YEARS FROM 1946 TO 1955 -  
(DEGREES FAHRENHEIT)

	<u>Absolute Highest</u> <u>Value of Wet</u> <u>Bulb Temperature</u> °F	<u>Highest Value of</u> <u>Wet Bulb Temperature</u> <u>Associated with Relative</u> <u>Humidity of 100 per cent</u> °F
January	54	54
February	52	52
March	58	54
April	58	56
May	66	58
June	74	64
July	74	66
August	74	66
September	68	66
October	62	62
November	58	58
December	56	56
Year	74	66

TABLE 9

MONTHLY AVERAGES OF READINGS OF MEAN SEA LEVEL BAROMETRIC PRESSURES  
IN MILLIBARS AND INCHES RECORDED AT RENFREW (GLASGOW) AIRPORT AT  
09 HOURS GREENWICH MEAN TIME ON EACH DAY DURING THE 30 YEARS  
FROM 1931 TO 1960

	<u>millibars</u>	<u>equivalent in</u> <u>inches</u>
January	1010.8	29.85
February	1013.0	29.91
March	1014.0	29.94
April	1014.1	29.95
May	1016.1	30.00
June	1014.8	29.97
July	1012.4	29.90
August	1012.8	29.91
September	1013.3	29.92
October	1012.5	29.90
November	1010.5	29.84
December	1009.7	29.82
Year	1012.8	29.91



TABLE 9A

HIGHEST AND LOWEST MEAN SEA LEVEL PRESSURES (IN MILLIBARS AND INCHES) RECORDED IN  
THE BRITISH ISLES FROM 1870 TO 1965

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
<u>Highest</u> Pressure	1054.7 mb 31.15 in	1051.1 mb 31.04 in	1047.1 mb 30.92 in	1044.5 mb 30.84 in	1042.2 mb 30.78 in	1043.1 mb 30.80 in	1038.3 mb 30.66 in	1036.7 mb 30.61 in	1038.6 mb 30.67 in	1045.6 mb 30.88 in	1044.5 mb 30.84 in	1051.9 mb 31.06 in
Place	Aberdeen	Nairn	Valentia	Eskdalemuir	Dublin	Clones	North Shields	Pembroke	Kew	Dyce	Benbecula	Wick
Date	1902	1902	1900	1938	1943	1959	1911	1949	1906	1956	1956	1926
<u>Lowest</u> Pressure	925.5 mb 27.33 in	942.3 mb 27.83 in	946.2 mb 27.94 in	952.9 mb 28.14 in	968.0 mb 28.58 in	976.8 mb 28.84 in	976.0 mb 28.82 in	967.8 mb 28.58 in	957.1 mb 28.26 in	946.8 mb 27.96 in	939.7 mb 27.75 in	927.2 mb 27.38 in
Place	Ochertyre	Cork	Wick	Malin Head	Sealand	Wick	Tynemouth	Sule Skerry	Claremorris	Cawdor Castle	Monach Lighthouse	Belfast
Date	1884	1951	1876	1948	1943	1944	1922	1957	1953	1891	1877	1886
Range in millibars	129.2	108.8	100.9	91.6	74.2	66.3	62.3	68.9	81.5	98.8	104.8	124.7



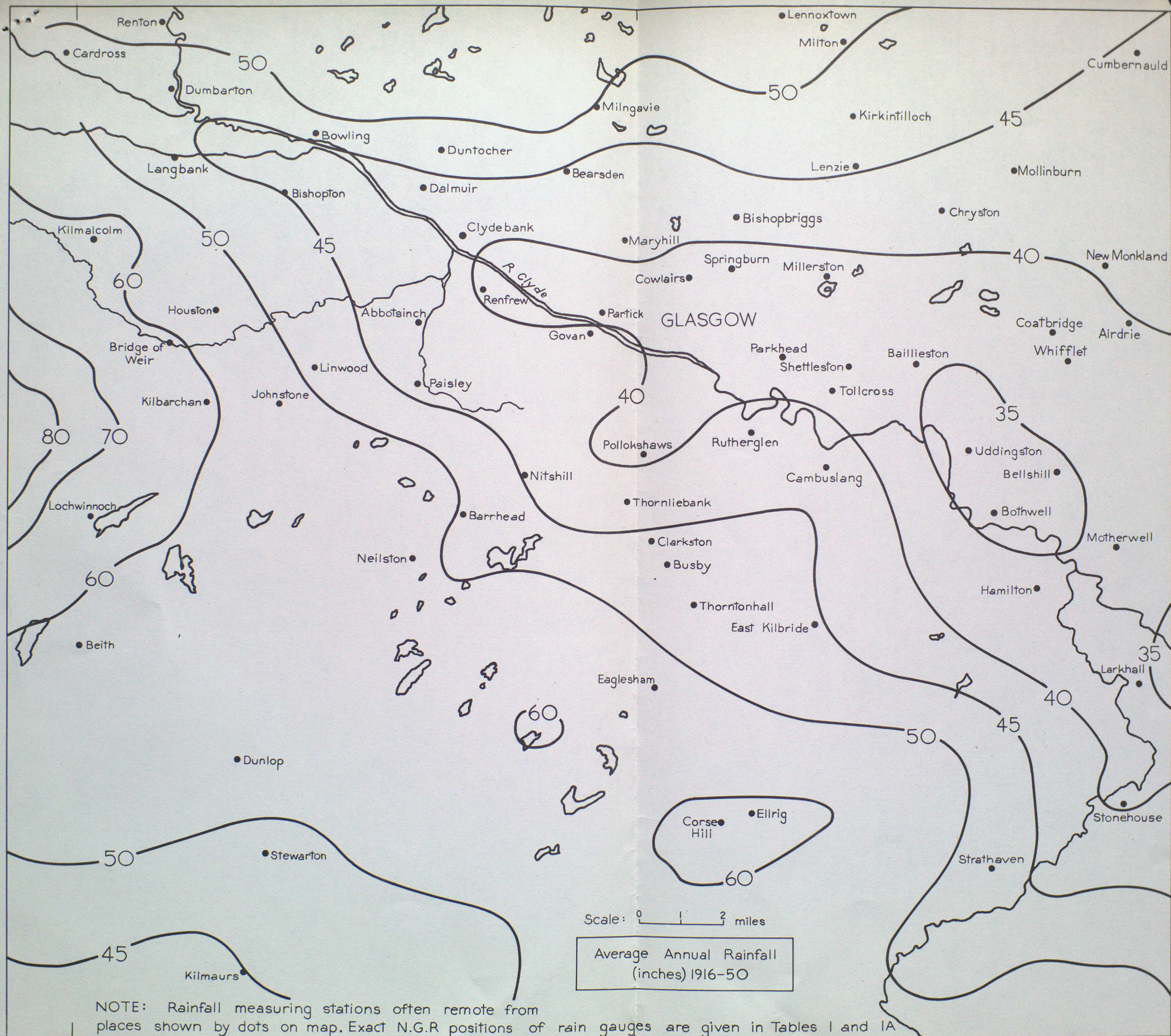


Fig 1



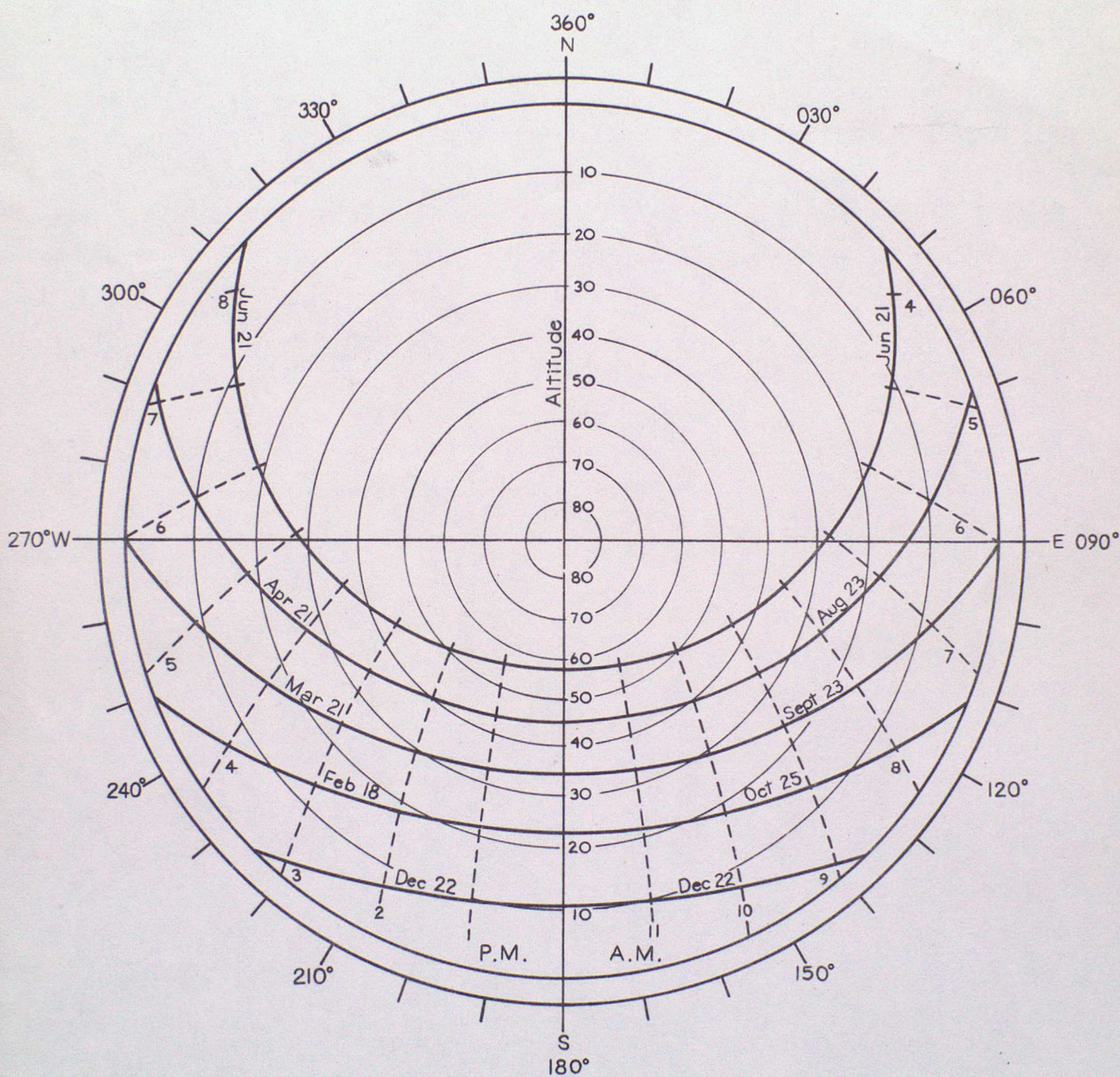


Fig 2. SOLAR CHART FOR GLASGOW Latitude 56°N