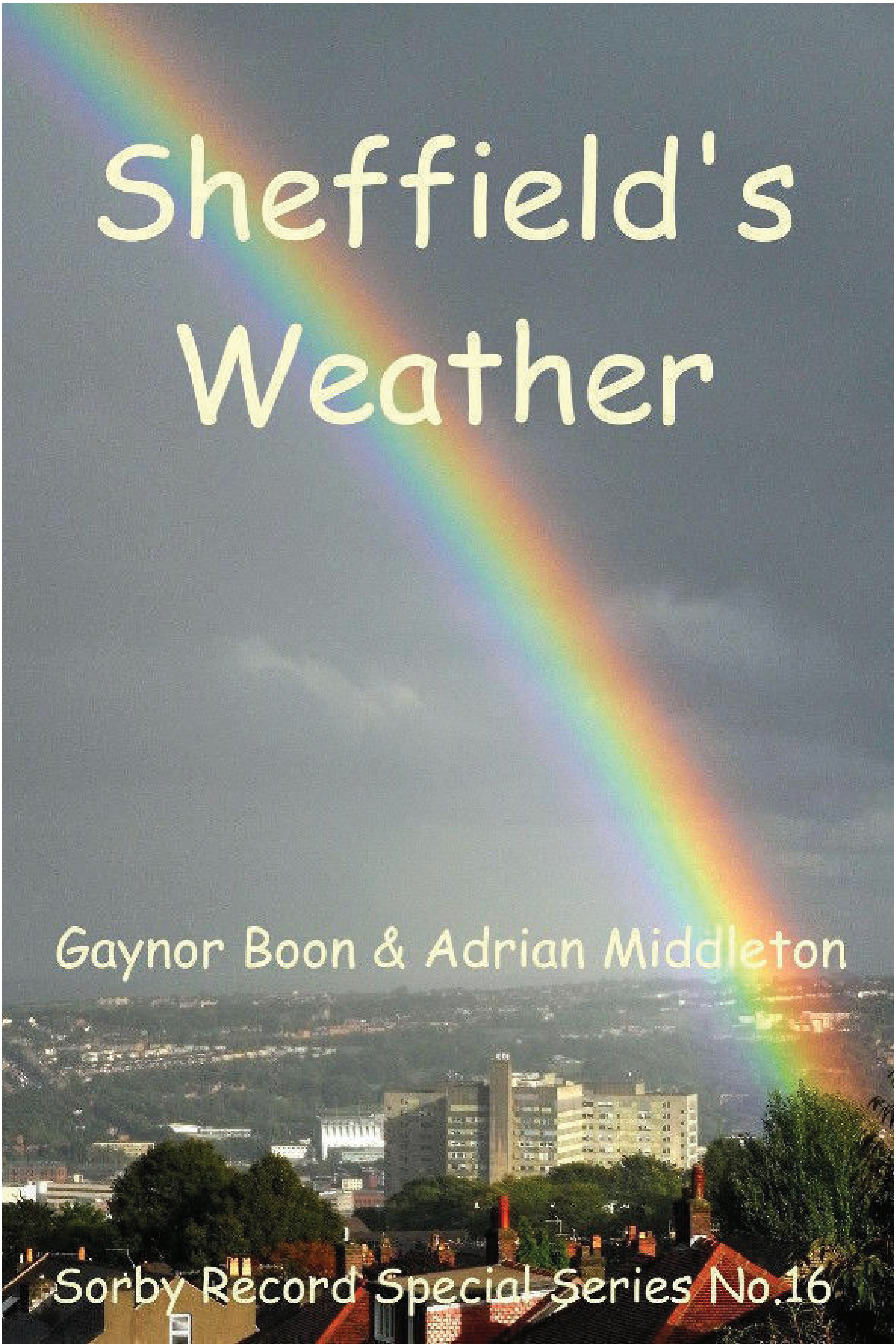

Sheffield's Weather

Gaynor Boon & Adrian Middleton

Sorby Record Special Series No.16

Sheffield's Weather

Gaynor Boon
and
Adrian Middleton

Sorby Record Special Series No.16

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Contents

From Edward Carpenter's "Sheffield" (in ***Towards Democracy***, 1883)

The great wind blew over the world,
The great soft Southwest, making a clear light along the far horizon;
The sky overhead was serenest blue, and here and there a solitary white cloud scudded swiftly below it.
The great soft wind! How it blew in gusts as it would unroot the very rocks, eddying and whistling round the angles!
The great autumnal wind! bearing from the valley below clouds of paper and rubbish instead of dead leaves.
…
And as I lifted my eyes, lo! across the great wearied throbbing city the far unblemished hills,
Hills of thick moss and heather,
Coming near in the clear light, in the recent rain yet shining.
And over them along the horizon moving, the gorgeous procession of shining clouds,
And beyond them, lo! in fancy, the sea and the shores of other lands,
And the great globe itself curving with its land and its sea and its clouds in supreme beauty among the stars.

Sheffield City Council's Eco-Schools Project is supporting the production of this publication because it is the young people in our schools today who will inherit from us the challenge of adapting life in Sheffield to the potentially dramatic changes in our climate in the next few decades, brought on by the green house gases human society continues to release into our atmosphere.

To adapt wisely we will need solid scientific local weather studies and this document exemplifies the role the Sorby Natural History Society continues to play in our city in providing that solid scientific foundation for action.

Every secondary school in Sheffield will receive a copy.

For more information about Sheffield Eco-Schools contact: *ecoschools@sheffield.gov.uk*

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Introduction

Sheffield has a long history of weather recording with documentary evidence that can be traced from the 1500s to the present. Many of the earliest records are narrative accounts, consisting of weather observations made in the course of writing up personal diaries and journals. They yield valuable information about the consequences of extreme weather events upon everyday life when livelihoods were much more affected by the vagaries of weather than they are today. There are also phenological records and nature diaries that provide details of the weather in relation to the life cycles of plants and animals and the arrival of the seasons.

By the nineteenth century, curiosity about the wider world led to the development of groups and societies where knowledge could be shared. From time to time science was the subject for discussion, including the new science of meteorology, although it was often approached in connection to astronomy (and astrology) or to matters of health. Meteorological societies were formed in London from 1823 and the emphasis gradually turned to the measurement of weather and the development of instruments. A handful of weather observers are known to have been taking measurements of the weather in Sheffield at this time although it was not until the early 1880s that the City of Sheffield embraced meteorological recording. This led to the establishment of Weston Park Weather Station in 1882 , from which continuous daily readings of weather have been made ever since.

This account presents an overview of Sheffield's weather and climate and a retrospective of its weather records and weather observers with particular emphasis on the history and development of Weston Park Weather Station. It also includes the charted analyses of the long period data held there which indicate that Sheffield's climate has changed faster in the last few decades than at any time previous since records began at Weston Park. Using extrapolated, grid-based data provided by the UK Climate Impacts Program (UKCP09) the analyses are extended to the recording area of the Sorby Natural History Society and some key observations noted. Comparisons are also made with UK and global trends, thus taking the perspective from local to global proportion. We include lists of extremes and ranges of particular weather parameters recorded at Weston Park and finally a chronological listing of documented extreme weather events from across the region.

No attempt is made here to describe or explain the fundamentals of meteorology or to provide the details of weather experienced across the UK. For an overview of these topics we recommend the following texts :

Barry, R.G. and Chorley, R.J. (2003) 'Atmosphere, weather and climate' (8th edition) London

Stirling, R. (1997) 'The Weather of Britain' (2nd edition) London.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the dedication of Elijah Howarth and all subsequent weather observers at Weston Park Weather Station.

We are grateful to Museums Sheffield for access to the archived data from Weston Park Weather Station and for permission to publish extracts. We are also grateful to Sheffield Local Studies Library, the National Meteorological Library and Archive (Exeter), Sheffield Newspapers for access to documents held in their files; to Mike Sparling for permission to quote from the journal of William Peniston; and Jane K. Mills for permission to reproduce the photograph of Daniel Doncaster.

We would also like to acknowledge the use of Ordnance Survey data used in preparing the maps for the publication (© Crown copyright Ordnance Survey. All rights reserved) and the use of British Geological Survey data as a basis for the outline map shown in 'Sheffield's Weather' (© NERC. All rights reserved).

Gaynor Boon & Adrian Middleton
December 2010

Sheffield's Weather

GEOGRAPHICAL SETTING

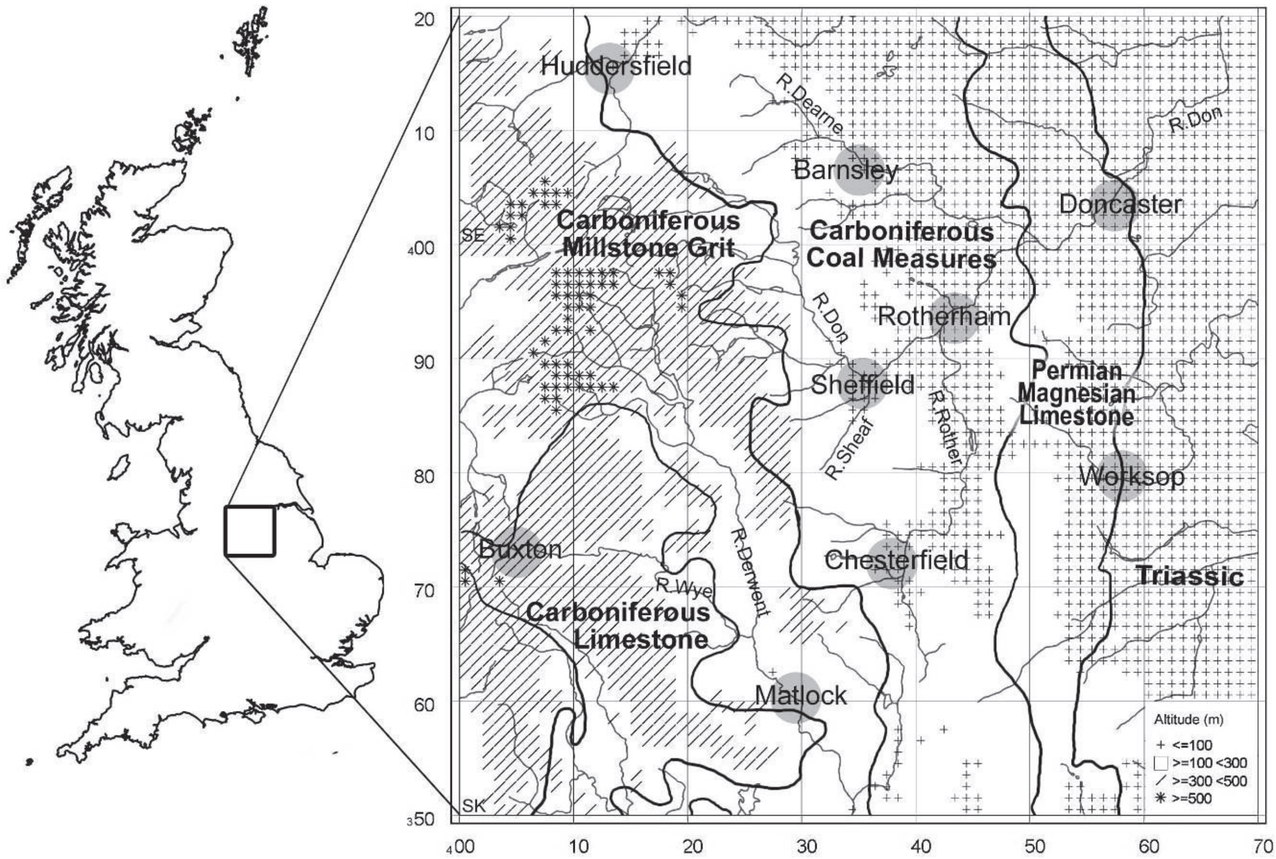

Figure 1 Sheffield in context
showing topography (shaded) and major 'solid' geology (boundaries)

The physical geography of Sheffield and its region makes the area a particularly interesting one for observing the weather. Centrally positioned within northern England, Sheffield is almost equidistant from east and west coasts, tucked into the lee of a north-south trending topographical range which acts as a natural barrier to air masses but also generates its own weather. The Peak District, lying at the southern reaches of the Pennine Hills, is the main watershed of the region and separates the catchments of rivers draining into the Humber on its eastern slopes from those draining into the Mersey on the west. At its centre is the High Peak, a plateau-topped dome of Lower Carboniferous Limestone flanked by steep, inward facing scarp-slopes carved from beds of Upper Carboniferous gritstone and sandstone. Sheffield nestles in the foothills of the Peak District's eastern dip slopes, at the confluence of its namesake River Sheaf with the River Don. To the north, south and south-east of the city are smaller hills whilst to the north-east the River Don occupies the wide floodplain that extends to Rotherham. Further east, beyond the city boundary, the topography becomes gently undulating and the Permian Magnesian Limestone is encountered at outcrop, this forming the low ridge between Doncaster and Worksop.

This varied geology and topography of the region supports an equally varied range of superficial geology, soils, habitats and land uses. Any one of these factors can have a marked influence upon the local weather and climate.

PREVAILING WEATHER

In keeping with much of the UK, the region's prevailing weather is typically frontal, consisting of a succession of depressions (cyclones) born of the mid latitudes that are transported several hundred kilometres eastwards across the North Atlantic Ocean by the 'jet' stream[1]. Many of these approach Britain from the Irish Sea and make rapid progress inland via the low lying Cheshire Gap and Bristol Channel whilst a sharp increase in altitude at the Welsh mountains forces the moisture-laden air to precipitate. Sheffield lies in direct line of this track of frontal weather although most of the rain it brings falls over the Peak District, especially upon the western slopes and to the north of Buxton. These upland areas can experience prolonged periods of rain accompanied by hill fog and poor visibility (Figure 2). Sheffield and its neighbouring eastern lowlands escape much of the onslaught of weather approaching from the west since they lie in the so-called 'rain shadow' location on the leeward side of the hills. Accordingly, annual rainfall amounts generally decrease across the region from the high watershed divide to the easternmost parts of the region. Rainfall over the Dark Peak is nearly three times that recorded at Doncaster[2], a difference of around 600 metres in altitude over a ground distance of just 30 km.

Temperatures are noticeably cooler over the Peak District than they are in Sheffield as a consequence of the normal fall in temperature with altitude; the mean annual temperature over the Dark Peak is around 4^{o}C lower than for Sheffield. It can be as much as 10^{o}C, however, on hot summer days and cold winter nights. This also means that snow lingers for many more days at altitudes above 300 metres than it does in the lower lying areas, and the growing season is shorter.

Figure 2 Hill fog associated with frontal rain, Totley Moor 26th Oct 2010

Being midway between west and east coasts, the region also experiences a degree of 'continentality' in the weather, especially east of Sheffield where the temperature range is

[1] Strong upper air winds
[2] See charts in section 'Climate Trends in the Region'

greatest and the driest and sunniest conditions occur. Absolute extremes of summer heat and winter cold generally occur when anticyclones are nearby. These cells of high pressure frequently develop over the vast continental areas of Northern Europe and Russia, particularly in summer and winter. They are associated with light or calm winds and clear skies, enabling rapid night-time cooling and day-time heating to occur which is intensified when soil moisture levels are low (a characteristic of freely drained soils).

Settled periods of anticyclonic weather may also bring a phenomenon known as 'anticyclonic gloom' to the eastern parts of the region. This occurs when layer cloud (stratocumulus) forms over the North Sea as dry continental air collects moisture on its sea passage. With the exception to the Lincolnshire Wolds, the ground between Sheffield and the east coast is relatively low lying and with an easterly wind the cloud may extend far inland and be remarkably persistent. It can make a significant difference to Sheffield's weather; the western high suburbs may be bathed in bright sunshine whilst the city centre eastwards remains dull under the low grey cloud.

The prevailing winds across the region are westerly, occurring in association with frontal weather (Figure 3a). They most commonly originate from a compass bearing range of 180^o-315^o with particular spikes at 225^o (south-west), 270^o (west), 292^o (west-north-west) and 315^o (north-west). Note also the secondary spikes between 360^o (north) to 45^o (north-east). The strongest winds are from directions 292^o (west-north-west) and 315^o (north-west), with second order winds from direction 247^o (west-south-west) (Figure 3b).

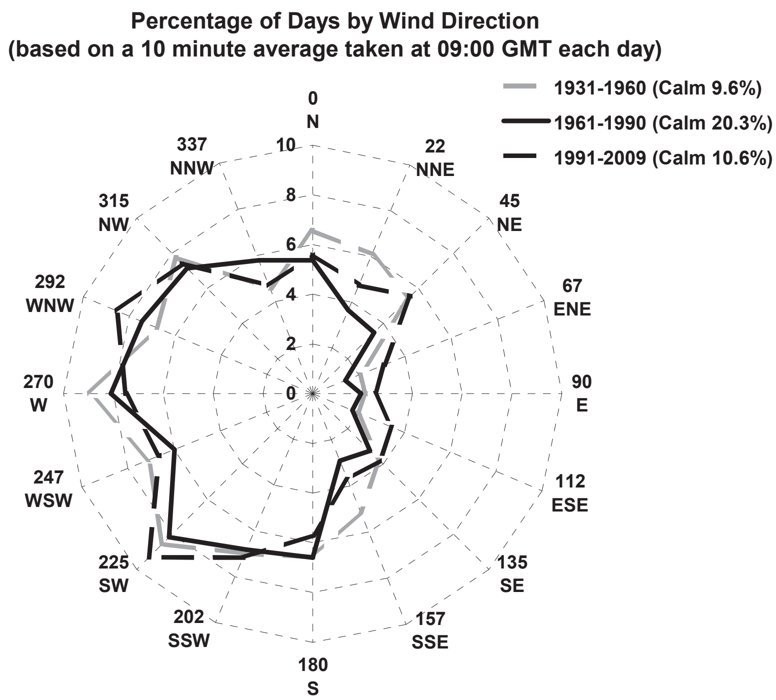

Figure 3a Weston Park wind data showing frequency of winds by direction.

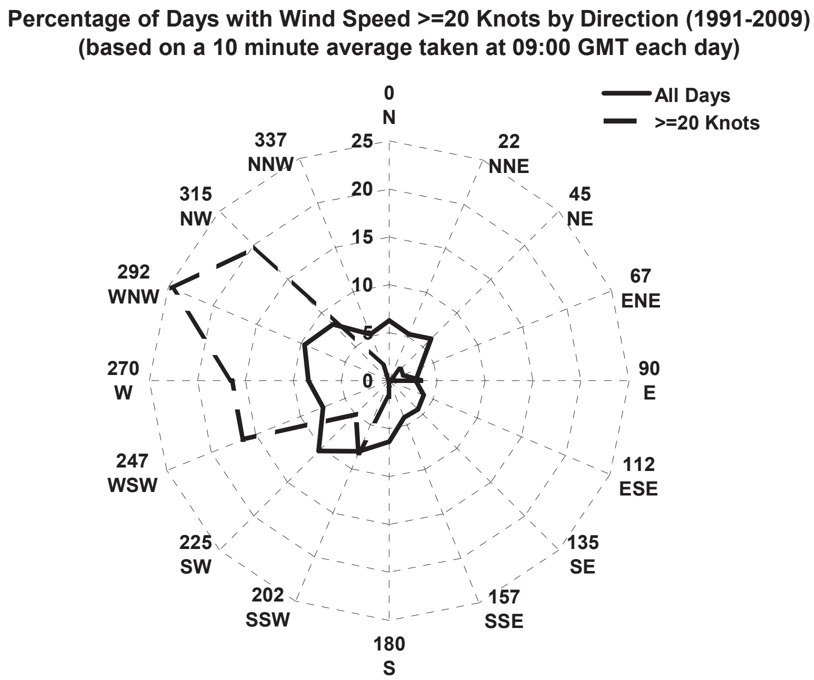

Figure 3b Weston Park wind data showing direction of highest winds

LOCAL EFFECTS

The topographical contrasts between east and west have a major influence upon local weather and are worthy of closer examination with reference to particular weather events.

Many people living in the region still remember the disastrous gales of 16th February 1962 which brought the highest winds ever recorded in the region[3]. The greatest damage occurred in a narrow belt extending from Chesterfield to Leeds, with Sheffield being the worst affected area. The severity of gale damage in Sheffield and Chesterfield is thought to have been exacerbated by a phenomenon known as lee-waves. These occur when normal airflow aloft in a hilly or mountainous region is subjected to a wave-like pattern of flow as it passes over the terrain, creating vertical deformations in the flow that reach considerable magnitude (Figure 4). During the strong westerly gales of February 1962, lee-waves and associated turbulence were in evidence on the leeward side of the Pennines. A large proportion of Sheffield's damaged properties were located near the tops of slopes facing west or north-west, such as those at Arbourthorne and Sky Edge which took the full force of the gale. Many of the properties at Arbourthorne were prefabricated and so were completely flattened (Figure 5). A further consequence of the local topography was the added funnelling effect created by a narrow valley (known as Jervis Lum) aligned parallel with the general wind direction. The effect was also observed at the ridge at the Bole Hills, Walkley where houses at the summit of the ridge took the full force of the wind as it was funnelled through the Loxley valley (Figure 6).

The city was most severely hit from 0400 hours with a maximum wind gust of 84 knots recorded just past 0600hrs (Figure 7) but there were also 6 other gusts of 80 knots or more between 0450-0710hrs and at least 36 gusts of more than 70 knots between 0450-1300hrs[4]. The gales caused a great deal of disruption through the night and people were

[3] Since accurate measurements of wind speed began in the region in 1958
[4] Aanensen (1965)

displaced for weeks afterwards. Four lives were lost and almost 600 people received hospital treatment. A total of 118 houses were completely destroyed and an incredible 91,398 properties damaged[5].

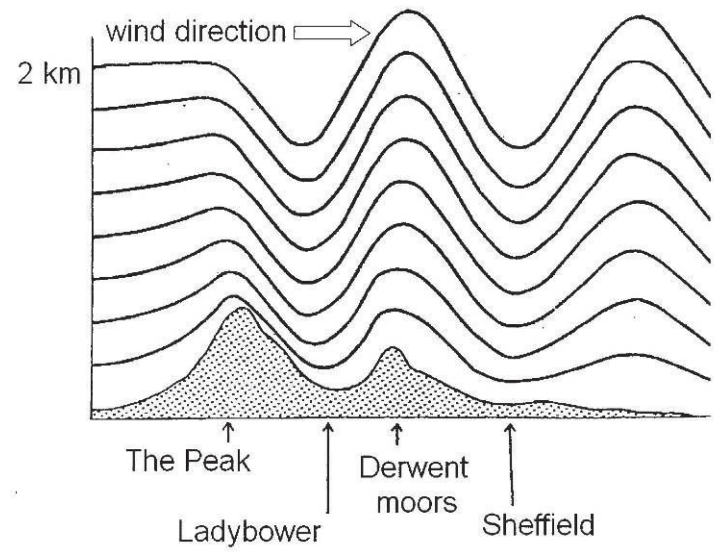

Figure 4 The development of lee-waves (from Aanensen, C.J.M. AND Sawyer, J.S. (1963))

Figure 5 Damage to prefabs at Arbourthorne, February 1962 (courtesy of Sheffield Newspapers)

[5] Extracted from the Report of Parliamentary and General Purposes Committee to the City Council – 7th March 1962

Figure 6 Damage to house on Heavygate Road, Walkley, February 1962 (courtesy of Sheffield Newspapers)

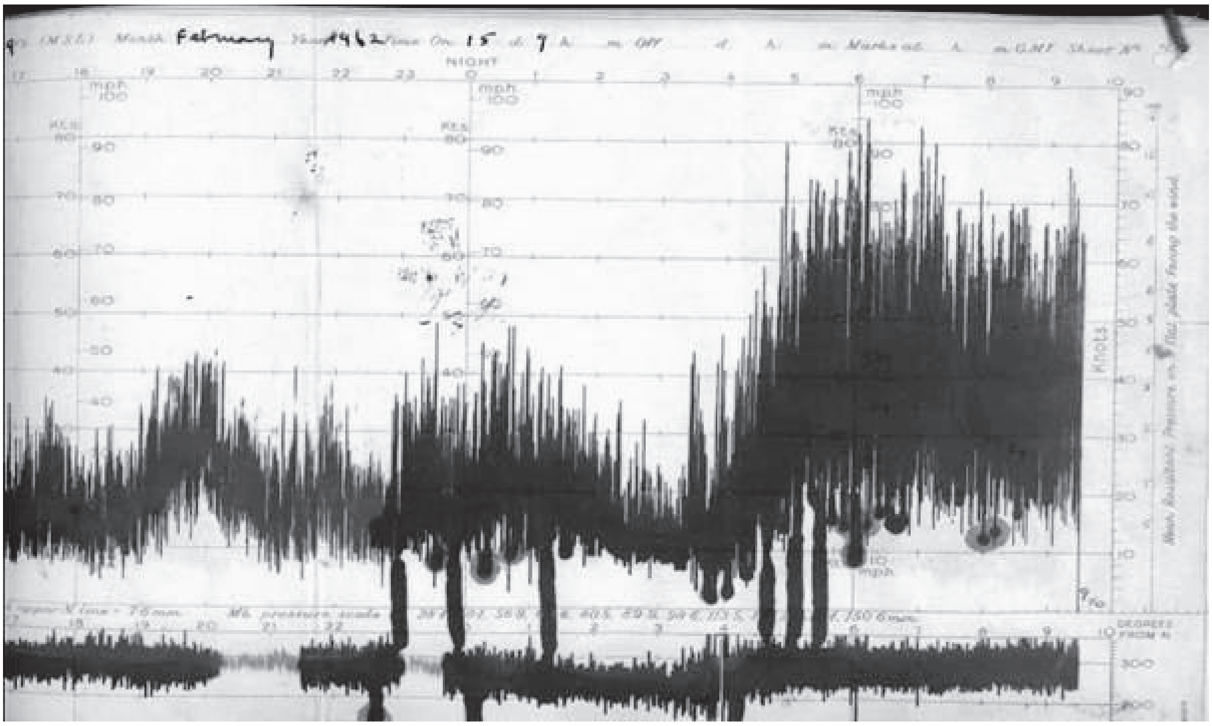

Figure 7 The Sheffield 'Hurricane' February 16th 1962 recorded by Dines Pressure-tube anemograph at Weston Park Weather Station (© Museums Sheffield)

Another effect of the local topography upon wind flow patterns was noted by Garnett in the Peak District where west facing, gritstone scarp slopes ('edges') rise sharply above the limestone plateau, as at Bradwell and Hucklow Edge. Differential heating over the two types of surface is known to give rise to strong vertical air currents against the edges that have taken gliders to altitudes of 10,000 feet[6].

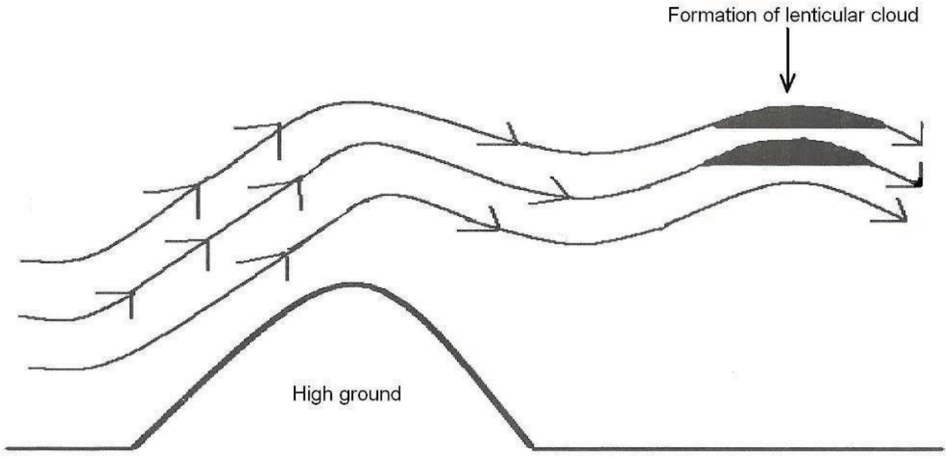

Figure 8 Formation of lenticular cloud

Figure 9 Lenticular clouds viewed from Handsworth, Sheffield (© G. Boon)

The wave generating effect that the Peak District hills have upon airflow can also trigger the development of 'orographic' clouds. Lenticular cloud is an example of this type of cloud and is relatively frequent in any given year, forming downwind of high ground in a strong west or north-westerly airflow. The cloud forms as moist air ascends the wave, condenses

[6] Garnett, A. (1956)

on reaching dew point[7], passes the crest of the wave and then evaporates on descent to below dew point, leaving a stationary, lens-shaped cloud (Figure 8). These clouds have a smoothed appearance and may be stacked one on top of another (Figure 9). The shape has frequently been likened to that of a 'flying saucer' and no doubt it has occasionally been mistaken for one.

A much rarer cloud that is also thought to have an association with hilly or mountainous terrain[8] is 'nacreous' cloud. This cloud is unmistakable due to the striking iridescence it displays and which gives rise to its alternative name; 'mother-of-pearl' cloud. It is thought to consist of minute, supercooled water droplets formed high up in the stratosphere, much higher than common high clouds such as cirrus. Normally these clouds are only observed at high latitudes but on 16th February 1996 nacreous clouds were observed as far south as Sheffield and Chesterfield (see colour plate NNN). They were observed in Leeds and Edinburgh too, occurring for about an hour at sunset in a strong westerly air flow.

Figure 10 Floods at Granville Road, Sheffield 15th July 1973 (courtesy of Sheffield Newspapers)

The region's physical relief has also contributed to the floods that occur in the valleys of the Sheaf, Don and Rother from time to time following extreme rainfall events. Two particularly noteworthy occasions in living memory were 15th July 1973, Sheffield's wettest day of the 20th century when 119 mm of rain fell in just 24 hours (Figure 10), and more recently June 2007, the wettest month on record at Weston Park. Both of these events led

[7] The temperature at which condensation occurs
[8] Denyer, G. (1996)

to flooding of lower lying areas, the steep western valleys channeling large volumes of fast-flowing water into the tributaries of the River Don from a considerable upland catchment area.

The June 2007 floods were particularly severe and were the consequence of two periods of heavy rain falling in relatively quick succession, the first occurring from the 13th to the 15th, followed by another deluge nine days later (Figure 11). By the time of the second event the ground was already saturated and land drains and river channels choked with debris dislodged by higher than average river discharge (soil moisture levels by late April had actually been very low but were recharged almost fully due to a wet May[9]). Unusually, the frontal rain came from an easterly direction and intensified as it was forced to rise with the terrain. The prevailing surface weather also coincided with a trough in the upper air, thus stalling the depression over the region for many hours. Unable to accommodate the sheer volume of water discharging from its fast flowing tributaries upstream, both Rivers Don and Sheaf burst their banks and severe flooding occurred. Lives were lost, properties devastated and many roads and businesses were closed, including the M1 and the Meadowhall shopping centre (Figure 12). The floodwaters continued to wreak havoc over the next 48 hours as they moved downstream to Rotherham and Doncaster.

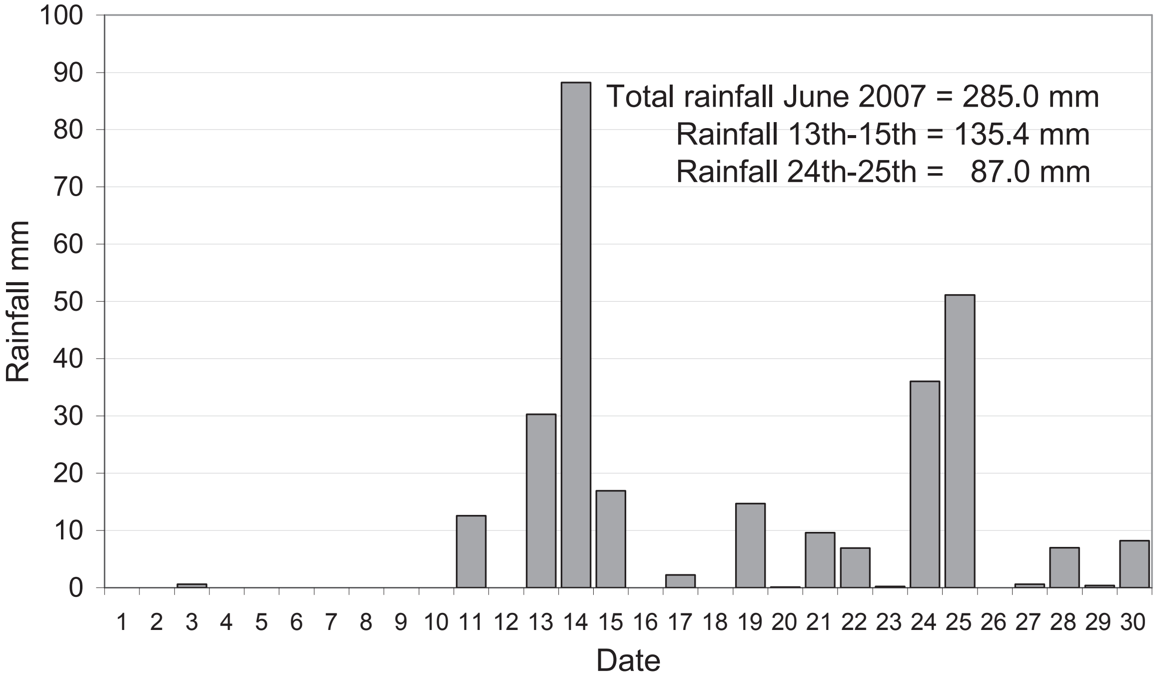

Figure 11 Daily rainfall at Weston Park, June 2007

[9] Marsh, T. & Hannaford, J. (2007)

Figure 12 River Don floods at Meadowhall 25th June 2007 [10]

The hills also have an effect on temperature distribution across the region aside from the usual decrease in temperature with height. Under anticyclonic conditions when winds are calm and there is little mixing of air, the hills of Sheffield can generate a 'katabatic' cooling effect with the result that temperatures fall much lower in valleys and over low lying ground than they do at higher altitudes. This occurs when cool, dense air drains down slope and collects in valley bottoms. Combined with *in situ* cooling through radiation this gives rise to some very low temperatures in the deep valleys of the Peak District and over the low ground to the east of Sheffield. Overnight on 28/29 February 1944 air temperatures fell to a minimum of -5°C at Weston Park but just 10km away in Rotherham temperatures fell to -11°C[11]. The temperature differences can be even greater if the underlying soils are sandy and free draining, since temperatures are also affected by the thermal conductivity of the soil. An indication of this is shown in Figure 13 which compares the number of ground frosts occurring at Weston Park (1911-1917) with those recorded at Hodsock Priory near Worksop[12]. The lowest temperature on record at Hodsock is -21°C and at Weston Park is -14.6°C. Weston Park weather station occupies a mid-slope position and, therefore, the minimum temperatures recorded there never reach the extreme 'lows' encountered elsewhere in the region.

[10] Image: *http://en.wikipedia.org/wiki/2007_United_Kingdom_floods#South_Yorkshire*
[11] Recorded at Rotherham meteorological station by Leslie Atkinson (see section 'Sheffield's Past Weather Observers')
[12] A private weather station operated at Hodsock Priory between approximately 1880-1940

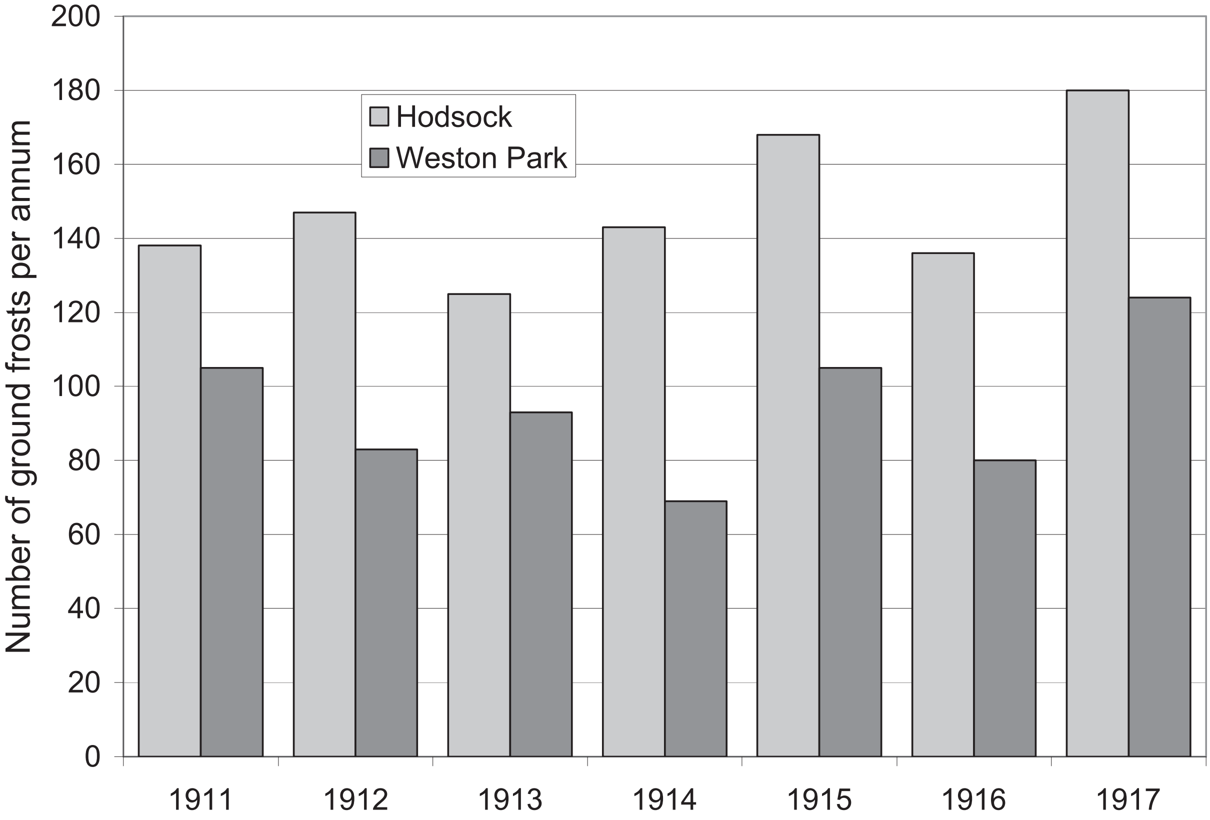

Figure 13 Comparisons of annual number of ground frost between Weston Park and Hodsock Priory (near Worksop) for the years 1911-1917

If the cooling affects a deeper layer of air, a veil of fog or freezing fog may form under a temperature inversion. The valley is then filled with fog whilst higher ground is clear and sunny. These radiation fogs are a very typical feature of the vales of Sheffield on still winter mornings and may sometimes linger all day or for several days if there is little wind and temperatures remain very low (Figure 14). Good examples also occur in the Derbyshire Dales and over the floodplains of the Don and Rother. The phenomenon is aptly described by Samuel Roberts as witnessed by him from the 'Cholera Mount' in 1833[13].

> *"It is not very unusual, after a frosty night, to see from the high grounds near Sheffield, about sunrise, the vapours from the water mixed with smoke of the town, unable to rise, lying in a heavy, damp, dark, cold mass, hiding every thing that is beneath it, while the sun is shining brilliantly on the hills above, in a clear sky, though a pure dry air. The going suddenly from the latter, into the former, is something like plunging into a cold bath. On the morning in question this was particularly the case. The vapour lay very deep and dense, the church vanes were all hid. The vapoury fog running up the vallies of the Porter and Sheaf, lay level to the distant hills. The prospect was strikingly sublime".*

[13] Samuel Roberts, 1839 'On the Cholera Mount, as seen at Sunrise, on the Sabbath morning, January 27th, 1833'

Figure 14 The top of the Royal Hallamshire Hospital appearing through fog, viewed from Crookes (©: J.P.Richards)

MICROCLIMATES

With its many geographical contrasts, numerous microclimates occur within the Sheffield region and these are principally defined by altitude, aspect, soils and land use. Sunny south-facing slopes can reach temperatures several degrees higher than their north-facing counterparts whereas the lowest parts of some valleys see little sunshine, especially in winter. Microclimate studies in Lathkill dale (with its east-west trending valley) during a 12 year period beginning 1971 found direct incoming radiation in winter to be eliminated entirely on the north facing slope[14]. It was also discovered that the north and south facing slopes differed in mean soil temperatures by 2.4^{o}C and in mean air temperature by 2.9^{o}C. The temperature differentials were greatest, however, in summer daily maximum air temperatures (up to 7^{o}C). In winter the differentials were much lower (not greater than 2^{o}C). Diurnal variations in temperature were found to be greatest on the south facing slopes, particularly in soil temperatures in spring and summer. Differences in temperature between the slopes were much less marked at night.

URBAN HEAT ISLAND

The City of Sheffield generates a microclimate of its own which is most noticeable during anticyclonic conditions when there is little mixing of air. On such occasions significant contrasts in temperature may occur between the city centre and rural suburbs as heat is released from buildings, roads, heating and cooling systems or is generated by transport.

[14] Rorison, I.H. et al (1986)

Temperature differences are generally greater at night and also in summer. Studies in other cities have shown that large areas of water and vegetation cover can contribute a noticeable cooling effect within the overall pattern[15]. Sheffield's urban heat island was first described by Elijah Howarth, founder of Weston Park weather station, in a presentation to the British Association in 1910. Several further studies were undertaken in the 1960s by Dr Alice Garnett of Sheffield University.

Together with a reduction in atmospheric particulate matter, it is likely that urban heating has also contributed to a reduction in the number of foggy days in the city by keeping temperatures sufficiently high for air to remain above its dew point, thereby preventing the formation of fog. Comparisons in the number of fog lying days in the 1940s/50s and 1990s/2000s at Weston Park are shown in Figure 15. The number of foggy mornings in Rotherham is also shown for the earlier period (records from this station ceased in 1970). In many instances it is twice the number recorded at Weston Park, principally due to the lower lying position of Rotherham and its closer proximity to former heavy industry along the valleys of the Don and Rother, fog being much intensified by industrial pollution. The year 1958 was particularly foggy for both cities and foggy mornings were recorded in most months but with an unusually persistent spell of fog during the last fortnight of November.

Number of occasions with fog reported at 0900hrs

Year	Weston Park	Rotherham
1947	31	64
1948	25	47
1949	18	47
1950	11	31
1951	21	60
1952	24	43
1953	42	67
1954	20	37
1955	37	40
1956	32	57
1957	41	48
1958	74	75
1959	36	58

Year	Weston Park
1997	9
1998	3
1999	0
2000	1
2001	9
2002	6
2003	10
2004	4
2005	3
2006	1
2007	4
2008	2
2009	3

Figure 15 Comparisons of 'fog days' between Sheffield and Rotherham

Since the 1980s there has been much urban renewal in Sheffield including the transformation of the Don Valley from a place of predominantly heavy industry to one occupied by service industries; offices, retail, and residential dwellings. Closer to the city centre where development opportunities are more constrained by existing buildings and roads, the trend has been to build office and residential apartment blocks skywards. Not only does this contribute to raising temperatures in the immediate vicinity but it also changes patterns and rates of rainfall run-off and the pattern of local wind circulation.

[15] Knight, S. et al (2010)

Buildings, tall trees and high walls can produce a sheltering effect, reducing wind speeds but creating turbulence, gustiness and changes in wind direction[16].

As shown by the above examples, the region's landscape has a considerable effect upon the range of weather that occurs and which differs considerably from one place to another. To aid our understanding of this variability and to be able to quantify our climate more precisely and test the accuracy of modelled data[17], further high quality, long term weather stations are required across the region. Ideally these should be positioned on the low lying ground to the east of Sheffield and in the highest reaches of the western hills, in order that a more accurate record of the theoretical extremes of our climate can be obtained.

A more detailed analysis of weather statistics from Weston Park and the extrapolation of climate data across the region are presented in the later sections of this work.

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[16] Evans, R.A. & Lee, B.E. (1980)
[17] See section 'Climate trends in the Region'

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Sheffield's Past Weather Observers

> ***"To effect a subject so important to every class and constitution of life, – to humanity, – to commerce, – to society, – to physical and moral improvement, – every nerve should be strained, every means used, and the best energies of every observer exerted. What is there more important to our convenience and comfort than a knowledge of the climate in which we dwell…"*** [1]

BEGINNINGS

The rapid rise in scientific enquiry and experimentation across Europe in the middle of the eighteenth century meant that in towns and cities throughout Britain, individuals who were interested in acquiring and sharing knowledge from the wider world began to congregate in groups and societies where information could be exchanged. It was mainly the gentry, clergymen, doctors and botanists who embraced science and indulged in scientific experiments. Sheffield was no exception, although records show that formal gatherings here were somewhat later than in other towns, in part due to the geographical isolation of the region.

One medical practitioner whose line of inquiry extended far beyond his professional vocation was Dr Thomas Short (?1690-1772) a Scot by birth who settled in Sheffield in about 1727[2]. Short was a prolific medical author with a considerable reputation and practice, his correspondents and friends including Sir Hans Sloane, then President of the Royal Society and Richard Richardson, the famous botanist and antiquary of Bradford. He was described as:

> *'having a bluntness and freedom in conversation that were not always agreeable … was irritable in his temper, and impatient of contradiction. But he had undoubted abilities in his profession, was indefatigable in his pursuit after knowledge, and irreproachable in his moral conduct.'* [3]

One of Short's over-riding interests was the study of weather and its connection to health and he made one of the earliest documented records of weather observations in Sheffield, a daily journal of weather from January 1727 to December 1755. This now resides in the University of Oxford's Bodleian Library. Short meticulously entered in his journal barometer and thermometer readings, the direction of the wind and a general description of the prevailing weather conditions, using terms such as '*misling*' and '*hotest*'. Occasionally he would note the number of '*wetting hours*' in the month. He was also the author of 'A General Chronological History of the Air, Weather, Seasons, Meteors etc', an account based upon his own weather observations but including also an extensive list of weird and wonderful global weather events from 2407AM[4] to 1740 AD. Short studied epidemiology and considered that various illnesses were caused by particular weather events. The terrible winter of 1740, followed by a very poor summer, not only kept Short busy in his professional capacity but also gave him plenty of opportunity to describe the weather in his characteristic style:

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[1] Carr Woods, R. (1838)
[2] Sutherland, C.L. (1934)
[3] Nichols, J. (1812) footnote beginning on page 451
[4] *Anno mundi* – date based on the creation of the world – the definition has varied, but in this case it probably refers to Bishop Ussher's estimate of the creation (23 October 4004BC)

> [The winter of 1740] *'exceeded in severity all of the kind that any living had seen and did most mischief both at Sea and Land, starving and killing much people, splitting Timber, destroying the Sheep left by the rot, killed winter corn.*'
> [There was] *'no Spring, nor Buds, nor Blossoms in Gardens. Great was the drought of April and hopeless the Agriculture before the 21st, that 16 inches of deep snow fell.'* [May was cold and dry] *'very healthy; but a most scabby Spring. Bleeding the sick did not answer well, blood let was not Coreaceous,'*
> [September] '*like the rest of the Summer was extremely cold – catarrhs, swelled faces, Tooth Achs* [sic], *and Rheums were common. The River Dun was frozen over on September 28th.'* [5]

Short carried out experiments on the health benefits of tea, sugar, wine, and tobacco and made an assessment of spa waters, travelling far and wide to collect samples of water. Some of his experiments produced such powerful odours that he was said to sleep over the coal house as he felt it would be beneficial to his lungs.

After his wife's death in 1762 he retired to Rotherham. He died ten years later and was buried in the Parish Church Sheffield, now the Cathedral.

One of the earliest groups to be formed in the region encouraged the study of 'natural history' in the broadest sense and is documented in the writings of White Watson (1760-1835) of Bakewell[6]. Watson is best remembered for his pioneering work on the rock strata of Derbyshire. By profession he was a marble worker, apprenticed to a monumental sculptor, and he made a living creating grottos, cabinets of fossils and unique stone tablets detailing the arrangement of strata below ground, which he offered for sale to wealthy patrons. Watson's grandfather and uncle were also stonemasons and worked on Chatsworth House.

Watson was a prolific keeper of notes, including numerous short notes about the weather. He kept correspondence, cash books, journals and diaries between 1780 and 1831 in which he made frequent, often daily, references to the weather. This is hardly surprising given the importance of weather to everyday life and to conducting business around the Peak District by horse and cart. The diaries include some rather incredible accounts of weather too including Watson's claim of having been struck by lightning on three separate occasions; once at Hartington (16th May 1872), during dinner in 1799 (!) and once more in June 1807 (no location provided). Such gems perhaps serve to remind us that a degree of caution should be employed when interpreting data of this nature. Watson recorded other unusual as well as 'normal' weather events, including heavy falls of snow, waterspouts and comet showers. Weather lore features prominently in the diaries and he nearly always records the weather on two dates in particular i.e. St Paul's (25th January) and St Swithin's (15th July) days, the first of which he regarded as a very important indicator of the state of the next harvest. There seems little logic as to how the weather on a specific date in January should foretell of the harvest weather although he records the weather on this day in nearly all of his diaries from 1811 onwards. He also quotes various weather sayings; 'When April blows his horn it's good for hay and corn', 'April borrows of March three days and they are ill, one of rain, another of snow, the third as cold as did blow' (he notes the latter with reference to 1813). Another of his diary entries (in 1827) suggests a slightly more scientific approach to weather observing with notes about how to make a chemical weather glass :

[5] Stevens, W. (1933)
[6] Watson lived at Bath House, Bakewell

'Take 2 drams of camphor ½ dram of purified nitre and ½ dram of murate of ammonia pulverise and dissolve them in 2oz proof spirit and put the composition into a glass and cover mouth with a piece of bladder which must be perforated with a pin to admit air.'

On 20th June 1799 Watson brought together a group of notable 'worthies' from across the region to share what they had observed in their experiments and studies of nature, simply calling the gatherings 'Meetings for the encouragement of Natural History of Derbyshire'. The meetings were arranged thrice yearly, held alternately in Sheffield (the Angel Inn), Chesterfield and Bakewell. Regular attendees included the botanist Jonathan Salt (1759-1815), and surgeons Dr William Younge (1762-1838) and Dr Hugh M. Cheney (1744-1830).

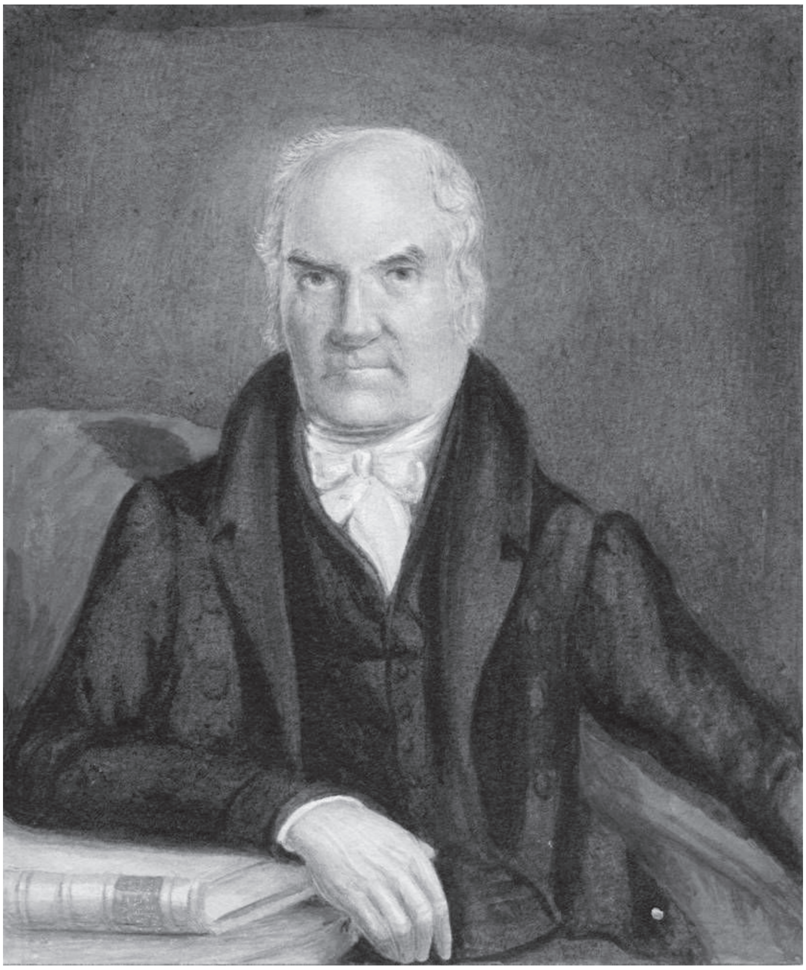

Figure 1 White Watson, from a picture in Derby Local Studies Library[7], painted after his death (reproduced courtesy of Derby City Council)

Watson's handwritten minutes (Figure 2) show that the first topic for discussion at these meetings was often the subject of weather, particularly its effects on plants, insects and birds. It is noted, for example, that early spring 1801 was considered to be unusually mild, but snow occurred in mid April causing damage to *Laburnum* and *Syringa* (lilac), along with wall fruits including peaches, apricots and nectarines. Drought is reported for the months of July and August 1801 and on 4th/5th September it is noted that rain was so heavy that the Don burst its banks below Rotherham and 'did considerable damage upon

[7] Derby Local Studies Library Portrait collection:W343 Watson, White

the levels'. The meetings continued for just a few years until autumn 1803, the last one occurring at the usual Sheffield venue, The Angel Inn on 28th September. On 6th January the following year, the same venue also held the inaugural meeting of 'The Society for the Promotion of Useful Knowledge', again with Salt, Cheney and Younge all in attendance and Watson proposed as a member in June that year. Weather was included within the list of subjects for discussion drawn up for members' approval.

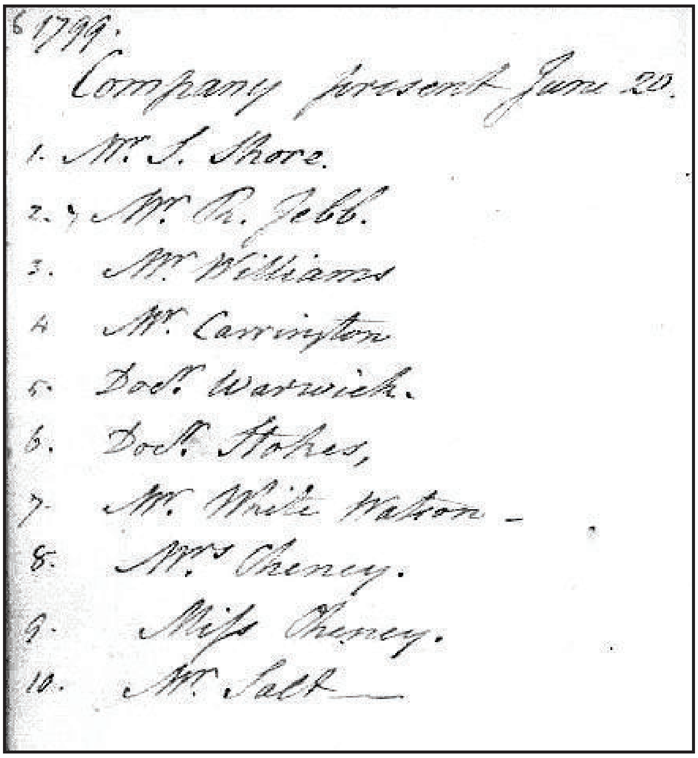
1799.
Company present June 20.
1. Mr. S. Shore.
2. Mr. Rt. Jebb.
3. Mr Williams
4 Mr Carrington
5. Doctr Warwick.
6. Doctr Stokes,
7. Mr White Watson –
8. Mrs Cheney.
9. Miss Cheney.
10. Mr Salt –

Figure 2 White Watson's minuted list of attendees from the inaugural gathering of 'Meetings for the encouragement of Natural History of Derbyshire' 20 June 1799 (courtesy of Museums Sheffield)

NINETEENTH CENTURY OBSERVERS

In 1822 the Sheffield Literary and Philosophical Society was founded and the Society grew rapidly and was well attended. Although the subjects for discussion were much more wide ranging, occasional interest was given over to the subject of weather and lectures delivered in related subjects. The annual accounts for 1826 reveal purchases of barometer, thermometer and hygrometer, along with a rain gauge in 1833. It is not known if any measurements were made, however, or even where the instruments were kept, although in 1833 the council had resolved that Mr W. Jackson, Mr Boultbee, and Dr Favell (all medical practitioners) should arrange to keep a 'Meteorological Journal'[8]. Papers given on meteorology included 'Atmospherical Electricity' and 'The Mechanical Causes of Thunder' in 1839 and in the following year, a series of four lectures on the 'Law of Storms' by Professor Epsy of Philadelphia along with a paper 'On Rain' by Dr Bartolome.

Preserved in the National Meteorological Archives in Exeter are two volumes of hand-written, bound manuscripts of weather readings, charts and letters for the years 1838-1840 (Figure 3) that were originally forwarded to Mr W. H. White Esq., Secretary of the

[8] Porter, W.S. (1922), p53

Meteorological Society[9], Hatton Gardens, London by William Joseph Simmonite of Sheffield. They include tabulated readings of air pressure, temperature, wind speed and direction, and notes about the general character of the prevailing weather, as well as lengthy correspondence to White. Simmonite had originally written to White in relation to the weather readings published in the 'Gardeners Gazette', with a view to having some of his own readings included. White published a weekly column comparing various forecasts and debated their respective merits. It appears from later correspondence that the Gardeners Gazette eventually ceased publishing weather records and Simmonite wrote to White to say he was, therefore, discontinuing his subscription.

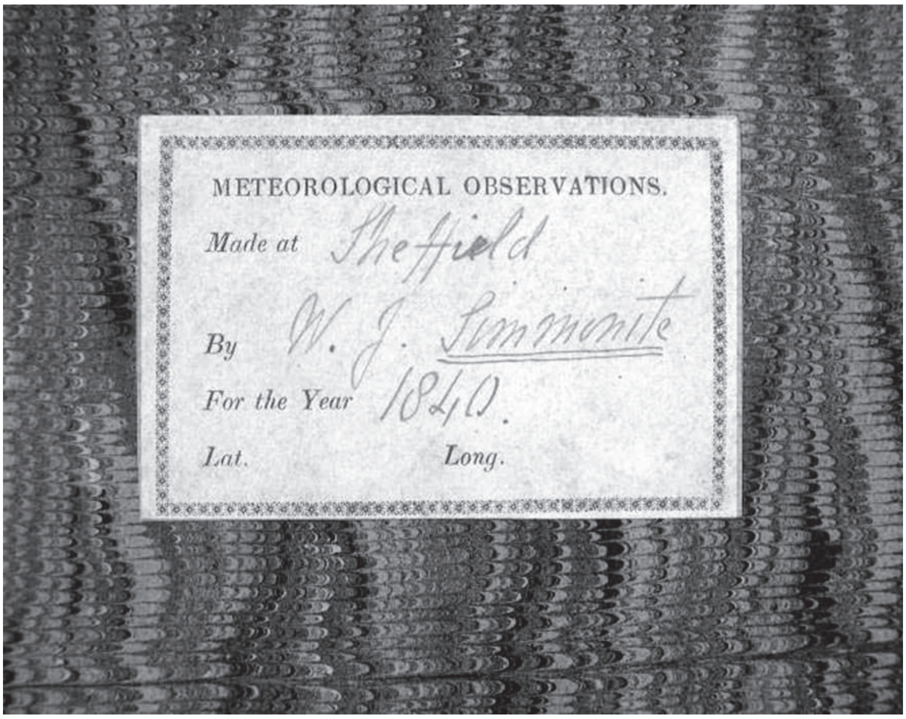

Figure 3 W.J. Simmonite's journal of weather observations for 1840 (courtesy of National Meteorological Archive)

William J. Simmonite (1809-1863) was born at Whiston near Rotherham and was 'Professor' of Medicine and Mathematics and a prominent herbalist in Sheffield during the mid 19th century. He also taught English and mathematics to students at the Bethel Academy on Coalpit Lane (now Cambridge Street) (Figure 4). Simmonite was most famed, however, as one of the leading proponents of astro-meteorology, the belief that all weather is controlled by the sun, moon and the aspect of the planets. Ever since Aristotle's work 'The Meteorologica', about planets and their effects upon the weather, there have been followers of astro-meteorology. Simmonite's interest in the subject was nurtured by his grandfather who had been a student of the astro-meteorology in 1773 and had created refined astro-meteorological charts based upon his detailed observations. Simmonite used these to make weather predictions and seemingly achieved a high degree of success. 'The Literary Gazette and Journal of Belles Lettres, Arts and Sciences..' Dec. 8th 1838 gives the following commendation :

> *'Mr W.J. Simmonite who it seems has astonished York and Lancashire by the accuracy of his weather wisdom in the 'Sheffield Iris' '.*

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[9] Likely to be The Meteorological Society of London, revived in November 1836, from an earlier society that had begun in 1826 but had flourished for only seven months.

A letter written to Simmonite by J. Middleton-Wright of Stockport on 2nd October 1843 and published in 'The Astro- Philosopher and Meteorologist' (1851) reads:

> '*Your services in the cause of science, especially in that of Astro-Meteorology, are beyond my praise - they are already on the wings of fame, - they are wafted to the shores of America – for I have sent one of your works there, and a friend of mine there, has spoken of your exertions in this country in terms of approbation. He designates yourself and Mr White, Secretary, as the Castor and Pollux[10] of Astro-Meteorology in this Kingdom. May your exertions in the progress of Science meet with that support from the public which they deserve, and which is the ernest wish of, Yours most faithfully*…'

News of Simmonite's reputation did indeed reach the shores of America. 'The United States Horoscope and Meteorologist', published in Philadelphia around this time states:

> *'The Meteorologist of this age is W.J. Simmonite of Yorkshire, England. In the year 1839, he put forth his first publication. Should Mr Simmonite live to the ordinary age of man, he will do the cause of truth essential service.'*

Simmonite listed the angular positions of planets by zodiacal sign (Figures 5 & 6). He published these in inexpensive almanacs that were extremely popular at the time although there were many others in circulation too, some selling in hundreds of thousands per year (e.g. Zadkiel's Almanac)[11].

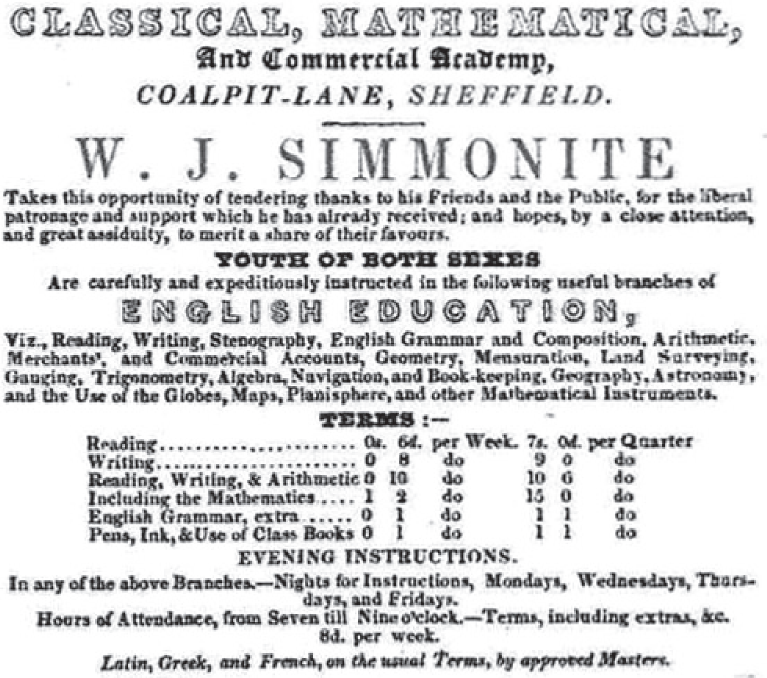

Figure 4 Advertisement in 1837 for W.J.Simmonite's education classes in Sheffield

[10] Castor and Pollux were twin brothers in Greek and Roman mythology. In the myth the twins shared the same mother but had different fathers. Pollux was immortal and Castor was mortal. When Castor died, Pollux asked Zeus (his father) to let him share his own immortality with his twin to keep them together and they were transformed into the Gemini constellation.
[11] Farnell, K. (2006).

Figure 5 Simmonite's hand drawn astro-meteorological chart for Sheffield of the winter quarter 1840 (courtesy National Meteorological Archive)

A TABLE OF SOL-SATURN ASPECTS, AND THEIR EFFECTS, AT SHEFFIELD, 1843.

DATE.	ASPECTS.	THERMOMETER. FALL IN Max.	Min.	Mean.	☉ in	STATE OF THE WEATHER.
January 7	☌	11	11	5	♑	threatening.
,, 9	Par.	12	14	9	♑	sleet.
Feb... 9	S✻	3	6	4	♒	drizzling rain, night frosty.
,, 16	SQ.	2	6	4	,,	fine, frost.
,, 26	S□	4	5	2	♓	chilly, night rainy.
March 14	✻	6	10	3	,,	showers.
,, 26	Qu.	2	1	1	♈	cool showers.
April. 16	□	1	11	0	,,	threatening.
,, 24	Trecile	12	16	14	♉	fine.
May.. 6	Sta.	13	15	14	,,	cold showery day.
,, 17	△	19	5	9	,,	ditto.
,, 26	Par.	5	2	2	♊	slight rain.
June. 1	Ssq.	2	3	3	,,	showers, wind.
,, 10	Bq.	8	8	10	,,	showery.
,, 16	Qx.	5	4	4	,,	fine.
July.. 15	☍	9 R.	5 R.	8 R.	♋	cloudy and rain.
Aug.. 13	Qx.	2 R.	0	0	♌	fine.
,, 19	Bq.	2	0	0	,,	fine.
,, 28	Ssq.	2	2	0	♍	showers.
Sept.. 12	△	3	8	4	,,	showers.
,, 24	Sta. & Tre.	6	9	11	♎	fine.
Oct... 13	□	13	12	14	,,	rain and wind.
Nov.. 1	Qu.	2	4	2	♏	slight showers.
,, 14	✻	5	5	1	,,	sleet, night frost.
,, 30	S□ & Par.	4	9	3	♐	dense, frost night.
Dec... 8	Dec.	4	6	2	,,	ditto, ditto.
,, 17	S✻	3	4	5		ditto, ditto.

Figure 6 Simmonite's weather chart at Sheffield in relation to the planetary aspects of Saturn and the sun 1843 (from 'The Scientific and Literary Messenger' 1843)

Simmonite was a prolific writer and editor during his relatively short life and authored many books and papers including 'The Meteorologist' first published in 1839, 'W.J. Simmonite's Astronomical Ephemeris' 1847, 'Medical Botany' 1848, 'The Astro-Philosopher and Meteorologist' 1848/1850, 'Horary Astrology' 1851 and the 'Astronomical and Meteorological Almanac' 1860/1861. He also edited 'The Scientific and Literary Messenger' 1842-1844 and established a society in Sheffield for the study of Science, Astro-philosophy and Meteorology (Figure 7).

By the mid-1800s many leading scientists of the day were questioning the credibility of astro-meteorology even though two of its most notable followers Lieutenant R.J. Morrison, R.N.[12] and Mr W.H. White were founders of the Meteorological Society of London[13]. The

[12] Morrison, along with Simmonite, was a foremost astro-meteorologist of the day. His pseudonym was Zadkiel – the archangel associated with the planet Jupiter. This was also the pseudonym of William Lilly, a 17th century astrologer of whom Morrison was a disciple. See Walker, J.M. (1993).

[13] This incarnation of the society formed in 1848. Two other meteorological societies of London had existed for a short time prior to this one - White and Morrison had both also been prominent members of the second one.

close association of the subject to astrology, which was then illegal, gave it a particular notoriety. Astronomy was then the only officially recognised celestial science. When one of Simmonite's astrologer friends was convicted in 1852, Simmonite gave up his public talks on astrology, refused personal interviews and closed his private school although he continued his astrological almanacs, but solely by correspondence.

In recent years astro-meteorology is enjoying a resurgence of interest.

THE SHEFFIELD ASTRO-PHILOSOPHICAL, METEOROLOGICAL, AND PHYSICAL SCIENCE SOCIETY,

Established March 4*th*, 1843.

The ob ect of this Society is to promote the investigation and cultivation of Astrology and Astronomy, to prove to unprejudicial minds the indubitable truth and possibility of Astro-Meteorology and Astro-Phrenology ; to practically demonstrate the applicability of the Astral Philosophy to the affairs of society : with a view of improving the deplorable condition of mankind, and to promote the happiness and pecuniary advantage of the human family, by averting the threatened calamity, which, without Astrology, cannot be foreseen.

The Society consists of three Classes :—

1st. Members or those persons residing in Sheffield and its neighbourhood.
2nd. Associates or those persons co-operating with the Society, but residing out of the neighbourhood of Sheffield.
3rd. Honorary Members.

The Society meets every First Wednesday, in each month, at 8 o'clock, P. M., at the Society's Institute, at the Sheffield British Institution.

Members admitted by Ballot.

Entrance Fee 5s., and a Subscription of 5s. per Year, paid half-yearly. The Subscriptions become due when Sol enters Aries and Libra.

Subjects for discussion are brought forward and signified the previous meeting night. Questions and figures transmitted to every Member for his judgment, which shall be sent or brought by *every* Member and Associate, and the result entered into the Minute Books.

Application for Membership to be made, and books and instruments sent to the Treasurer, addressed to

W. J. SIMMONITE, A. M.,
St. George's Square, Sheffield.

Figure 7 Advertisement for 'The Sheffield Astro-philosophical, Meteorological and Physical Science Society', est'd. 1843

Another nineteenth century account of weather observations in the region is evidenced in the transcript[14] of the hand-written journal (in private ownership) entitled 'Remarkable Occurrences', believed to have been authored by William Peniston (1793-1863). Peniston was a miller by profession and was formerly a resident of Stone, near Maltby. He also lived for a time at Oldcoates and in retirement moved to Goldthorpe Place, a croft in the grounds of Mushroom Hall, Sheffield, just a short distance from the present day Weston Park weather station.

[14] Unpublished transcript © Mike Sparling (2005)

Peniston's journal consists mostly of descriptions of the weather, together with occasional barometer and thermometer readings throughout a 53 year period (1808-1861) including readings from Goldthorpe Place during the later years. These predate the records of Weston Park weather station by around 20 years and, therefore, usefully extend the period of continuous weather recording in this part of Sheffield.

Peniston's journal makes for fascinating reading[15] as indicated in the excerpts below:

> (July 13th 1808) '*a very remarkable hot day; was supposed the hottest that had ever been here in England; many horses fell dead on the road, and many men were killed by the excessive heat while working in the fields, and gooseberries were actually roasted on the trees'*
>
> *'1825 December…on the 14th was a very severe thunderstorm which did very material damage to Tickhill church, breaking the chimes and windows….the lightning was very white so as to dazzle peoples eyes and blind them for a short time; many sheep were lost by being frightened into the water ditches.'*

He also makes reference in the journal to rainfall measurements recorded at Broomhall Park, Sheffield. It is likely that he is referring to the measurements made by the grandson of Daniel Doncaster (1757-1819), the founder of the well-known Sheffield firm of steel manufacturers, Messrs. Daniel Doncaster and Sons, established in 1778 and still thriving today as 'Doncasters Group Ltd.,'[16].

Daniel Doncaster Jnr. (1835-1912) (Figure 8) was elected a member of the British Meteorological Society[17] in 1863, nominated by Louis P. Casella, James Glaisher[18] and Charles Vincent Walker. He prepared charts and hand drawn graphs of the measurements he took at Broomhall Park and forwarded these to the British Meteorological Society. Charts for the years 1852-1884 (with some periods missing) are now in the National Meteorological Archive (Figure 9). They include tabulated readings of monthly and yearly averages and extremes for air temperature, rainfall and air pressure, and hygrometer and wind direction readings. There are no further records after 1884, the year that Doncaster's father died and the point at which Daniel Doncaster Jnr. presumably would have taken over control of the firm.

For the years documented by both Peniston and Doncaster their independent weather observations overlap to give a comprehensive account of the weather. In November 1854 Peniston writes '*A very great scarcity of water occurred particularly in the supply of towns and canals" and "Much less rain has fallen here than in the average year.'* Doncaster calculates 1854 to be the driest year in the fourteen-year period from1852-1865 with a total of 22.22 inches of rainfall. Similarly both determine the following year also to be

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[15] More extensive references to Peniston's journal can be found in the section 'Weather events in and around Sheffield'
[16] see *http://www.doncasters.com/aboutus/?s=1&p=2*
[17] The British Meteorological Society was formed in 1850, and absorbed the Meteorological Society of London. When the Royal Charter was granted to the British Meteorological Society in 1866, the name changed to the Meteorological Society and Daniel Doncaster automatically became a Fellow.
[18] James Glaisher was a founder member of the British Meteorological Society.and a pioneering balloonist. Between 1862 and 1866 Glaisher made numerous ascents in order to measure the temperature and humidity of the atmosphere at its highest levels. On one ascent in 1862, he broke the world record for altitude, but passed out before a reading could be taken. Estimates suggest that he rose to approximately 7 miles above sea-level.

unusually dry, Peniston highlighting specifically the month of May for which he notes a scarcity of water at the corn mill and it being the first he had ever noted at that time of year. His description of an abundant pasturage throughout 1857 with scarcely any frost and very little snow is borne out by Doncaster's statistics which show an average annual temperature of 50.9°F for 1857 and it being the mildest year recorded between1852-1865.

From time to time Daniel Doncaster also supplied his weather readings to another Sheffield weather observer, William Frederic Cooper (1828-1889). Cooper was a member of the Sheffield Literary and Philosophical Society (1842) and was elected Fellow of the Meteorological Society in June 1872 nominated by Robert H Scott, Director of the Meteorological Office, by Henry Stokes-Eaton and Arthur Brewin. At that time he was resident at John Street (off London Road) Sheffield but moved to St Mary's Road in 1872. In 1878 the Meteorological Society's membership list gives his address as 'Dannemora Place' on New Shoreham Street.

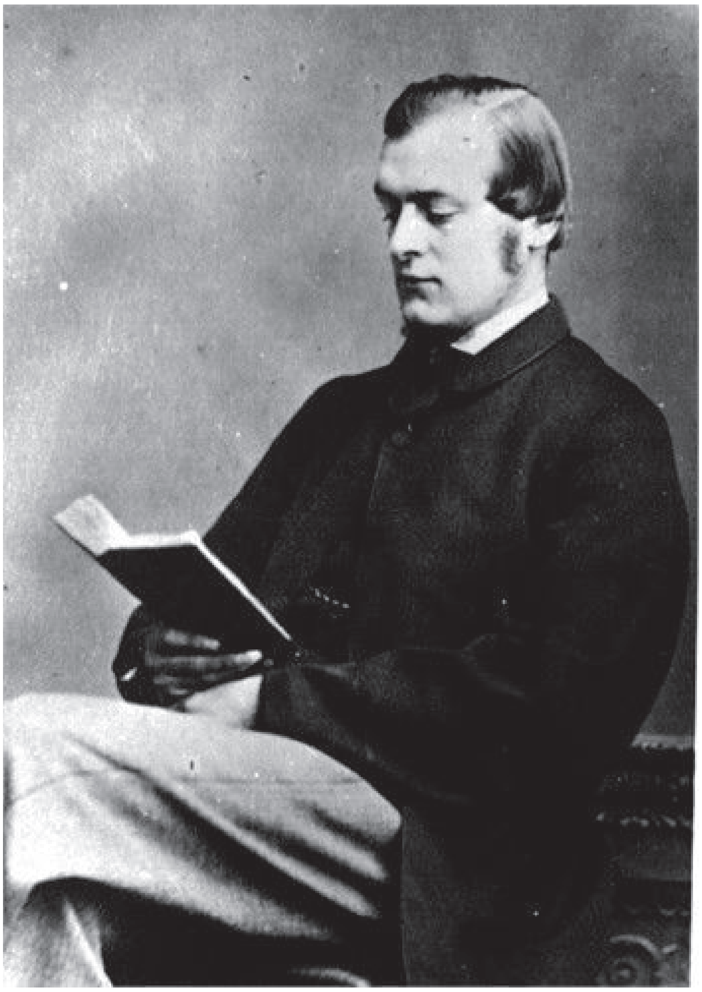


Figure 8 Daniel Doncaster circa 1864 (© Jane K. Mills)

For a ten year period from 1874 to 1884 Cooper forwarded detailed weather observations to the Director of the Meteorological Office[19]. In the beginning he enthusiastically measured air pressure and temperature and made observations of cloud cover and wind up to four times a day. This then dropped to twice a day, 0800hrs and 1100hrs GMT, and continued thus for the next ten years. He also recorded the flowering times of cherry (20th April), apple & pear (23rd April), *Laburnum* (24th April) and lilac (25th April) in the first year

[19] Then at 116 Victoria Street London SW

of observations. Cooper added descriptions of the weather to his journal, including an account of a thunderstorm on 7th August 1875 that began at 1pm and continued to 11pm during which he noted rain to have fallen in torrents for hours at a time and lightning that lasted throughout the night. On the 11th August he noted peculiar long stratus clouds to the south-east. These may well have been lenticular clouds (discussed earlier in 'Sheffield's weather'). Two particularly severe and successive winters also are noted in his observations. The first of these was 1878/79 which began early towards the end of October and lasted until the end of February. In December and January temperatures fell below 32°F on 54 occasions and throughout the winter there were 35 days with snow. In November 1879 there were seven days with snow followed by an exceptionally hard frost in December with temperatures during the first seven days not reaching above 32°F and a record overnight temperature of 3°F (-16.1°C) on the 7th (note the similarities with Nov/Dec 2010). The last three weeks of January 1880 were also cold with temperatures dropping below 32°F on 22 days of the month. Both Cooper's and Daniel Doncaster's observations attest to a cold March in 1883 with record minimum temperatures of 14°F and 13°F (-10°C) respectively. Cooper reported snow on 14 days during the latter part of the month and air frost on 24 days of the month. At Weston Park minimum temperatures fell to 17°F (-8.4°C) and 23 days of air frost were recorded.

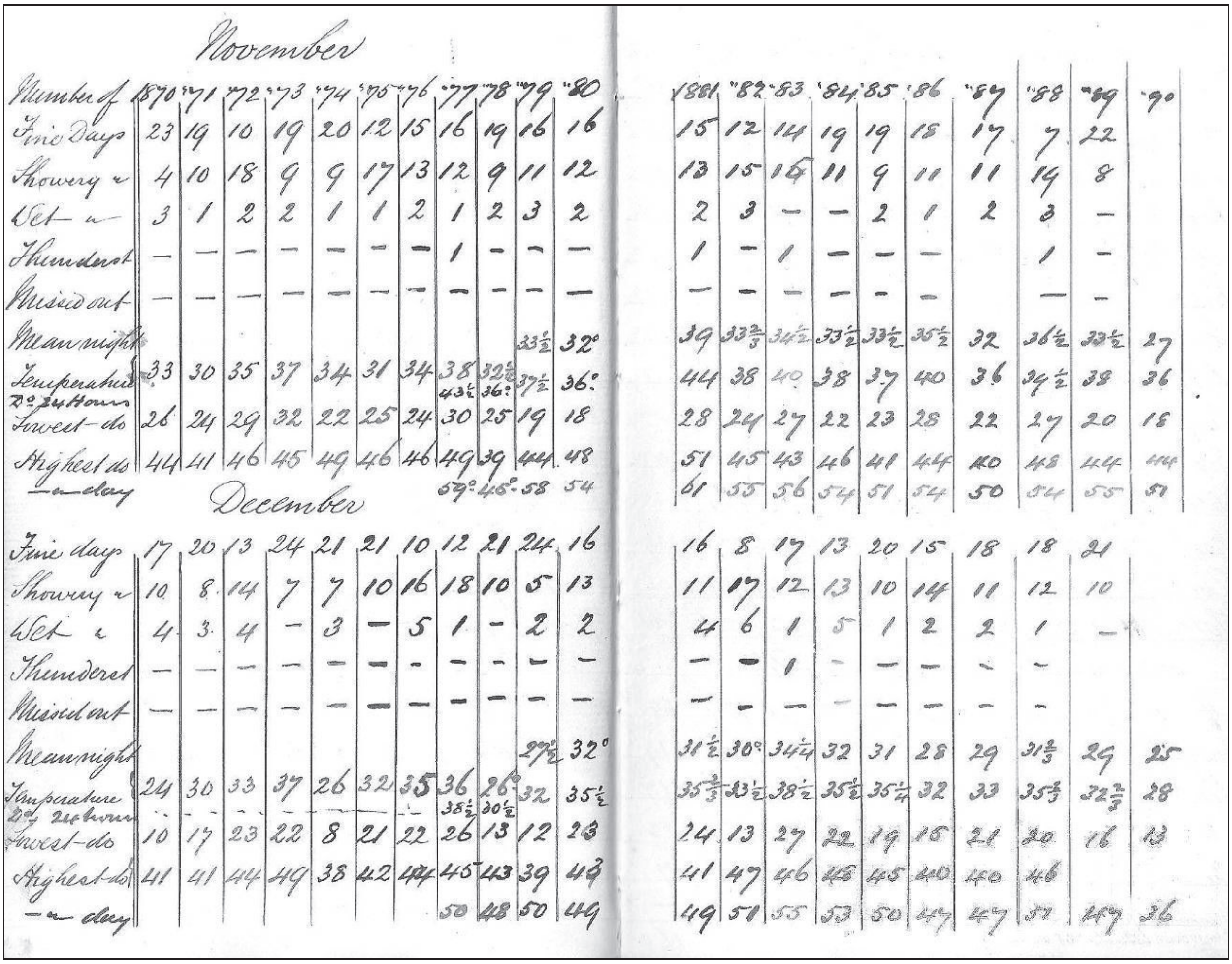
Summary of Meteorological Observations for 1866.
Taken at Broomhall Park, Sheffield, by Daniel Doncaster Jr
53° 22' 27" N LATITUDE. 1° 29' 19" W LONGITUDE. 337 ft above the Sea

1866 MONTHS.	ATMOSPHERIC PRESSURE. Highest Inches	Date	Lowest Inches	Date	Mean 32° at 337 feet above Sea Level	TEMPERATURE OF THE AIR. Highest	Date	Lowest	Date	Average Max:	Average Min:	Adopted Mean	Nights at or below 32°	RAINFALL. Total Depth Inches	Greatest Fall in 24 hours Depth	Date	Days on which ·01 or more fell	Taken at Crookesmoor Side 600 feet above the sea	Prevailing Wind.
January	30·079	26th	28·425	9th	29·277	52·5	14th	19·9	12th	44·3	38·2	41·2	4	2·78	·34	27th	22	3·14	W.
February	29·872	21	28·298	11	29·237	52·2	5	24·9	14	44·4	34·4	38·9	11	3·36	·75	11	23	3·71	N.W.
March	29·925	10	28·430	24	29·223	60·8	29	19·7	1	45·3	33·8	38·7	14	2·03	·52	23	22	2·24	N.W.
April	30·035	23	28·999	2	29·454	72·1	27	29·0	30	53·5	39·0	45·9	1	1·41	·40	2	19	1·53	E.
May	30·066	16	29·346	27	29·594	72·6	19	30·7	4	59·6	39·4	48·3	3	·92	·25	11	11	1·09	E.
June	29·871	9	29·080	18	29·556	87·4	27	41·0	18	67·3	50·7	56·9		4·18	1·18	18	17	3·84	W & E.
July	29·927	11	28·955	3	29·569	83·1	12	45·0	7 & 18	66·8	52·1	57·5		4·00	1·85	28	14	4·51	W.
August	29·725	23	28·910	7	29·513	70·6	19	44·4	18	63·5	50·7	55·6		3·10	·81	29	19	3·41	N.W.
September	29·729	30	28·956	22	29·435	64·5	6	39·7	25	59·9	48·5	53·1		4·87	·69	16	30	5·18	S.W.
October	30·154	6	29·230	30	29·715	61·4	1 & 19	32·4	17	54·2	45·5	48·9		2·98	·79	18	23	3·01	N.E.
November	29·883	29	28·791	16	29·491	58·4	6	28·0	20	48·7	38·5	43·7	6	3·52	·70	16	20	3·85	W.
December	30·073	22	28·823	30	29·475	56·4	4	26·7	1	46·4	37·0	41·7	7	3·01	·51	6	22	3·20	N.W
Annual Mean &c.	30·079	Jany 26	28·298	Feby 11	29·461	83·1	July 12	19·7	March 1	54·5	42·3	47·5	46	36·16	1·85	July 28	242	38·71	W.

Figure 9 Meteorological observations recorded by Daniel Doncaster Jnr. at Broomhall Park, Sheffield for 1866 (courtesy of National Meteorological Archive)

Weather measurements were also made in Sheffield at this time by another steel manufacturer (and Master Cutler in 1887) James Dixon (1851-1947) F.R. Met.S., of Stumperlowe, Fulwood, who kept records of rainfall and temperatures, and made accompanying notes about the weather over 67 years between 1869 and 1936 (there are periods of no record within this). Six of his handwritten journals survive and are now in the meteorological archive of Museums Sheffield (Figure 10).

A particularly cold December was noted by Dixon in 1870 when the thermometer dropped to 10°F (-12.2°C) (Figure 8) and there was skating on all the reservoirs on Christmas Eve. He also noted a spell of severe cold in December 1874, the cold setting in from the 9th with '*good skating to be had on all the reservoirs at Redmires*' from the 20th. He noted 31st December 1874 to be the coldest day since 1860, with the temperature the next morning at just 5°F (-15°C).



November

Number of	1870	'71	'72	'73	'74	'75	'76	'77	'78	'79	'80
Fine Days	23	19	10	19	20	12	15	16	19	16	16
Showery "	4	10	18	9	9	17	13	12	9	11	12
Wet "	3	1	2	2	1	1	2	1	2	3	2
Thunderst	—	—	—	—	—	—	—	1	—	—	—
Missed out	—	—	—	—	—	—	—	—	—	—	—
Mean night										33½	32°
Temperature	33	30	35	37	34	31	34	38	32½	37½	36°
D° 24 Hours								43½	36°		
Lowest do	26	24	29	32	22	25	24	30	25	19	18
Highest do	44	41	46	45	49	46	46	49	39	44	48
— a day								59°	46°	58	54

Number of	1881	'82	'83	'84	'85	'86	'87	'88	'89	'90
Fine Days	15	12	14	19	19	18	17	7	22	
Showery "	13	15	16	11	9	11	11	14	8	
Wet "	2	3	—	—	2	1	2	3	—	
Thunderst	1	—	1	—	—	—		1	—	
Missed out	—	—	—	—	—	—		—	—	
Mean night	39	33⅔	34½	33½	33½	35½	32	36½	33½	27
Temperature	44	38	40	38	37	40	36	34½	38	36
Lowest do	28	24	27	22	23	28	22	27	20	18
Highest do	51	45	43	46	41	44	40	48	44	44
— a day	61	55	56	54	51	54	50	54	55	51

December

	1870	'71	'72	'73	'74	'75	'76	'77	'78	'79	'80
Fine days	17	20	13	24	21	21	10	12	21	24	16
Showery "	10	8	14	7	7	10	16	18	10	5	13
Wet "	4	3	4	—	3	—	5	1	—	2	2
Thunderst	—	—	—	—	—	—	—	—	—	—	—
Missed out	—	—	—	—	—	—	—	—	—	—	—
Mean night										27½	32°
Temperature	24	30	33	37	26	32	35	36	26°	32	35½
D° 24 hours								38½	30½		
Lowest do	10	17	23	22	8	21	22	26	13	12	23
Highest do	41	41	44	49	38	42	44	45	43	39	43
— a day								50	48	50	49

	1881	'82	'83	'84	'85	'86	'87	'88	'89	'90
Fine days	16	8	17	13	20	15	18	18	21	
Showery "	11	17	12	13	10	14	11	12	10	
Wet "	4	6	1	5	1	2	2	1	—	
Thunderst	—	—	1	—	—	—	—	—		
Missed out	—	—	—	—	—	—	—	—		
Mean night	31½	30°	34¼	32	31	28	29	31⅔	29	25
Temperature	35⅔	33½	38½	35½	35¼	32	33	35⅔	32⅔	28
Lowest do	24	13	27	22	19	15	21	20	16	13
Highest do	41	47	46	45	45	40	40	46		
— a day	49	51	55	53	50	47	47	51	47	36

Figure 10 Weather journal kept by James Dixon of Fulwood, Sheffield (courtesy Museum Sheffield)

Evidence for the existence of other 'official' weather recording sites in Sheffield in the early 1900s can be witnessed in the station inspection reports undertaken by the Meteorological Office at the time. These are now kept at the National Meteorological Archive in Exeter although the whereabouts of many of the day to day readings at these stations is not known at the time of writing.

Mr C J Barker, formerly of 62 West Street, Sheffield operated a weather station from the rooftop of the Radical Club at 84 West Street around 1900. A Meteorological Office inspection report dated September 9th 1901 reports a range of instruments in use at the site including a Fortin barometer, Richards aneroidograph (barograph), Jordan sun recorder, two eight-inch rain gauges, a Stevenson screen (thermometer shelter) with dry bulb, wet bulb, maximum and minimum thermometers, solar radiation thermometer, terrestrial radiation thermometers and small cup anemometer. There is also a plan of the rooftop site showing the positions of the various instruments along with a note about Mr Barker's enthusiasm for weather recording and his carefully maintained records. Barker also generously donated two sunshine recorders and a rain gauge to the Museums Committee for use by them in other districts of Sheffield. One of the recorders was set up at High Hazels Museum in 1902 and maintained by Elijah Howarth, Curator of Weston

Park Museum. The rain gauge was installed in High Hazels Park in 1905. A second sunshine recorder donated by Barker in 1906 was fixed at Moscar in 1907 but later moved to Lodge Moor (probably to the former hospital where it could be maintained by hospital staff on behalf of the City's Medical Officer of Health). Another sunshine recorder was once in operation in Attercliffe, maintained on the rooftop of Attercliffe Public Baths by the City's Medical Officer of Health, Mr Downing. A Met Office inspection report of this recording site in September 1901 includes the following note:

> *'The approach to the roof is through the ladies private bathroom and it is impossible therefore to ensure that the cards*[20] *shall be changed at any fixed time. Mr Downing can only go when the bath-room* [sic] *is not in use, and it would be practically impossible for a woman to go up.'*

The report also describes the location of the site to be in the manufacturing part of the town with smoke-producing factories extending for roughly two miles on all sides. It also records that when the sun was low in the sky it would not have the power to burn through the smoky atmosphere. A later inspection in July 1906 again refers to the smoky state of the atmosphere and the difficulty in obtaining access to the 'very dirty' roof. Two years later there is mention that the sunshine records were in part used as a means of educating the public to take an active interest in the investigation of smoke nuisance. It also claims that some progress had already been made in this direction.

By 1909 at least four sunshine recorders were in operation throughout Sheffield; Attercliffe, High Hazels, Weston Park and Lodge Moor. Elijah Howarth (weather observer at Weston Park) collated readings from all of these sunshine recorders in the ledgers he kept at Weston Park weather station. A comparison of them for the years 1909-1915 is shown in Figure 11. This indicates that sunshine totals at Attercliffe were around 25% less than in the smoke-free higher suburbs.

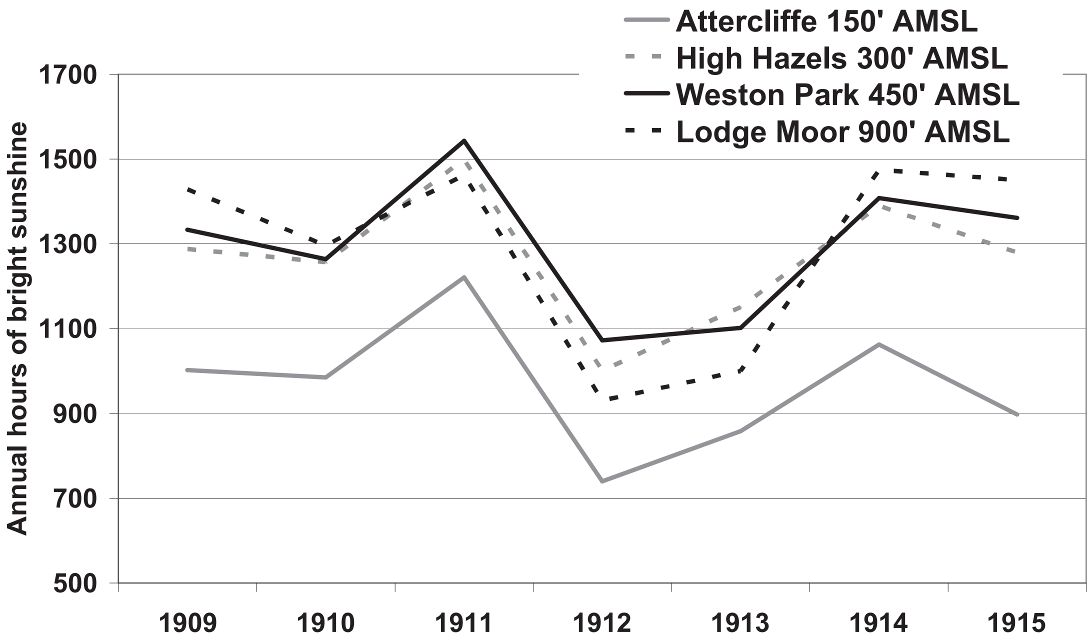


Figure 11 Annual sunshine totals (in hours of bright sunshine) recorded across Sheffield between 1909-1915

[20] a new recording card was slotted into the sunshine recorder each day

Socialist poet Edward Carpenter (who lived at Millthorpe, nr. Sheffield), summed up the nature of the Sheffield smogs rather dramatically in a piece for the 'Sheffield Independent' in May 1889, where he described the giant thick cloud of smog rising out of Sheffield to be like 'the smoke arising from Judgment Day; the altar on which the lives of many thousands would be sacrificed.' He described how 100,000 adults and children were struggling to find sunlight and air, enduring miserable lives, unable to breathe and dying of related illnesses.

In 1859, George James Symons set up a system for collating rainfall records throughout the British Isles by sending out circulars inviting all the observers he knew of in England (some 168 at the time) to submit their records. He published the results the following year in the pamphlet 'English Rainfall 1860' and it was so popular that this became the first in a long run of publications that were renamed 'British Rainfall' and which ran for almost 100 years after Symons' death [21]. The list of subscribers by 1880 included a Duke, two Earls, three MP's, a fleet of admirals and numerous clergymen and civil engineers[22] amongst numerous other public bodies and local authorities. The aforementioned Daniel Doncaster was Symons' correspondent for the Sheffield rainfall returns and he is named in the first 1860 pamphlet as the authority for Sheffield, the sole entry for Sheffield in fact. Interestingly, he is also named as the correspondent for 'Redmires' [sic] nr. Leyburn, North Yorkshire.

During the course of his work, Symons also encouraged rain gauge standardization trials. This included important early pioneer work in Rotherham on the development of the modern rain gauge. Experiments were carried out by Mr R. Chrimes of Rotherham Water Works at Ulley and Boston reservoirs for at least eight years from 1865, principally with the aim of finding out about the effects of wind upon rainfall capture and also the differences in catchment amounts when gauges were set at different heights above the ground. Different types of rain gauges were used in the experiments – inclined, rotating and tipping-funnel versions and were positioned at 5 feet height intervals to a maximum elevation of 25 feet. Chrimes found that less rain was captured with increasing elevation from the ground. He also found capture rates to be greater when the gauge was inclined into the wind compared to when the funnel was horizontal. The planning and results of these ongoing experiments were published by Symons across several volumes of 'British Rainfall' from 1866 onwards.

At about this time Sheffield Waterworks and the Derwent Valley Water Board began to establish a network of rain gauges around the Sheffield region. The earliest of these was at Redmires, for which annual rainfall readings are available from 1836 and monthly readings from 1872. Others followed in 1872 at Crookes and Rivelin, in 1898 at Flouch and many others from 1911 and over the following fifty years or so, positioned in the catchment areas of the Rivers Rivelin, Loxley, Little Don and Ewden. The extract from 'British Rainfall' shown in Figure 12 shows just a few of the gauges in operation in the region in 1934.

Rainfall data for the region is now collated by the Environment Agency from public and private stations using a combination of automated and manual gauges. There are some 40 recording sites for the River Don catchment area at the time of writing. Rainfall has also been monitored at a number of sites across Sheffield by the City of Sheffield (City Engineer's Drainage Division) since 1914 using 8" automatic rain gauges (and a 12" open scale automatic rain gauge at Hadfield Dam). These sites include:

[21] Symons began the publication of the 'British Rainfall Organization'. It was taken over by the Meteorological Office in 1919, and ran until 1991 when it was ceased on economic grounds.
[22] Burt, S. (2010)

Site	Height AMSL	From date
City Engineer’s Olive Grove Depot	230’	1914
Wincobank Sewage Disposal Works	100’	1914
Hadfield Dam	625’	1921
Ringinglow Road	770’	1931
Chesterfield Road South	530’	1954
Moonshine Lane	470’	1964
Holbrook Sewage Disposal Works	160’	1970

The readings and some daily charts are preserved within the meteorological archive at Museums Sheffield.

208 BRITISH RAINFALL, 1934.

DIVISION IX—YORKSHIRE—(*con.*).

STATIONS.	AUTHORITIES.	Diam.	Rain-gauge: Height of Rim above Ground.	Rain-gauge: Height of Ground above Sea Level.	Average Rainfall.	1934. Rainfall.	1934. Days with ·01 in. or more.	1934. Days with ·04 in. or more.
5.—TRENT—Derwent. 7 sq. mi.								
D Burbage (Parsons House)*	Sheffield Corporation W.W.	8	1 0	1309	..	32·14	197	160
Burbage (Higger Lodge)*	Sheffield Corporation W.W.	5	1 0	1225	36·8	33·10	..	..
Burbage (Upper Burbage)*	Sheffield Corporation W.W.	5	1 0	1364	36·1	36·40	..	..
Howden Dean No. 72	Derwent Valley Water Bd.	5	1 0	965	..	43·87	..	..
M Derwent Dale (HowdenCl'gh) No. 64	Derwent Valley Water Bd.	5	1 0	1030	44·4	48·60	..	..
M Derwent Dale (Sandy Lee) No. 7	Derwent Valley Water Bd.	5	1 0	1340	..	42·26	..	..
Derwent Dale (Sandy Lee) *checkg.* 7A	Derwent Valley Water Bd.	5	1 0	1340	..	48·38	..	..
6.—TRENT—Left Bank Tributaries. 143 sq. mi.								
Lindrick Common (Woodside)	Mrs. M. E. Eardley	5	1 0	250	25·5	22·54	..	119
Austerfield P.S.	Doncaster & Tickhill Joint Water Bd.	8	1 0	32	..	19·31	161	117
D Rossington Main Colliery	Rossington Colliery Co., Ltd.	5	1 0	22	..	20·08	162	118
7.—OUSE—Don. 564 sq. mi.								
Burbage (Badger Ho.)†	Sheffield Corporation W.W.	5	1 0	1138	..	34·40	..	..
D Sheffield W.W. (Redmires R.) (R)	Sheffield Corporation W.W.	10	5 0	1110	40·3	35·08	209	157
D Sheffield W.W. (Redmires Res.)	Sheffield Corporation W.W.	8	4 0	1110	39·9	34·57	213	159
D Sheffield W.W. (Redmires R.) *new g.*	Sheffield Corporation W.W.	5	1 0	1110	..	36·09	213	158
§Rivelin (Oaking Clough)	Sheffield Corporation W.W.	8	1 0	1160	39·8	35·11	..	..
Rivelin (Middle Moss)	Sheffield Corporation W.W.	5	1 0	1168	41·0	37·80	..	..
D Sheffield W.W. (Rivelin) (+A)	Sheffield Corporation W.W.	8	1 6	564	35·2	33·60	183	150
Sheffield W.W. (Black Clough)	Sheffield Corporation W.W.	5	1 0	1175	40·3	42·18	..	..
D Sheffield W.W. (Crookes)	Sheffield Corporation W.W.	5	1 1	629	..	26·62	175	136
D Sheffield W.W. (Crookes)	Sheffield Corporation W.W.	8	2 0	629	..	25·09	175	133
D SHEFFIELD (Weston Park)	The Corpn. (E. Howarth, F.R.A.S.)	8	1 0	428	30·4	24·68	171	130
Loxley Valley (Crawshaw Wood)	Sheffield Corporation W.W.	5	1 0	1175	..	37·16	..	..
Loxley Valley (Broadcar)	Sheffield Corporation W.W.	5	1 0	1004	44·4	41·15	..	..
Loxley V. (Oaks Fm. Damflask)	Sheffield Corporation W.W.	5	1 0	650	36·1	34·21	..	..
Loxley V. (Loftshaw, Strines)	Sheffield Corporation W.W.	5	1 0	1011	43·2	36·98	..	..
D Loxley Valley (Bradfield Filters)	Sheffield Corporation W.W.	8	1 0	551	..	34·65	190	159
D Loxley V. (Dale Dike Res.)	Sheffield Corporation W.W.	8	1 0	715	39·5	37·59	214	164
Loxley Valley (Bragging Moss)	Sheffield Corporation W.W.	5	1 0	1360	..	43·64	..	..
Loxley V. (Thornseat)	Sheffield Corporation W.W.	5	1 0	1326	42·6	38·95	..	..
Loxley V. (Rocher Flat)	Sheffield Corporation W.W.	5	1 0	1106	37·1	31·74	..	..
Loxley V. (Emlin Moor)	Sheffield Corporation W.W.	5	1 0	998	41·3	38·22	..	..
Loxley Valley (White Lee Moor)	Sheffield Corporation W.W.	5	1 0	1170	..	35·74	..	..
Loxley Valley (Hobson Moss)	Sheffield Corporation W.W.	5	1 0	1530	..	41·61	..	..
D Rotherham (Ulley Res.) No. (2)	Vincent Turner, Esq., C.E.	5	1 0	184	23·4	21·12	152	113
D Rotherham (Ulley Res.) No. (3)	Vincent Turner, Esq., C.E.	5	1 0	132	23·2	21·63	152	115
D Wincobank (Sewage Works) (+A)	The late J. Haworth, Esq.	5	1 6	110	23·0	20·19	165	113
D Rotherham (Sitwell Vale)	G. Howard, Esq.	5	1 0	300	26·0	21·59	176	122
D Rotherham (Kimberw'rth Sch.)	Vincent Turner, Esq., C.E.	5	1 0	258	24·7	21·36	172	114
D Rotherham (Aldwarke Sew. Wks.) (+A)	James H. Kershaw, Esq.	5	1 4	71	24·7	20·46	171	110
D Rotherham (Thrybergh)	F. O. Kirby, Esq., C.E.	8	1 0	184	23·8	19·02	167	107
D Ecclesfield (Sewage Works)	F. Thurlby, Esq., C.E.	5	0 7	172	..	23·40	172	135

Figure 12 Extract from ‘British Rainfall 1934’ showing a selection of the rain gauges in operation in the Sheffield region.

TWENTIETH CENTURY OBSERVERS

The first meteorological society to be established in Sheffield in the 20th century was the Meteorological Section of the Sorby Scientific Society[23], founded in 1926 with the principal objective of furthering research into the levels of soot deposition in the region. It was concluded that in the south-west and south-east of the region 'dirt' deposition levels were half of those recorded in Burngreave during a prevailing south-westerly airflow. When winds became north-easterly, however, levels at Burngreave quadrupled! There was also a significant increase in soot deposition during foggy conditions. The results of these studies were published in two papers by Hugill, W. in Volume 1 of the Sorby Scientific Society Proceedings of 1929. Beyond this date, there is no further mention of the Sorby Meteorological Section though from correspondence in the meteorological archive of Museums Sheffield it is known that there were 14 amateur weather observers in the region in 1932.

The next meteorological group to be formed was the 'Sheffield and District Meteorological Group', instigated in 1954 by Jack Barwick of the City Museum[24] as part of his remit as Weston Park Weather station observer. Barwick had suggested via the local press that amateur weather observers in the region should come together to form a group. Eighteen members attended the first meeting held at the City Museum on the evening of 9th April 1954 and agreed to 'form a society to stimulate interest and study of the local weather, unusual phenomenom [sic], and their relation to the general weather stream over the country.'[25] Officers and committee members were duly elected and the group met regularly at the museum until 1960, averaging around seven meetings per year. Throughout this time they became involved in a number of research projects. One of these was a joint study with the Epidemiological Research Group, the University of Sheffield and The British Medical Association, to look at the effects of weather upon the high incidence of chronic bronchitis in the region. Over a six year period from 1955-1961, the group collected weather data for use in the study. This was used alongside sickness absence data gathered from a Sheffield Steel Works in the Lower Don region and atmospheric pollution data. It was concluded that pollution levels were directly affected by temperatures, the temperature also appearing to be a factor in how quickly those who were already off work sick returned to the workplace.

The Group also assisted in plotting patterns of snowfall distribution and visibility levels across the region. Many of its members returned detailed thunderstorm surveys to the Thunderstorm Census Bureau in Huddersfield, set up in 1924 by S. Morris Bower[26]; the information collated at the museum by Jack Barwick.

On the 3rd March 1961, the Sheffield and District Meteorological Group was wound up. At the same time, a Meteorological Secton was formed as part of the Sorby Natural History Society although it survived for just one year due to a dwindling membership. Several of the group's former members, however, including Leslie Atkinson, John Groocock and

[23] The Sorby Scientific Society was formed in January 1918 by the union of Sheffield Naturalists Club with the Sheffield Microscopical Society

[24] Formerly Weston Park Museum and now once again known by that name (from 2006).

[25] Transcribed from the handwritten minutes of the meeting, preserved in the J.A. Groocock archive of meteorological data at Museums Sheffield

[26] Morris-Bower devoted his entire working life to the study of weather. He died in 1982 and the Thunderstorm Census Organization was taken over by the Tornado and Storm Research organization (TORRO), itself founded in 1974

Sydney Whitaker, continued observing and sent returns to the Meteorological Office. They also signed up to a new society, the 'Climatological Observers Link' (COL). This was founded in 1970 by a small group of amateur meteorologists for enthusiasts of weather observing in the United Kingdom. The group thrives to the present day and now has an international membership numbering more than four hundred. Five members currently submit data from South Yorkshire; three in Doncaster and two in north Sheffield[27].

The following list of members of the former Sheffield and District Meteorological Group are noted for the quality of their observations and the length of time for which they maintained weather records.

John A. Groocock F.R.Met.S.

John Groocock established a weather station at Norton Lees, Sheffield (525' AMSL) in 1958. He had originally begun making weather observations after World War II, first at Upperthorpe, Sheffield and then from Norton Lees. John was Secretary of Sheffield District Meteorological Group (and of the Sorby Met Section in 1961) and also submitted data to the Air Pollution Research Unit of Sheffield University during the 1960s. After his death in 1981, the weather observations were continued by John's wife Frances and son Jonathan. Jonathan now maintains both manual and automated weather equipment full details of which, together with location information, archived and live weather data, and descriptions of the weather is now available via website *www.sheffieldweather.co.uk*. Rainfall figures from this site have been returned to the Meteorological Office throughout the period of operation.

An archive of paper records from the Norton Lees weather station including statistics, barograph and thermohygrograph charts, and correspondence of the Sheffield District Meteorological Group donated by Frances Groocock, is held within the meteorological archive of Museums Sheffield.

Leslie Atkinson F.R.Met.S

Leslie Atkinson established Rotherham (Broom Lane) weather station (284' AMSL) in 1935 and maintained continuous daily readings of rainfall, temperature and sunshine until 1970 when he retired to Scole, Norfolk. He continued his weather observing at Scole from 1972 until his death in 1980. Atkinson had a life-long interest in the weather that began thirteen years prior to him making formal observations. He returned his data to the Meteorological Office and also to the University of Sheffield, Geography Department and was Chairman of the Sheffield and District Meteorological Group (and of the Sorby Met Section). An archive of his paper records for the years 1954-1969 is held in the meteorological archive of Museums Sheffield.

Sidney T. Whitaker of Ecclesall

Sidney Whitaker established a weather station firstly at Ecclesall, Sheffield (689' AMSL), observing between the years 1958 -1962 inclusive, then later at Dore, Sheffield (695' AMSL) from 1962-1964 inclusive and 1976-1985 inclusive (he moved to Sunderland for a period from March 1964-1976). He returned data to the Met Office throughout each of the periods. Whitaker's interest in weather recording began whilst he was in the Royal Air Force although he began his formal records in response to an appeal from Weston Park Museum for volunteers to keep rainfall records (following the press article by Jack Barwick which led to the formation of the Sheffield and District Meteorological Group).

[27] for further details see *http://www.met.rdg.ac.uk/~brugge/col.html*

Geoffrey B. Ditcher

Geoffrey Ditcher of Beauchief, later Ecclesall then Millhouses, Sheffield was a very prolific weather correspondent who forwarded descriptive observations of weather to Weston Park Museum staff for many years from 1955 through to 1996. He frequently made comparisons between present and past weather events and also recalled extreme weather events in his writings. He also delivered talks on behalf of the Sheffield and District Meteorological Group, one entitled “Keeping Weather Records” was delivered to the University of Sheffield in the 1950s. He was Treasurer of the Group (and of the Sorby Met Section). One of his last communications, typed on the same typewriter he had used since 1955, is shown in Figure 13.

David Manterfield F.R.Met.S.

Records of rainfall and temperature were kept at Beauchief, Sheffield by David Manterfield from 1959 to 1963. Mr Manterfield also collated data from his workplace at Ickles, Rotherham from 1918 to around 1959.

In addition to the Sheffield and District Meteorological Group members, a few other former local weather observers are mentioned below:

Kenneth G. Tofield

Kenneth Tofield of Fulwood, Sheffield kept daily records of rainfall, wind speed and direction, thunder and snow from 1948 to 1968, along with maximum and minimum temperatures (although no instrument shelter was used).

Charles A. Whittington-Smith

Charles Whittington-Smith took daily readings of rainfall and maximum and minimum temperatures (from a thermohygrograph) firstly at Ranmoor, Sheffield than at Grindleford and later Bakewell, Derbyshire from the 1960s to 1980s. His observations of daily rainfall from 1967 were forwarded to the Meteorological Office and are now in the National Meteorological Archive, Exeter.

David S.B. Fellowes F.R.Met.S.

David Fellowes of Chesterfield, Derbyshire published a monthly summary of weather for the region for 19 years from 1965 to 1984 in addition to occasional papers in weather journals. He compiled weather data recorded at the Wingerworth Coke Research Centre and also collated weather statistics from a number of official and private weather stations and rainfall recording sites around the region. These included Weston Park, Chatsworth, Finningley, Watnall and Buxton. A number of his summaries are kept within the meteorological archive of Museums Sheffield.

Dennis Bradbury

Dennis Bradbury made daily notes about the weather in his personal diaries. He also kept thunderstorm records from 1932-1991. The diaries are now in the meteorological archive of Museums Sheffield.

30th January 1995.

Your Ref: NS/MET.

Ms Gaynor Boon,
Assistant Keeper,
Earth Sciences,
Weston Park Museum,
SHEFFIELD, S10 2TP.

Dear Ms Boon,

I refer to my last letter to you dated 30th June, 1994, when I brought my comments about the weather in Sheffield finally up to date.

The report on the weather in the first half of 1994 is contained therein. As for the second half, there were some notable features. The Dog Days of July and early August were notably hot, dry and very sunny - this good weather began at mid-summer. Cooler conditions ensued after the first week of August, but with another good Bank Holiday at the end of the month.

September was again revolting, with many heavy downpours of rain, especially on the 14th, similar to the same days in 1993. Sunshine was very deficient. October produced some very good sunny and warm weather in the middle of the month - a St. Luke's late summer, and very welcome after the wretched September, while both November and December were outstandingly warm, quite bright but often wet. There was no snow at all quite unlike the same period in 1993.

The warm weather in the middle of the summer, which extended from the Arctic to the Mediterranean, no doubt heated the sea extensively and was responsible for the very warm weather in the approach to and through beyond mid-winter - a complete misnomer on this occasion! Strong wind was also infrequent. Generally temperatures have been much higher than usual throughout Europe and also in North America for the same reason, but rainfall in southern Europe and the Mediterranean countries has been very heavy indeed, particularly in Northern Italy and Southern France in early November.

I would be pleased to receive the monthly details of weather reports from July to December and also the Official Annual Summary for 1994, and I enclose a stamped addressed envelope for you to send them along.

Thanking you.

I am,

Yours sincerely,

G.B.Ditcher

Figure 13 Comments on the weather of 1994 from weather observer and correspondent G.B. Ditcher (courtesy Museums Sheffield)

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Plate 1

Top — Nacreous cloud at sunset, Weston Park 16th February 1996 (© G. Boon)

Bottom — Sunrise at Woodhouse, 22nd October 2007 (© G. Boon)

Plate 2

Top Hoar frost on snow, Shirebrook valley, December 2010 (© G.Boon)

Bottom Padley Gorge viewed from Higger Tor, 19th November 2005 (© J P Richards)

A History of Weston Park Weather Station

INTRODUCTION

Weston Park is located approximately 2km west of Sheffield city centre, and half way up the hill slope that rises from the city centre to the suburbs of Walkley and Broomhill. The weather station is positioned on a relatively flat piece of land at the edge of Weston Park closest to Western Bank and immediately adjacent to Weston Park Museum.

Established in 1882 the weather station is one the oldest weather stations in the country, supplying data to the UK Met Office within the national network of some 300 or so weather stations. Since its inception, it has been managed by staff of the adjacent museum on behalf of the City of Sheffield and is now administered by Museums Sheffield. The station has co-operated with the Met Office throughout the entire period of its history. It is maintained to World Meteorological Organization (WMO) standards and is highly valued for the well-maintained site, consistency of recording and important archive of data. Stations like Weston Park which have a long and continuous recording period can boast a comprehensive data set against which the relevance of extreme weather events can be assessed and the subtle changes in climate can be monitored. For more than one hundred years, the weather station has been the basis of a busy and varied enquiry service generated by the general public, academia, business, commerce, local and central government departments and agencies, all of whom use data from the station in a wide variety of projects in their day to day work.

Weston Park Weather Station - site details:

Location	Weston Park, Sheffield, South Yorkshire
Latitude	53°22'52.91"N
Longitude	1°29'28.99"W
Grid reference	43 (SK) /33958731
Met Office station number	4061
Height of rain gauge AMSL	137 metres (450 feet)
Soil	clay

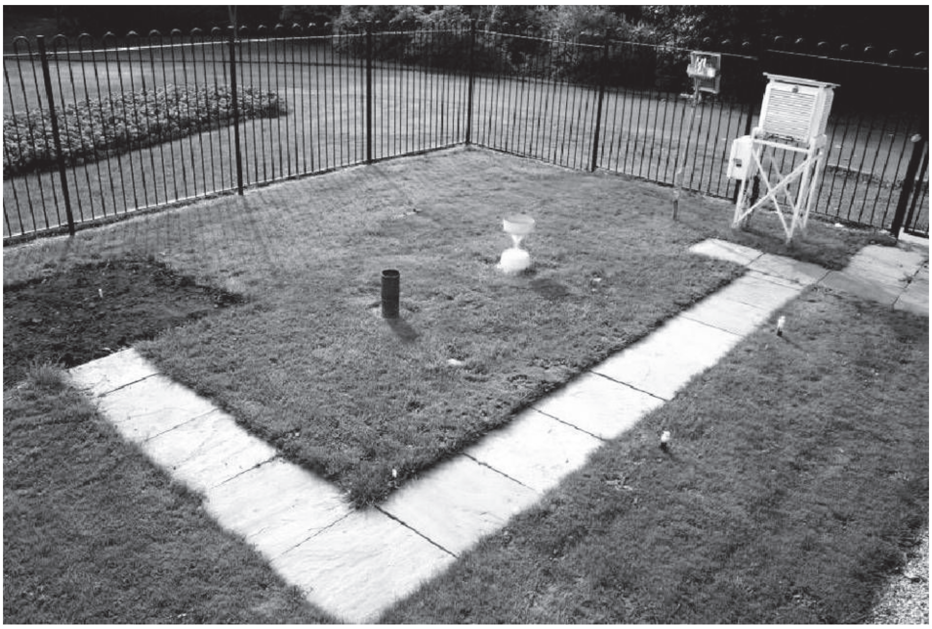
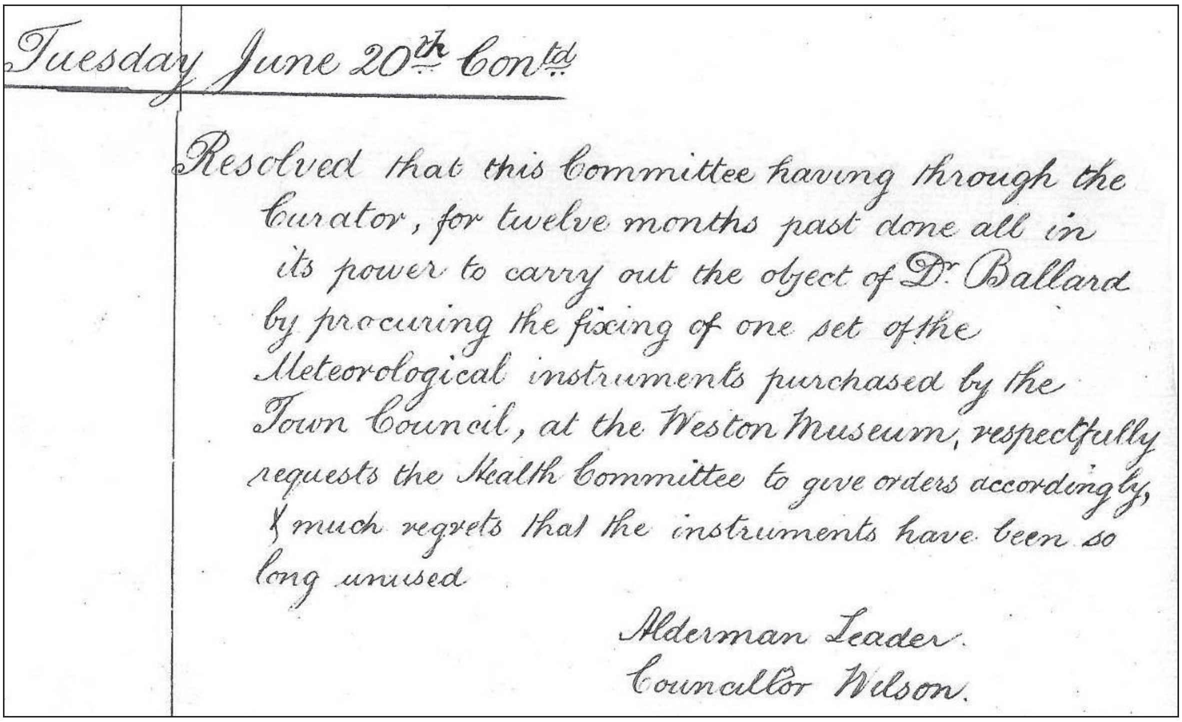


Figure 1 The instrument enclosure at Weston Park Weather Station, 2003

The proposal for *"atmospherical returns"* to be produced for Sheffield was first raised by Sheffield Public Health Department in the spring of 1881[1]. The necessity for scientific observations had arisen because the Board of Health could not provide accurate weather readings for use in research. These had been required for investigations into an outbreak of summer diarrhoea the previous year, an epidemic that had caused infant mortality rates to soar. It was subsequently agreed that a selection of weather instruments should be obtained for the city and furthermore, that the Curator of Weston Park Museum should be approached with regard to finding a suitable site for them to be installed. Although two sets of weather recording instruments were promptly ordered by the Town Council they mysteriously went astray, half eventually turning up at the Winter Street Hospital (later St. George's Hospital, and now part of the University of Sheffield). This led to a furious row in the council chambers and delayed the setting up of the station for a whole year (Figure 2).



Tuesday June 20th Contd

Resolved that this Committee having through the Curator, for twelve months past done all in its power to carry out the object of Dr Ballard by procuring the fixing of one set of the Meteorological instruments purchased by the Town Council, at the Weston Museum, respectfully requests the Health Committee to give orders accordingly, & much regrets that the instruments have been so long unused

Alderman Leader.
Councillor Wilson.

Figure 2 Minutes of the Museums Committee Meeting June 20th 1882

The Curator of Weston Park Museum, Elijah Howarth (1853-1938) had professed that he would be pleased to *"furnish an exceedingly good place"* for the instruments in Weston Park. Like many learned gentlemen of the time, he was a polymath and keen to pursue his interests in art and science, an ideal prerequisite for his future career. Born in Liverpool and educated at Cambridge, he became an assistant at Liverpool Museum in 1871. The family business was Howarths, sole makers of "Blattis" "the Union Cockroach Paste" (Figure 3). Elijah Howarth's role in the business was as 'Advisory Director'[2] to the company.

[1] Sheffield & Rotherham Independent, Thursday 14th June 1882
[2] per headed notepaper in Museums Sheffield's meteorological archive

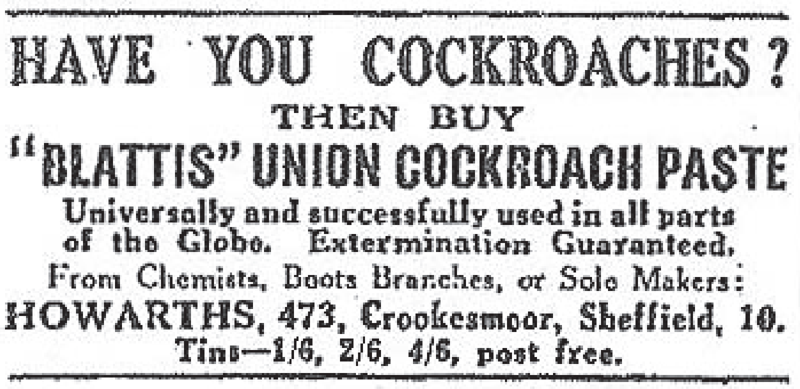


Figure 3 Advertisement from 'The Children's Newspaper', 7 September 1935

In January 1876, Howarth took up the Curatorship of Public Museums in Sheffield and also became Curator of the Mappin Art Gallery when it opened the following year, this allowing him to pursue his passion for both art and science. His competencies in astronomy, zoology, entomology, meteorology, archaeology as well as fine art, equipped him with the necessary skills to direct both establishments for 52 years and to lay solid foundations for their future development. Howarth belonged to many learned societies. He was a Fellow of the Royal Astronomical Society (1881), Fellow of the Royal Meteorological Society (1881), Fellow of the Zoological Society of London (1896), President of the Sheffield Naturalists Club (1890)[3] and a member of the Societé Zoologique de France (1896). He also operated Weston Park Observatory for several years, an interest that began in his Cambridge days where he studied under J.C. Adams, his sponsor for Fellowship of the Royal Astronomical Society. Howarth re-visited the Observatory at Cambridge and also the one at Greenwich to obtain the necessary skills to manage the Weston Park Observatory. Constructed in 1880, the Observatory was a very popular attraction at this time. The number of people who applied for tickets to visit on fine winter nights often greatly exceeded the capacity of the Observatory to accommodate them. It was open on average just 35 nights of the year, the number of visitors in1885 reaching 545. It was eventually closed in 1939, however, and later demolished.

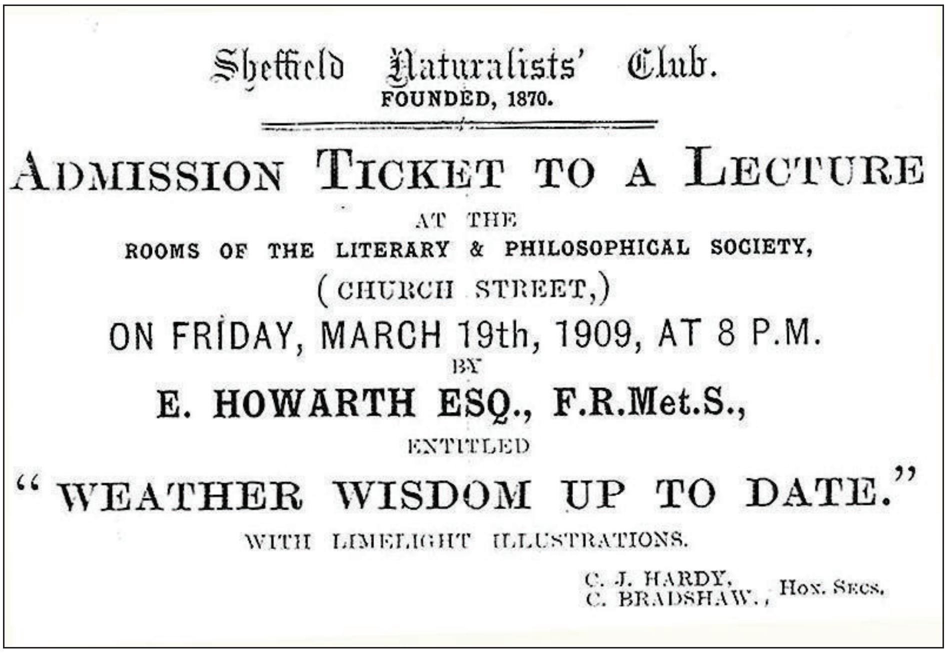
Howarth was a pioneer within the museum profession and he helped to found its professional body, the Museums Association in 1888. He was Honorary Secretary of the Association from 1891 -1909 and President 1912 -1913. He became first editor of the Association's 'Proceedings' and later editor of the 'Museums Journal'. Howarth was also a member of the UK government's Advisory Council of the Board of Education from 1912 - 1920 and he lectured widely on both art and science subjects (Figure 4). A snapshot of his character traits can be glimpsed from the entry in the Sheffield Weekly News of 29th December 1900 which describes thus:

> "*he is no dry as dust curator with eyes for nothing except scarce and uninteresting specimens*"
> "*Neither is it often that a gale or an eclipse or earthquake catches him napping. He is up to their little tricks and writes treatises about them, setting down naught in malice. He is death on blackbeetles and soars through the infinities of space in search of undiscovered planets*"….

[3] The Sheffield Naturalists Club merged with the Sheffield Microscopical Society in January 1918 to form the Sorby Scientific Society

"Despite all his learning, Mr Howarth is a social being with a liking for billiards and smoking concerts. He belongs to a golf club and argues therefrom, that he can play golf' [4].

Howarth also found time to be married twice and have seven children[5]!



Sheffield Naturalists' Club.
FOUNDED, 1870.

ADMISSION TICKET TO A LECTURE
AT THE
ROOMS OF THE LITERARY & PHILOSOPHICAL SOCIETY,
(CHURCH STREET,)
ON FRIDAY, MARCH 19th, 1909, AT 8 P.M.
BY
E. HOWARTH ESQ., F.R.Met.S.,
ENTITLED
"WEATHER WISDOM UP TO DATE."
WITH LIMELIGHT ILLUSTRATIONS.

C. J. HARDY,
C. BRADSHAW., Hon. Secs.

Figure 4 Copy of an admission ticket to one of Howarth's lectures

On the advice of the Meteorological Office[6] in August 1882 (Figure 5), Howarth established the weather station in Weston Park in September of the same year, positioning it on the flat, open area of grass directly east of the steps to the former Mappin Gallery entrance in Weston Park. He installed an instrument shelter containing a selection of thermometers to measure absolute, maximum and minimum temperatures, and set into the ground a Snowdon pattern copper rain gauge with an eight inch diameter collecting funnel (Figure 6).

A Fortin mercury 'stick' barometer was employed for the measurement of air pressure and this was mounted in the entrance to the museum where it could be seen by visitors[7]. The barometer consisted of a long, sealed column of mercury in a glass tube (Figure 7), the mercury balanced by the pressure of the atmosphere acting upon it. The mercury in the cistern was adjusted at each observation to a fixed point forming the 'zero' of the scale. A Vernier (adjustable scale) attached to the tube allowed accurate measurement of the level. As the length of the mercury column was also dependent upon temperature, altitude and gravity, a series of correction factors were applied to the reading in order to determine a corrected pressure measurement[8].

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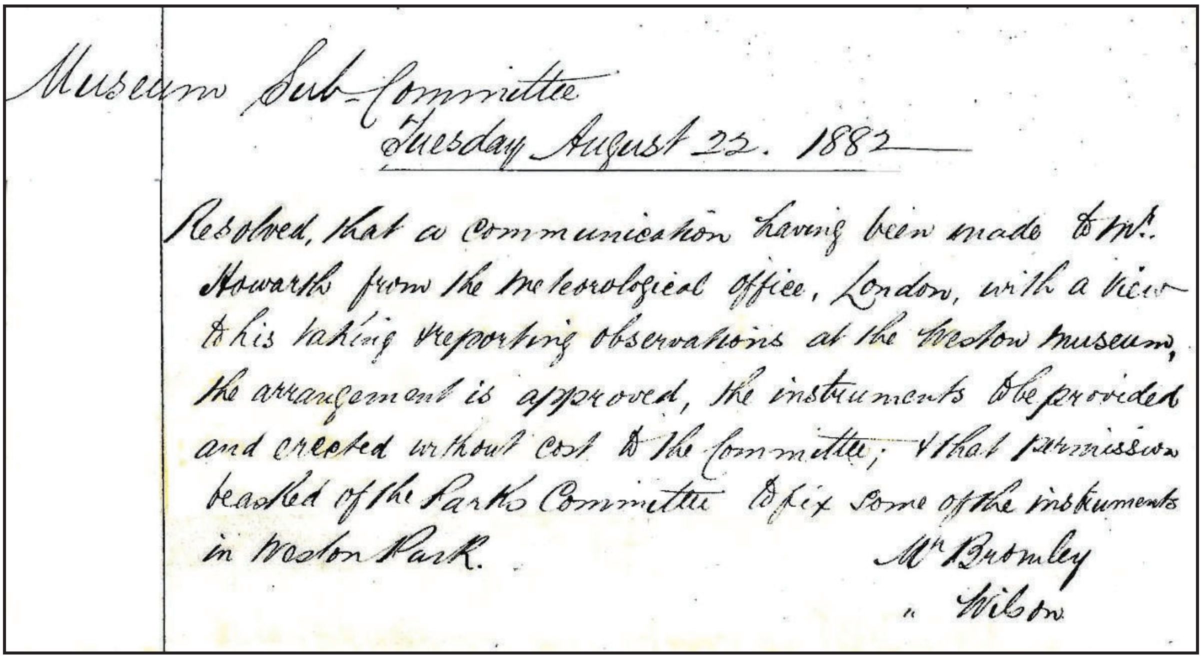
[4] Elijah Howarth from 'Big & Little Guns' re-issue from Sheffield Weekly News 29.12.1900.
[5] Source *http://www.ancestry.co.uk/*
[6] Then a department within the Board of Trade, it became part of the Air Ministry in 1920 and the 'Meteorological Office' in 1964 when the Air Ministry, Admiralty and War Office merged to become the 'Ministry of Defence'. It then became the 'Met Office' in 2000 when the new brand was launched.
[7] 1908 Meteorological Office site inspection report notes the removal of the barometer to the entrance of the offices which was considered to be a safer position.
[8] Defined in the Met Observer's Handbook



Museum Sub-Committee
Tuesday August 22. 1882

Resolved, that a communication having been made to Mr. Howarth from the Meteorological Office, London, with a view to his taking & reporting observations at the Weston Museum, the arrangement is approved, the instruments to be provided and erected without cost to the Committee; & that permission be asked of the Parks Committee to fix some of the instruments in Weston Park.

Mr Bromley
" Wilson

Figure 5 Minutes of the Museums Committee Meeting 22 August 1882

Barometer readings and estimations of wind direction began on Friday 1st September (Figure 8) with observations at 0900hrs, 1200hrs, 1500hrs, & 1800hrs GMT[9], followed five days later by measurements of temperature, relative humidity (at 0900hrs & 1800hrs) and rainfall (for 24 hours to 0900hrs). From 1st October 1882 Howarth added descriptions of the weather over the 24 hours daily and also increased the frequency of measurements, although on Sundays he read the instruments only at 0900 hrs.

In July 1897 a sunshine recorder (Figure 9) was purchased from the Meteorological Office (for £6 4s 6d) and installed on the rooftop of the former Mappin Art Gallery in September that year. This consisted of a 4" diameter glass sphere supported on a pedestal in a copper frame, positioned where it could be exposed to capture the theoretical maximum amount of bright sunshine. A card marked with hourly divisions was inserted into the frame each day before sunrise and removed after sunset, the sun when shining leaving a charred line on the card and thereby a record of the duration of sunshine. Three different shaped cards were used throughout the year to accommodate the changing elevation and duration of the sun. These were slotted into three different slots on the instrument frame; a long curved card for between mid April to 31 August, a shorter curved card between mid October to 28/29 February, and a straight card at each of the equinoxes (Figure 10).This procedure continues even today. In 1898 a wind vane was installed on the rooftop of Weston Park Museum whilst grass minimum, and earth thermometers at 1 foot and 4 feet depths were installed in the Park, the earth thermometers suspended below ground within an iron pipe driven into the ground to the required depth (Figure 11).

[9] Greenwich Mean Time – GMT (now Universal Time Co-ordinated – UTC)

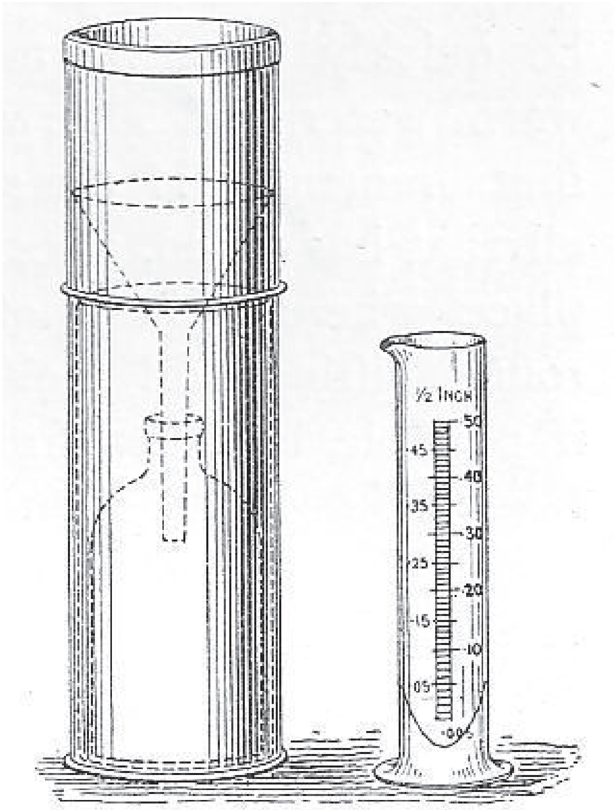


Figure 6 Snowdon pattern rain gauge with 'Camden' type tapered glass measuring cylinder (from Marriott, W. 1906)

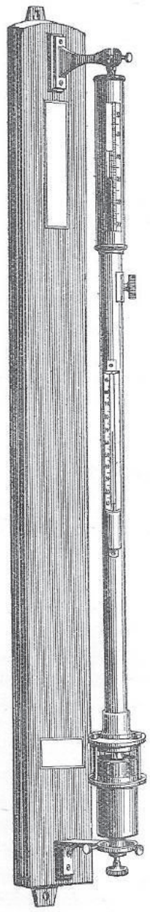


Figure 7 Fortin mercury barometer (from Marriott, W. 1906)

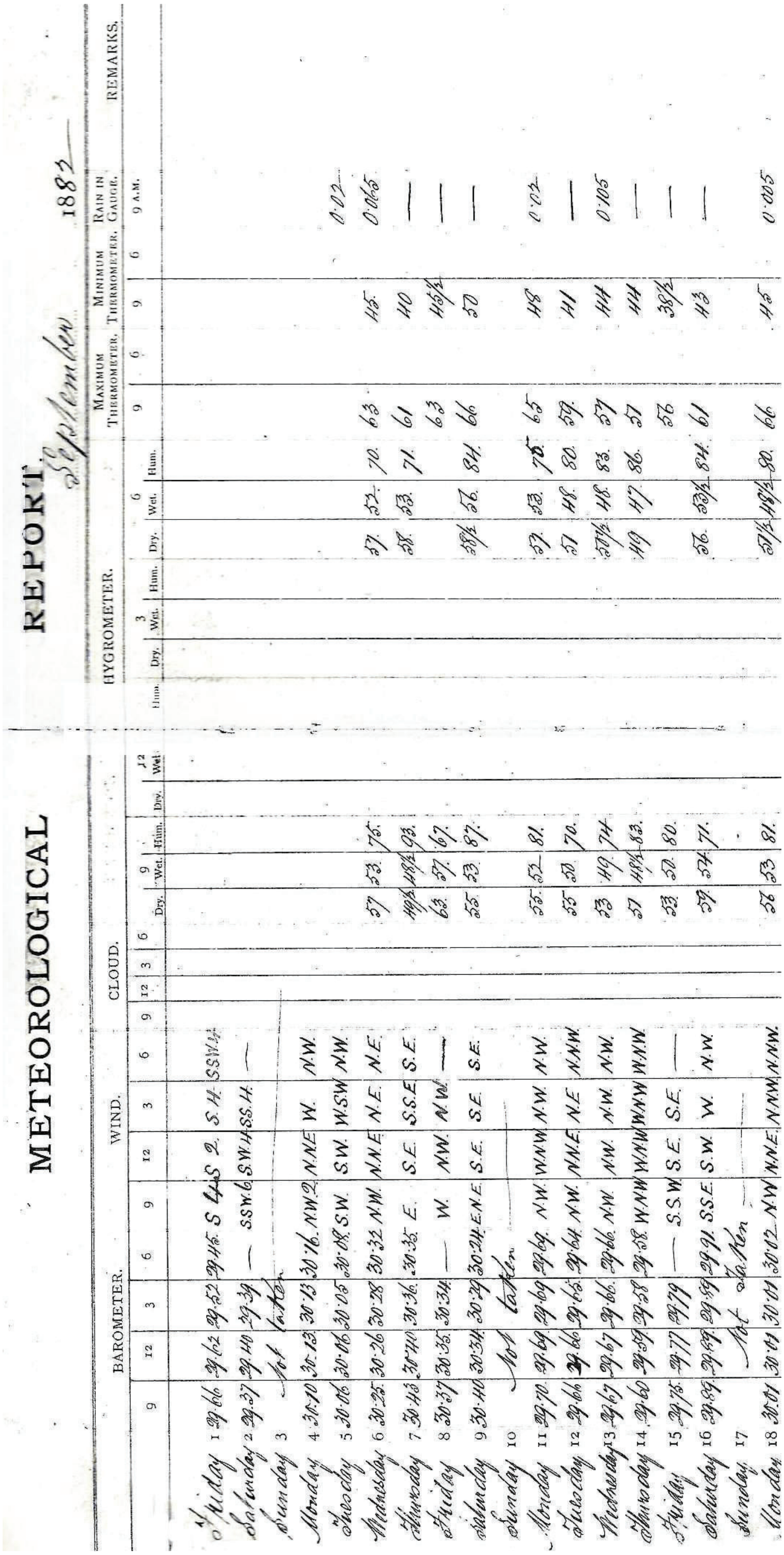


Figure 8 Elijah Howarth's first entries into the meteorological register September 1882 (courtesy of Museums Sheffield)

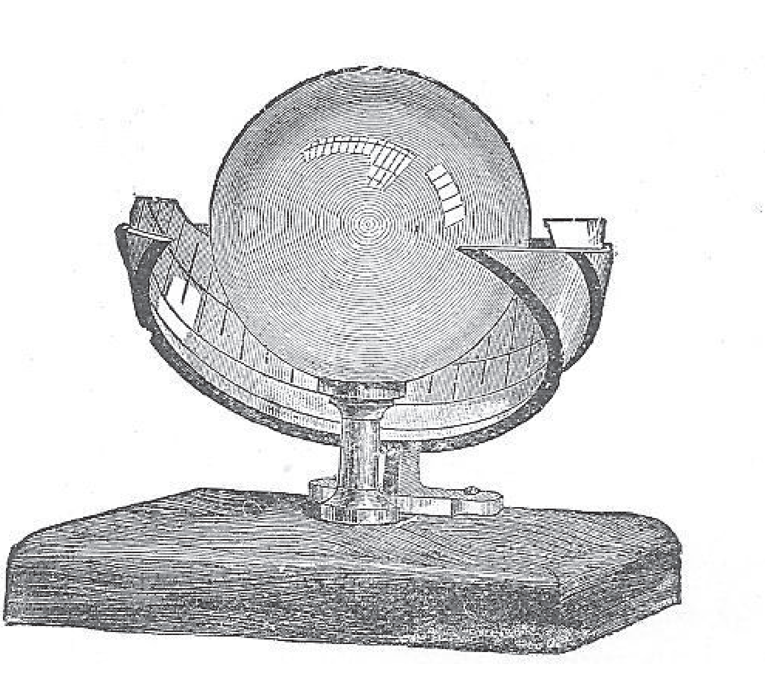
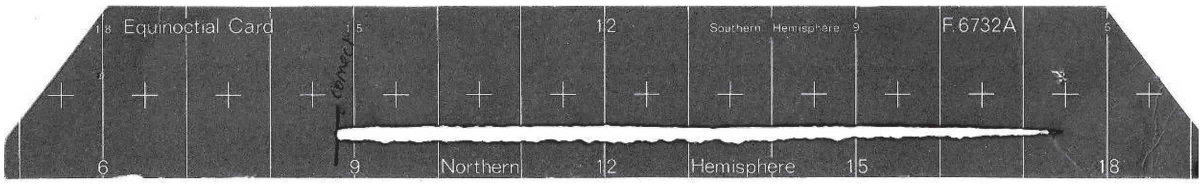
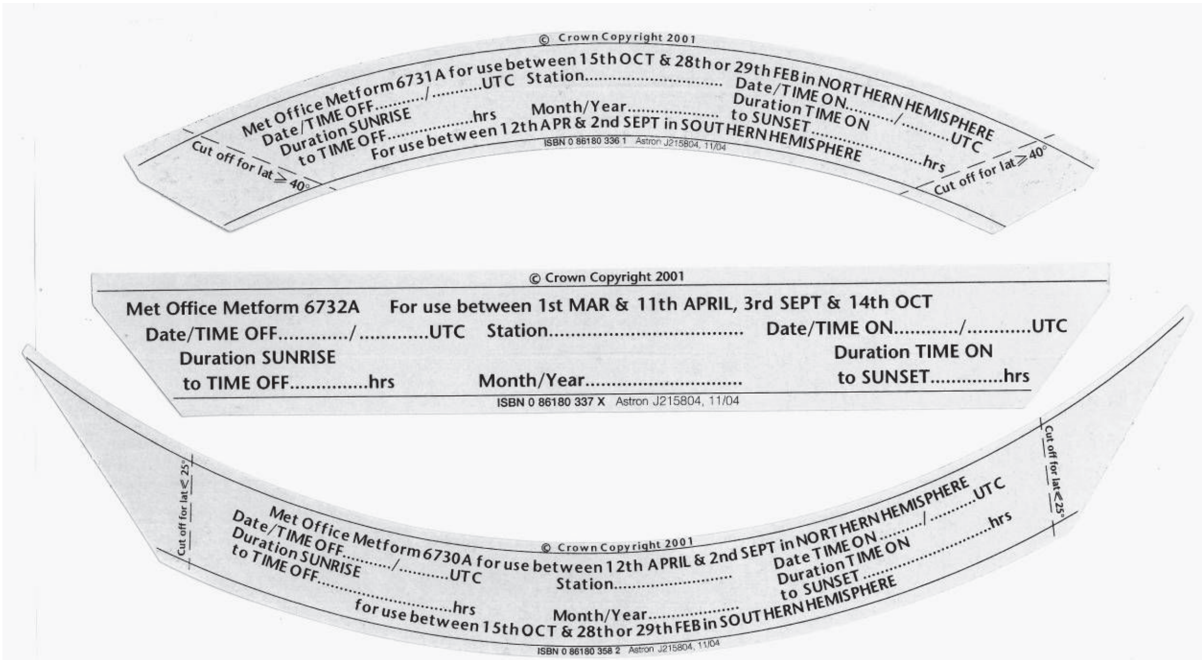


Figure 9 Campbell-Stokes sunshine recorder (from Marriot, W. 1906)

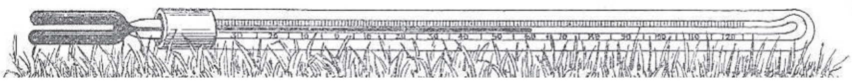


a)



b)

Figure 10
a) The equinoctial sunshine card used with Campbell Stokes sunshine recorder, showing charred line
b) The reverse side of the cards - summer (top), equinoctial (middle), winter (bottom) cards (courtesy of Museums Sheffield)



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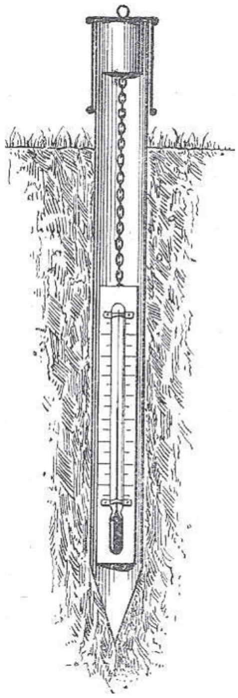


a)

Figure 11
a) Earth Thermometer
b) Grass minimum thermometer
(from Marriott, W. 1906)

Howarth was keen to follow up the original inquiry of the Board of Health regarding infant mortality rates and he began to investigate the possibility of a link between death rate and the temperature below ground. In 1910 he presented his findings at a meeting of the British Association in Sheffield in a paper entitled 'The Meteorology of Sheffield'. He outlined how infant mortality due to diarrhoea was of epidemic proportions when earth temperatures exceeded 12.2°C/54°F and fatal when the temperature was greater than 13.9°C/57°F.

The instrument additions to the station brought it up to the standards required by the Meteorological Office for climatological reporting stations and from this point onwards the readings from Weston Park were published in the Monthly Weather Report of the UK Meteorological Office[10]. The site inspection report of 1901 is testament to the diligence and enthusiasm of Howarth in managing the weather station:

> *"This is an excellent station, well supplied with instruments and well managed. Mr Howarth takes a keen interest in the work and gives much personal attention to it. The records are admirably kept."*

Howarth experimented with other weather instruments in addition to those comprising the core element of the weather station. Sometime between 1902 and 1906 a Casella anemometer (measuring wind speed) was installed on the rooftop of the museum. This consisted of three hemispherical metal cups mounted on metal arms pivoting about a vertical rod to enable them to spin freely, the differences between the pressure of the wind acting upon the concave and convex side of the cups causing them to spin (Figure 12). The number of revolutions made by the cups was proportional to the strength of the wind and generated a 'run of wind' on an attached counter. Howarth did not use these readings for his weekly returns to the Meteorological Office although he did use them in his reports to the local press. There was also a 'hyetograph' installed around 1910. This self-recording rain gauge, introduced by instrument makers Negretti and Zambra in 1908, collected

[10] Published from 1884-1993

rainfall in a cylindrical vessel containing a light metal float. The float was attached to a pen that drew a trace onto a chart fixed to a clockwork drum, creating a continuous record of the rate and duration of rainfall. The instrument was in good working order at the Meteorological Office site inspection visit in 1911 but at the next visit in 1919 (the biennial inspection visits were suspended during the war), Howarth disclaimed responsibility for it, declaring he had no confidence in its readings!

Figure 12 Robinson three cup anemometer
(from Meteorological Office 'The Observer's Handbook' 1934)

Howarth was also collating measurements from other weather instruments in different parts of the city including a number of sunshine recorders at various sites. His entries in the monthly registers give the sunshine readings for Attercliffe for a 20 year period from 1st January 1901 to 31st December 1921. There are also sunshine entries for High Hazels Park at the beginning of 1902. The latter coincided with Howarth's remit as Curator of Public Museums in Sheffield to curate the displays of local industry and natural history in the newly opened High Hazels Museum[11]. A former house in the grounds of the park, the museum provided extra space for the growing museum collection. Howarth had been lobbying the Town Council for extra display space for some considerable time. A rain gauge was installed at High Hazels Park in January 1906, both rain gauge and sunshine recorder donated by Mr C.J. Barker who also took weather readings at West Street, Sheffield (see entry in section 'Sheffield's past weather observers). Howarth also collated sunshine readings from Moscar as of 1stJanuary 1907 and was instructed by the Town Council Committee to send a weekly report of all the local sunshine records to the Sheffield newspapers. The sunshine recorder at Moscar was moved to Lodge Moor (possibly the former Lodge Moor Hospital site) on 28th December 1908 and readings continued from there until 23rd January 1916.

[11] Opened by the Lord Mayor of Sheffield (Alderman George Senior J. P.) on Saturday December 7th 1901 and closed in 1940 whereupon the contents were returned to Weston Park.

In June 1915 a Kew Pattern mercury barometer (purchased for £4 10s 0d) (Figure 13) was installed at the museum to replace the Fortin barometer which for some years had been difficult to read due to corrosion of the mercury within the cistern, seemingly a common problem with that style of barometer. The Kew Pattern barometer differed by having a sealed rigid cistern which did not require an adjustment to zero before use. The new barometer was mounted inside a display case in the central corridor of the museum where it could be observed by visitors.

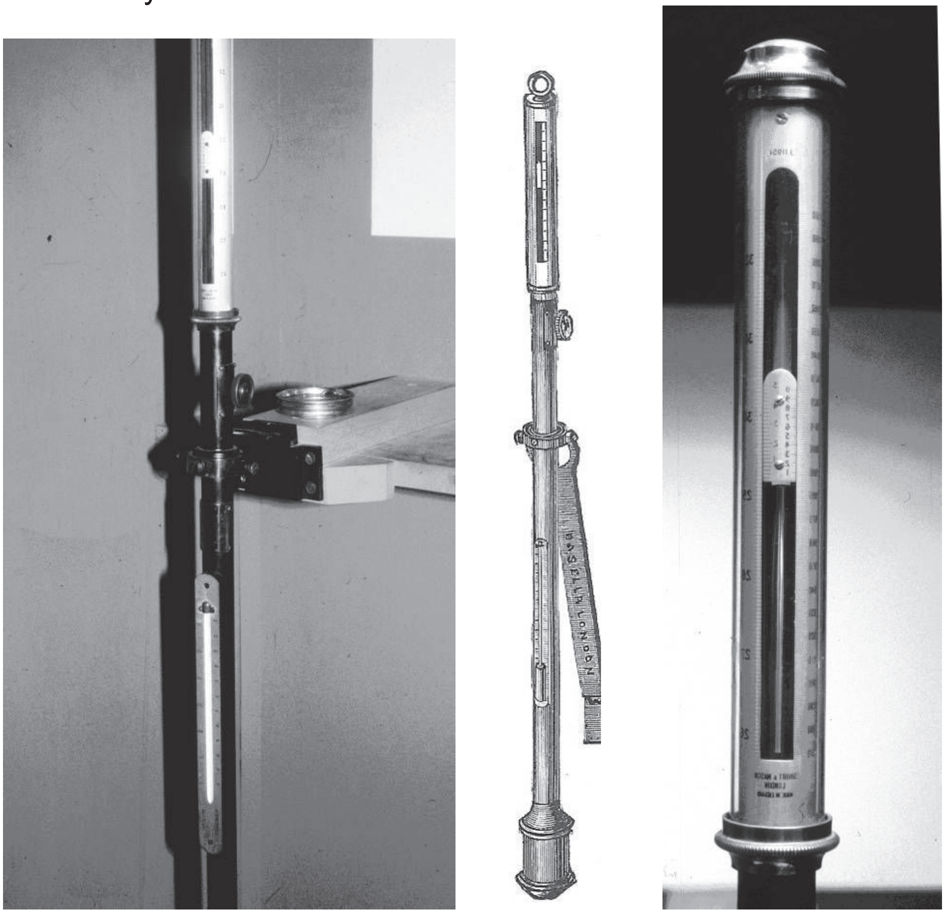


Figure 13 Kew-type mercury barometer showing close-up of Vernier (right)

The Meteorological Office site inspection report for August 1919 makes reference to Howarth's newspaper reports, and to his considerable interest in meteorology. It also details the instruments in use, noting the new barometer and describing the site of the 8" diameter rain gauge, now surrounded by a paling made of narrow wooded bars placed about two metres from the gauge[12]. Twelve months later, the rain gauge and thermometer screen were moved about 40 metres to the south-south-east as shown in Figure 14. The relative positions of the wind vane and sunshine recorder on the rooftops of the museum and art gallery are also shown.

A temporary move of the thermometers and rain gauge is noted from an entry into the meteorological register on 11th July 1905 at the occasion of the royal visit of King Edward VII and Queen Alexandra. The occasion was the official opening of the University of Sheffield in 1905. No doubt there were crowds of people milling through Weston Park during the event. The instruments were moved back to their usual recording site 2 days later.

[12] The site report also notes soot gauges in operation around the city, and the sunshine recorders in Attercliffe and High Hazels Park.

The reports that Howarth forwarded twice daily to the local press included the weather readings from Weston Park, his comments on the Meteorological Office's daily weather chart and a forecast. He had begun including weather forecasts initially to warn miners of potential changes in atmospheric pressure which could trigger the escape of deadly gas in the mines. His aptitude for forecasting earned him the local title of "Elijah the Prophet". Howarth provided weekly summaries to the newspapers also and his reports were posted up at the Town Hall for 51 years from 1885. His enthusiasm for the subject of meteorology is summed up in a Sheffield Telegraph account of him:

> *"Mr Howarth was never happier than when the weather happened to be doing something especially eccentric; he would discourse on the phenomenon as enthusiastically as if the British climate was his own domestic pet, whose tricks and freakishness he loved to watch".*

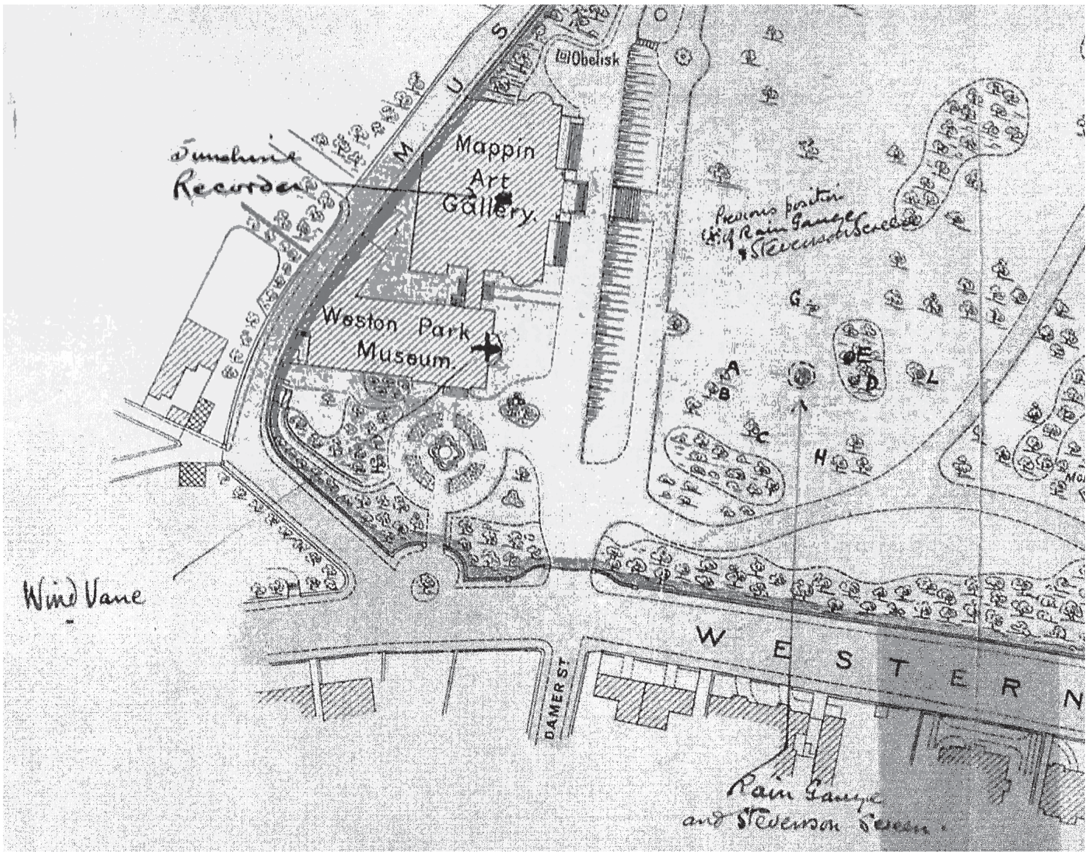


Figure 14 Plan of Weston Park August 1920 indicating the revised position of the rain gauge and thermometer Screen (courtesy of the National Meteorological Archive)

Figure 15 Elijah Howarth in the 1920s
(courtesy of Museums Sheffield,
original photo: Mr J. Guibal, grandson of Elijah Howarth)

Howarth's tenacity and diligence in monitoring the weather in Sheffield for over 46 years until his retirement aged 75 in September 1928 is an incredible achievement. His 52 years of service to Sheffield museums department is also remarkable. He continued to maintain the daily register of weather observations during his retirement until December 31st 1936, although the field observations were made by various individuals whom Howarth had selected to deputise. Rainfall measurements at High Hazels ceased at Howarth's retirement although he had the rain gauge moved to his private address in Crookesmoor. There are no records, however, of any measurements he may have kept there. Sunshine readings at High Hazels ceased in October 1928. Howarth had agreed that after his retirement he would continue compiling the readings on behalf of the Corporation. He also continued his forecasts for the newspapers and although he was paid a fee for this, his only income in his latter years, he was paying 5/- a week for three museum attendants to take the daily weather readings. In March 1932, Howarth told them that he was cutting the payment by a third and as they refused to agree to it, he decided he would arrange for his own staff to take the readings. By the next day, however, he had had a change of heart and phoned one of the museum attendants to tell them to carry on as usual. This happened again in December that year although this time it was Howarth's assistant (Miss Young) who telephoned the curator and passed on the message that Mrs Howarth wished her husband's instructions to be ignored and for the usual arrangements to continue. The situation grew steadily worse and Howarth pursued the matter again in a letter to Curator J. W. Baggaley the following January. Baggaley replied by reminding Howarth that the current arrangement had been agreed with the Town Clerk and thus any decisions about changing it should be made between Howarth and the same. In defiance, Howarth claimed that the operation of the weather station had never been included in the list of his official duties whilst he was in the employ of the museum authorities and that many of the instruments had been bought from his own pocket. He also laid claim to the bound volumes of weather records still in his possession but eventually agreed to deposit them with the Corporation on his death. By this time it is clear that Howarth must have been very frail. Even the register entries from 1933 were penned by another hand, possibly that of Howarth's wife. Howarth's pencilled weather diary notes occur alongside the inked register entries for a little while but there are no entries by him after February 1933. The general maintenance of the weather station had also begun to suffer. The Meteorological Office site inspection report of October 1936 notes:

> *"The station is in a terrible state because there is no qualified supervision" and "Mr Howarth is very old and difficult to deal with!"*
> *"…he pays museum workmen a shilling or two a week to do the observing and sends a boy to collect the pocket register from the museum".*

Following this inspection the Meteorological Office suspended the supply of all forms and weather charts to Howarth and wrote to the Town Clerk to say that the Sheffield observations would no longer be included in the official publications of the Air Ministry, including the Monthly Weather Report, unless the station was brought back to the required standard. On Christmas Eve 1936 Mrs Howarth wrote to Baggaley to say that her husband would be discontinuing the meteorological work after 31st December and asked for the registers to be collected as soon as possible thereafter. Elijah Howarth died on April 1st, 1938.

From 1st January 1937 the meteorological observations in the archives at Weston Park Weather Station are written in Baggaley's hand, together with a note in the frontispiece of the register announcing the same Joseph W. Baggaley (Director of City Museums) to have assumed responsibility for continuation of the meteorological records.

Baggaley (1886-1962) had been Howarth's assistant at the museum. Originally from Nottingham, he joined the museum in 1900 as a 'pupil assistant' after leaving the Central High School. He became 'Biological Assistant' in 1914 and also deputy weather observer. Baggaley signed up for the war effort on 7th June 1916 and was posted to Salonica where he helped set up the first field station although was subsequently struck down with dysentery and malaria, thus rendering him unfit for further service abroad. He was then posted to the Meteorological Office, London for a few weeks before being transferred to Salisbury Plain to work at the 'School of Invasion and Bomb Dropping'. There he instructed and trained meteorologists for detachment to various war centres and assisted in supplying meteorological data for night-flying sorties.

Baggaley returned to his museum duties on 2nd January 1919 and became Assistant Curator, pursuing his particular interests in archaeology and zoological preparation techniques. He published several papers for the Hunter Archaeological Society and the Museums Journal. He was a Fellow of the Zoological Society, a member of the American Museums Association and a member of the Sorby Scientific Society, becoming its Secretary in 1928. Baggaley also continued as deputy weather observer during this time. The Meteorological Office site visit report in 1919 remarks how fortunate the station is to have an observer with experience from The Meteorological Section of the Royal Engineers. Although he perhaps lacked the same passion for meteorology that Howarth undoubtedly had, Baggaley was careful and methodical in his approach to maintaining the records, describing it thus:

> *"The work is not spectacular, but it is done faithfully every day".*

He was joined in the meteorological work by museum assistant Alfred Walker, who was employed by the museum from 1910. Walker died in 1952 whilst still employed by the Museums Department. When Howarth retired in 1928 Baggaley took up the position of Curator of Museums and served until his retirement in 1951.

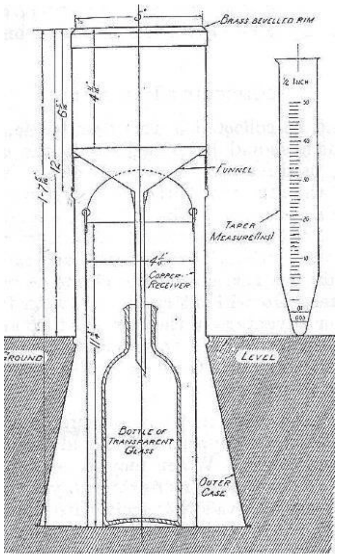


Figure 16 Construction of the 5 inch diameter copper rain gauge (from: The Observer's Handbook, Meteorological Office, London 1934)

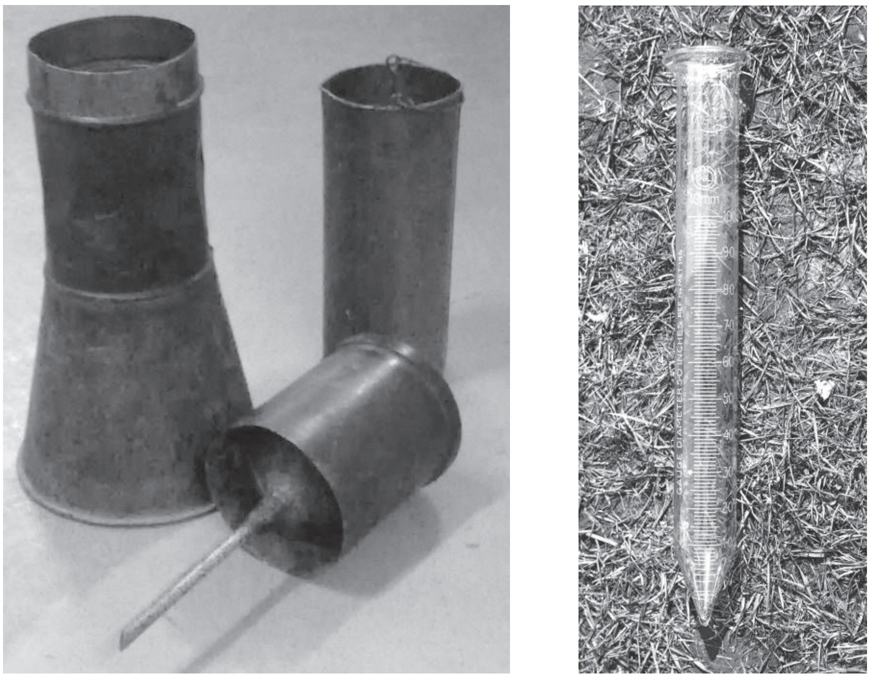


Figure 17 Component parts of the 5 inch rain gauge together with tapered glass measuring cylinder (courtesy of Museums Sheffield)

Figure 18 Joseph W. Baggaley measuring rainfall from the 5 inch gauge[13] (courtesy of Sheffield Newspapers)

Once Baggaley had taken over from Howarth he was quick to bring the station back up to its former high standards. On the advice of the Meteorological Office, a new 5 inch diameter standard rain gauge with splayed base (Figures 16 & 17) was ordered, together with a sunshine recorder. A new fence was installed around the perimeter of the instrument enclosure and the thermometer screen was repaired and painted.

At the outbreak of World War II, reporting of weather statistics to the media was suspended by the Air Ministry for a time for reasons of 'official secrecy'[14] and publication of the Meteorological Office's 'Daily Weather Report' was deliberately delayed, being sent out to observers some 15 days in arrears. The Air Ministry took over preparation of all official weather reports for the press and public. In April 1940 a circular was sent to observers requiring them to forward the observations by telegram each month although this was abandoned just a few months later due to paper shortages. Later that year, Baggaley was contacted personally by an officer from the Office's 'Air Ministry and Home Security' with a request that hourly wind readings be supplied to the Office between 10pm to 6am until further notice, the prevailing weather being extremely critical to the timing of military manoeuvres. That same year on 12th and 15th December, Sheffield was itself subject to heavy German air raids, suffering much damage, destruction and terrible loss of life. During the first raid, which lasted from 6pm until 3am in the morning, the museum building also took a hit.

[13] Photograph reproduced from front page of the 'Daily Independent' 2.2.1937
[14] per Air Ministry correspondence in the Weston Park Museum weather archives

In February 1948, an electrical cup counter anemometer was installed alongside the instruments already on the rooftop of the museum.

Baggaley provided the Meteorological Office with a full account of the instruments in use in 1951. It lists the Kew Pattern mercury barometer, screen with maximum, minimum, dry bulb, and wet bulb thermometers, grass minimum, 1ft & 4ft earth thermometers, the 5 inch rain gauge and Campbell Stokes sunshine recorder. In October the following year the thermometers and rain gauge were moved for a second time to a new position about 25 metres to the south-west, in order to make way for a conservatory to commemorate the Festival of Britain (Figure 19)[15]. A heated debate ensued between the Parks and Museums Committees as to which should have priority over the site, much to the delight of the local media who covered the story with the headline 'Depression over Weston Park'[16]!

Figure 19 1980's photo showing the relative positions of the conservatory and weather station (© Museums Sheffield).

In 1952, the barometer that had been in continuous daily use since 1915 was replaced by a newer Kew Pattern barometer which, in turn, was read daily up until 2003 when the museum closed for refurbishment[17]. The Kew Pattern barometer now resides in the museum collections and can be seen on show in the Foyer display of weather instruments (at the time of writing). A Short and Mason aneroid barograph was also in use, this preserving an autographic record of air pressure on a weekly chart attached to a clockwork drum (Figures 20 & 21).

[15] demolished in November 1999
[16] Sheffield Telegraph 22nd June 1950
[17] The earlier barometer was replaced as it was found to be reading 1-2millibars higher than actual when calibrated in April 1950. It was bought for ten pounds by Nether Edge Grammar School for use in the Physics Dept.

H. Raymond Singleton became Director of Museums on Baggaley's retirement and also took over the responsibility for managing the meteorological station. The day to day operation of it he passed to newly appointed schools officer Jack Barwick and both he and Singleton became Fellows of the Royal Meteorological Society in 1952 as the Museums Committee requested they should. Letters of nomination and support were provided by A. Wentworth Ping of the Yorkshire Philosophical Society and Yorkshire Museum, and Dr D.R. Davies of the Mathematics Department of Sheffield University.

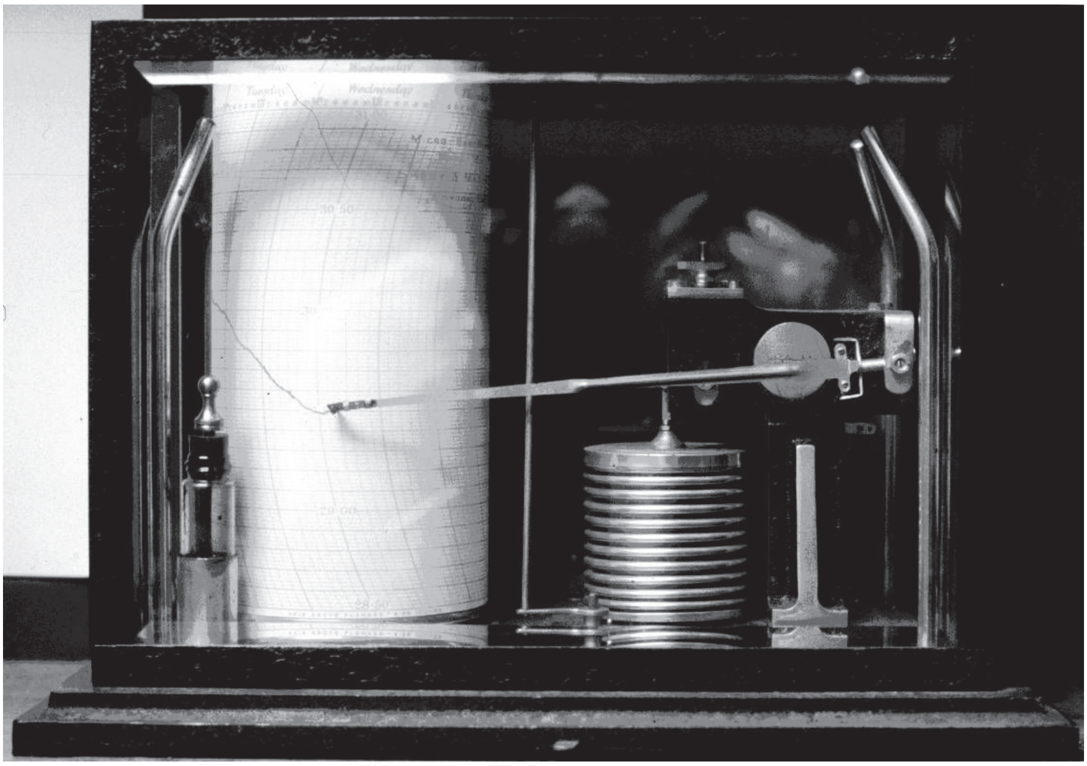


Figure 20 Short and Mason aneroid barograph in use at Weston Park Weather Station until 1989 (courtesy of Museums Sheffield).

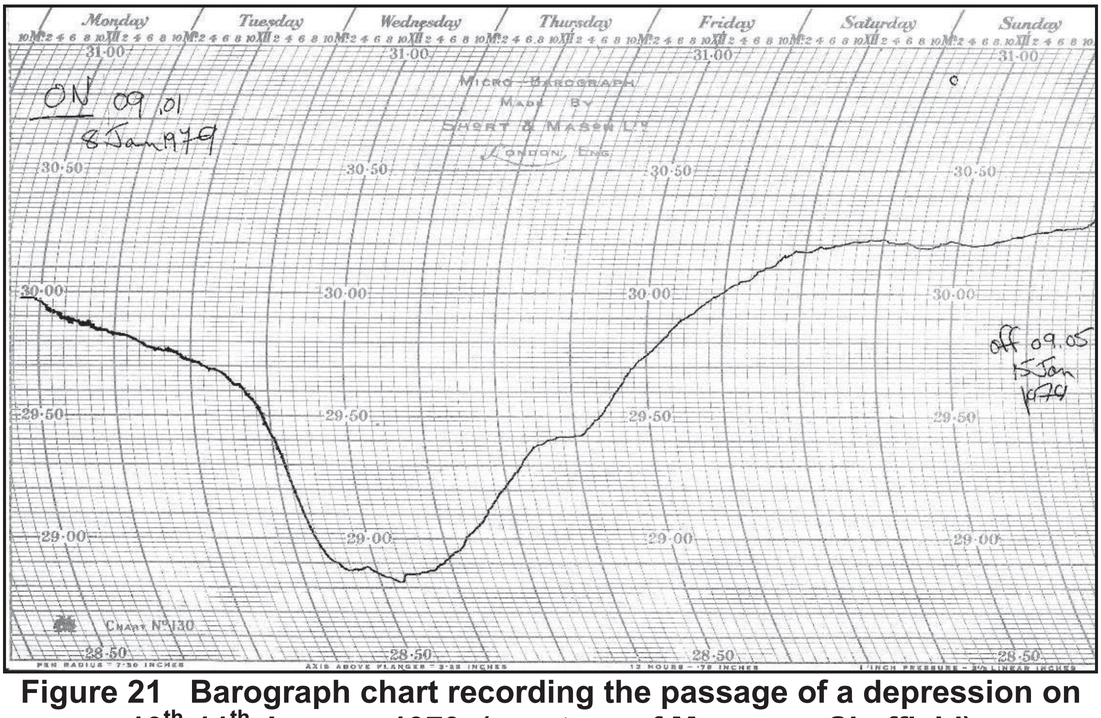


Figure 21 Barograph chart recording the passage of a depression on 10th-11th January 1979 (courtesy of Museums Sheffield)

Barwick was keen to raise the profile of the station and promoted its existence with great enthusiasm. The readings continued to be sent out to a range of organisations including the Meteorological Office, the National Coal Board, the City's Board of Health, the British Electricity Authority, the Yorkshire Electricity Board and the Smoke Abatement Office. Information was readily available to the general public and from April 1st 1953 the posting of the daily weather reports and monthly weather summaries resumed at the Town Hall, Central Library and City Museum after a period of cessation during the war. In 1954 Barwick founded the Sheffield and District Meteorological Group, bringing together amateur weather observers from across the district for the first time. He promoted the weather station for educational use, arranged visits for schools and produced a pamphlet for teachers entitled 'The Climate of Sheffield'. More than 1000 of these were distributed in the first year and became so popular that an updated version quickly followed. The subject of meteorology easily attracted most enquiries at the museum[18] from a wide variety of sources. These included enquiries from architects in relation to proposed new building extensions at Sheffield University and Jessop's Hospital and the drainage of a new housing estate, also from building companies concerned with frost damage to newly laid cement. Information about air frosts and lying snow was supplied to the City Engineer's Highways Department. Temperature readings were supplied to a food-canning firm to calculate the fine-tuning of their planting and cropping programme, summer temperature data provided to an ice-cream manufacturer and to another business monitoring temperature and humidity in shops, factories and offices. There was also partnership work with the Smoke Abatement Committee; the thick smogs of the time were severely deleterious to the health. Advice was given to the Sheffield Arctic Exploration Group bound for Norway on what type of weather to expect and how to survive it. In 1955 Barwick conducted a twelve week course of lectures entitled "The Study of Weather' organised by the Workers' Educational Association. Its success prompted the arrangement of a second course that year of equal duration entitled 'Climate and Ecology'. By this time Barwick had arranged for the daily weather bulletin to be posted at ten different sites across the city including the branch libraries of Ecclesall, Firth Park, Manor, Highfield and Hillsborough, as well as the Court of Assizes. In 1958, the year before his departure to Doncaster Museum, Barwick was answering around 1000 enquiries per year about the weather.

To mark the 75th anniversary of the establishment of the station, a Dines pressure tube anemograph (Figure 22) was installed at the museum in 1958 (Barwick and Singleton had begun researching it some 4 years earlier). Wind speed and direction had been recorded daily since the station was set up but the readings were a combination of cup-counter and Beaufort Scale observations, providing at best, estimates of wind speed at a specific point in time. The Dines anemograph allowed continuous autographic recording of both wind speed and direction on the same chart and furthermore, there was no necessity to venture outdoors to take a reading. The vane and the pressure 'head' were mounted atop a ten metre mast, 22 metres above street level whilst the recording part of the instrument was positioned within a display case along the main corridor in the museum. Here visitors could view the output on the daily chart, fixed to a rotating, clockwork drum (Figure 23). The anemograph was installed just in time to record for posterity the full force of the 'Sheffield Hurricane' in February 1962 when gusts reached 96 miles per hour on 16th, the highest ever documented in Sheffield (see section 'Sheffield's weather')[19].

After Barwick's departure the responsibility for Weston Park Weather Station passed to the newly established Natural History section of the museum and has remained so up to the

[18] As outlined in the Museum's annual reports from around 1955 onwards.
[19] Considerable wind damage occurred too in earlier gales on March 1st 1956 and December 22nd 1894 although no anemographs were in operation at this time to give an accurate assessment of speed.

time of writing. Natural history assistant Michael Clegg contributed to the operation of the weather station between 1959-1963, succeeded by assistant (later Keeper of Natural History) David A. E. Spalding and his assistant Timothy S. Sands between the years 1963-67 and in 1968 Keeper of Natural History, Timothy H. Riley. Over the decade there were several assistants who came and went, many of whom had some involvement in recording the weather.

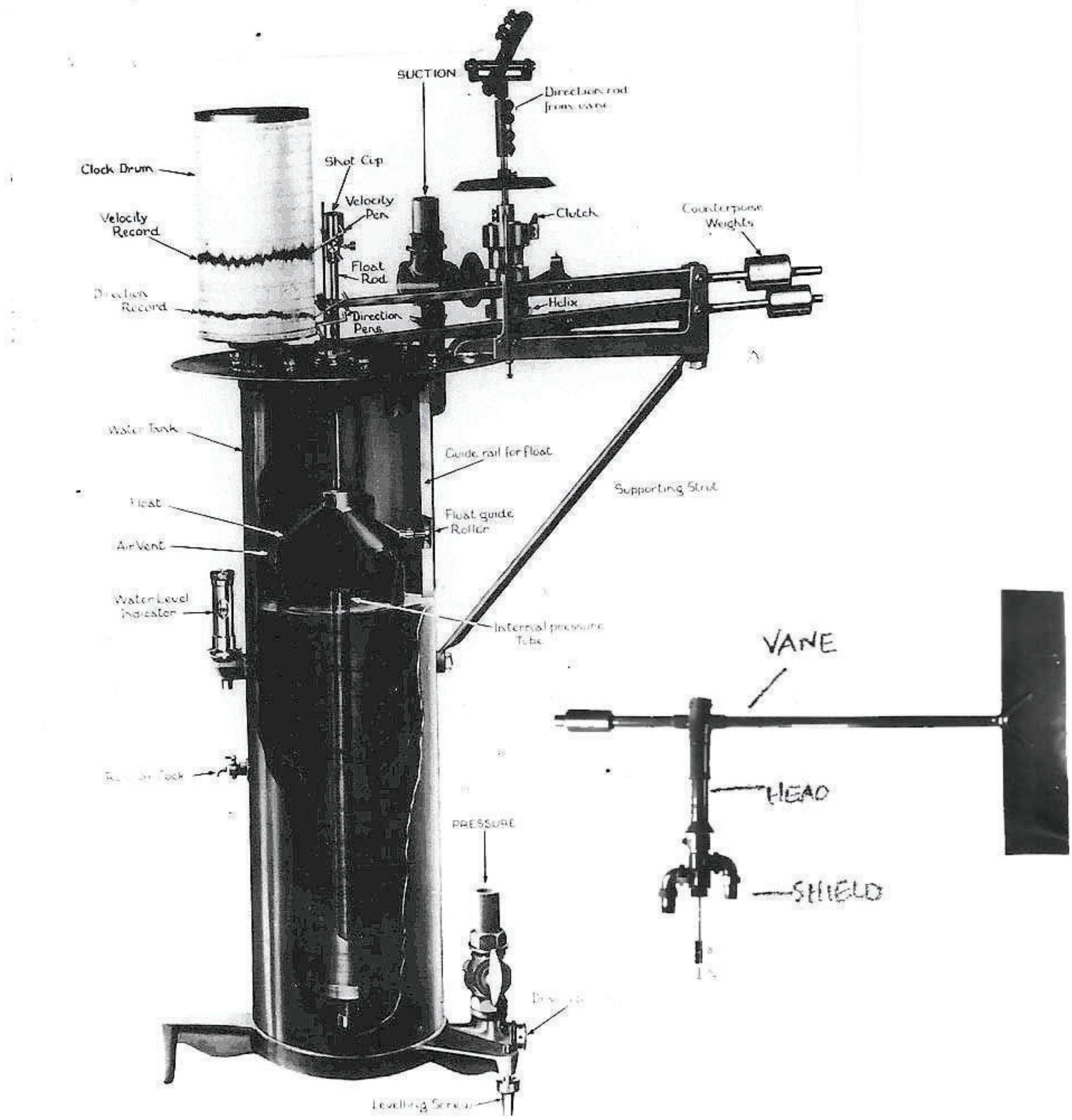


Figure 22 Dines pressure tube anemograph (courtesy of Museums Sheffield)

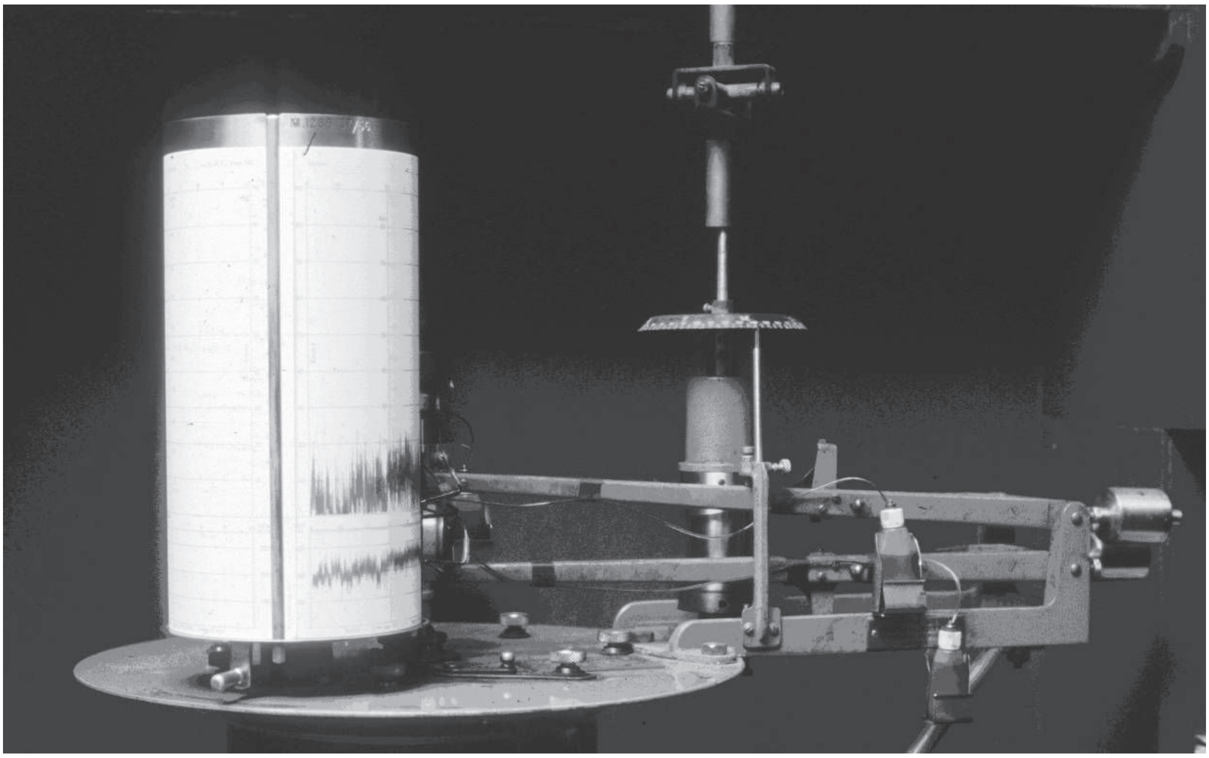


Figure 23 Dines Pressure Tube Anemograph recording output with wind speed represented in the top part of the chart and direction underneath (© Museums Sheffield)

Metrification of weather readings began in 1961 in the Meteorological Office, although voluntary co-operating stations were not required to submit metric readings until the beginning of the next decade. Thermometers with the Celsius scale were introduced in time for reporting in the new units from 1st January 1972 (also millimetres of rain instead of inches). In line with recommendations by the World Meteorological Organization, the measuring of earth temperatures also changed from 4 feet depth (127 cm) to 100cm and amendments were made to the reporting of ground frosts. The definition adopted from 1906 considered ground frost to have occurred when the temperature just above ground level fell to -0.8°C[20]. From January 1961 it was reported when the grass minimum temperature fell to 0.0°C or below.

From 1975, Keeper Tim Riley was assisted by Sheffield University graduate Derek Whiteley who joined the museum as Assistant Keeper of Natural History and soon became involved with the day to day running of the weather station. The following year Whiteley revised 'The Climate of Sheffield'[21] and continued to service the large number of weather enquiries. By this time the subject had become so popular that Riley sought funding to employ a part-time member of staff to take over the running of the weather station. The first appointment came in November 1978 when graduate Steve P. Garland (Figure 24) took up the post of Trainee Technician Natural Sciences/Meteorology (re-graded to Assistant Keeper in May 1981) with Whiteley as deputy weather observer. The number of enquiries at this time had increased to around 3000 per annum. There were regular clients such as the Meteorological Office, the Electricity Board, the Registrar General and Office of Statistics and from 1982 daily readings were supplied to the local newspaper "The Star".

[20] Justified by the statement "injury to the tissues of growing plants is not caused until the temperature has fallen appreciably below the freezing point of water" as per Meteorological Office Memo M.16782/60/M.O.3., 1960
[21] the leaflet was revised again in 1984 by S Garland

The duties were not without some rather onerous tasks too including the calculation of sunset, sunrise and lighting-up times on behalf of the City Council for their council year books and diaries (these continued to 1983). Some slightly more unusual requests for data included temperature readings provided to Thorntons (of chocolate fame) during the hot summers of the mid 1970s, wind and temperature readings for Spurn Bird Observatory and somewhat pioneering at the time, sunshine records supplied for researching the effectiveness of solar panels in the region. Weather information was also provided for research projects in medical science. One set out to correlate the higher sunshine totals observed since the introduction of the Clean Air Act, with an increase in reported cases of skin cancer. Another set out to correlate absolute minimum temperatures for 1981-85 with deaths through hypothermia.

Figure 24 Steve Garland taking measurements of rainfall from the 5" raingauge, 1982 (© Museums Sheffield)

Throughout this period all observations were still made manually. The daily readings were obtained at 0900hrs GMT and written first into the Met Office field registers Metform 3100 (Figure 25) at the time of observation and then copied by hand each month into large ten year bound journals and transcribed to the Meteorological Office template - Metform 3208B (Figures 26 & 27), the monthly data entered as coded columns to facilitate subsequent keying-in of data by Meteorological Office staff. The data would be then be validated by the Meteorological Office and a list of any amendments returned to the observer.

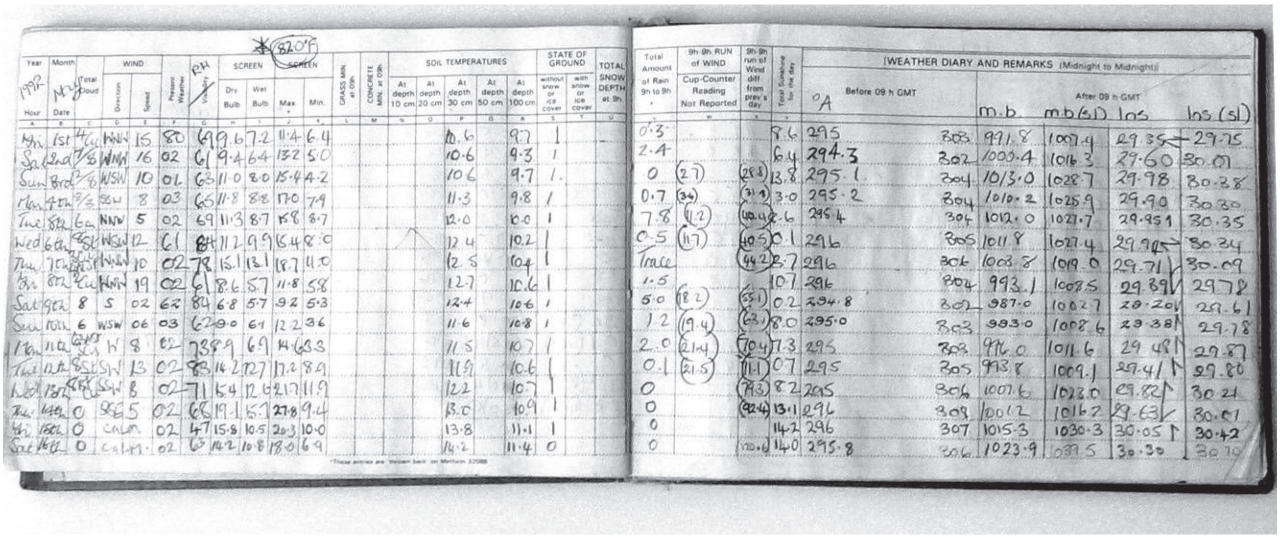
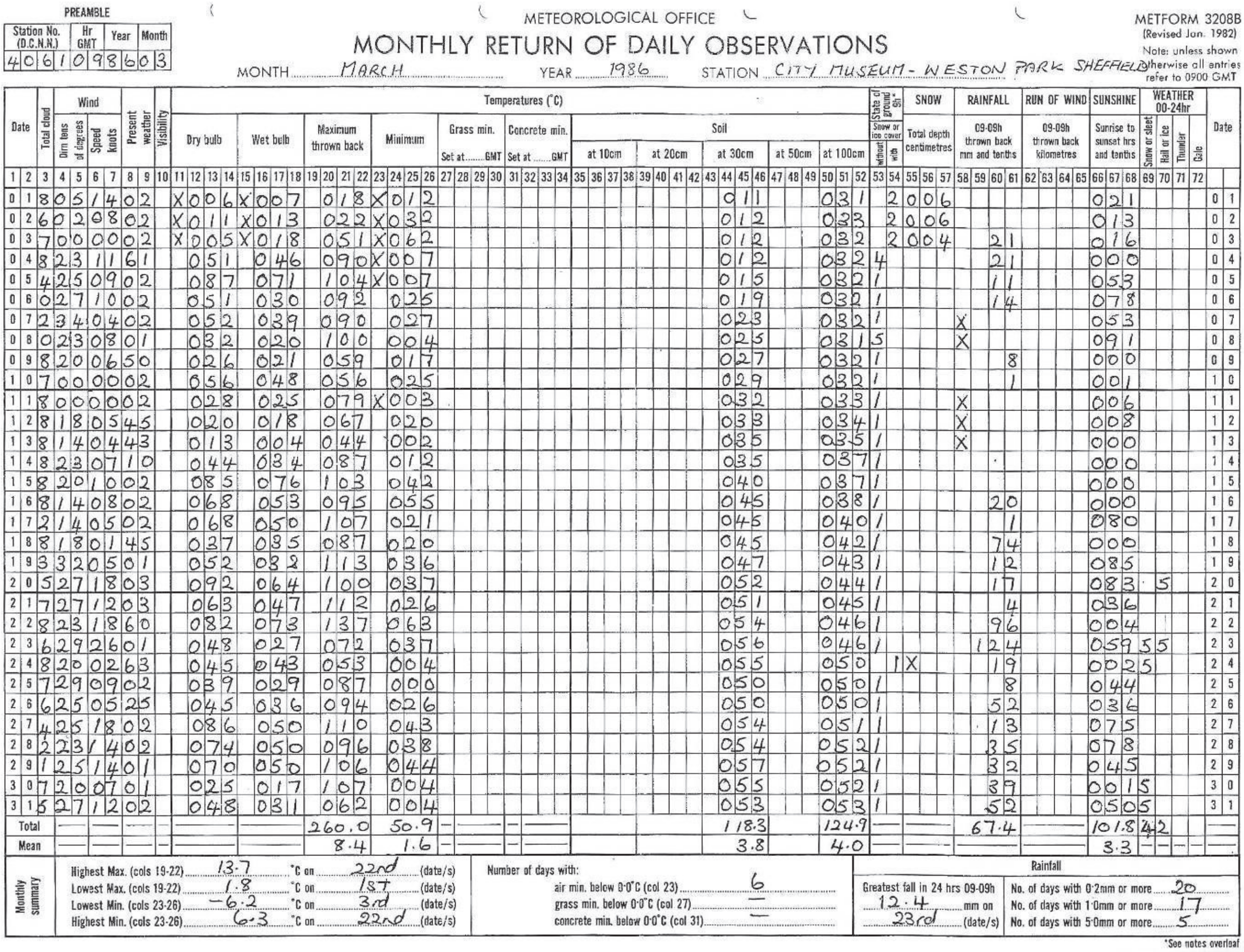


Figure 25   Metform 3100 field register (courtesy of Museums Sheffield)



PREAMBLE

Station No. (D.C.N.N.)	Hr GMT	Year	Month
4061	09	86	03

METEOROLOGICAL OFFICE

METFORM 3208B (Revised Jan. 1982)

MONTHLY RETURN OF DAILY OBSERVATIONS

MONTH MARCH YEAR 1986 STATION CITY MUSEUM - WESTON PARK SHEFFIELD

Note: unless shown otherwise all entries refer to 0900 GMT

Date (1-2)	Total cloud (3)	Wind dir tens of degrees (4-5)	Wind speed knots (6-7)	Present weather (8-9)	Visibility (10)	Dry bulb (11-14)	Wet bulb (15-18)	Maximum thrown back (19-22)	Minimum (23-26)	Grass min. (27-30)	Concrete min. (31-34)	Soil at 10cm	Soil at 20cm	Soil at 30cm (43-46)	Soil at 50cm	Soil at 100cm (50-52)	State of ground* without (53)	with (54)	Snow total depth centimetres (55-57)	Rainfall 09-09h thrown back mm and tenths (58-61)	Run of wind 09-09h thrown back kilometres (62-65)	Sunshine sunrise to sunset hrs and tenths (66-68)	Snow or sleet (69)	Hail or ice (70)	Thunder (71)	Gale (72)	Date
01	8	05	14	02		X006	X007	018	X012					011		031		2	006			021					01
02	6	02	08	02		X011	X013	022	X032					012		033		2	006			013					02
03	7	00	00	02		X005	X018	051	X062					012		032		2	004	21		016					03
04	8	23	11	61		051	046	090	X007					012		032	4			21		000					04
05	4	25	09	02		087	071	104	X007					015		032	1			11		053					05
06	0	27	10	02		051	030	092	025					019		032	1			14		078					06
07	2	34	04	02		052	039	090	027					023		032	1			X		053					07
08	0	23	08	01		032	020	100	004					025		031	5			X		091					08
09	8	20	06	50		026	021	059	017					027		032	1			8		000					09
10	7	00	00	02		056	048	056	025					029		032	1			1		001					10
11	8	00	00	02		028	025	079	X003					032		033	1			X		006					11
12	8	18	05	45		020	018	067	020					033		034	1			X		008					12
13	8	14	04	43		013	004	044	002					035		035	1			X		000					13
14	8	23	07	10		044	034	087	012					035		037	1			·		000					14
15	8	20	10	02		085	076	103	042					040		037	1					000					15
16	8	14	08	02		068	053	095	055					045		038	1			20		000					16
17	2	14	05	02		068	050	107	021					045		040	1			1		080					17
18	8	18	01	45		037	035	087	020					045		042	1			74		000					18
19	3	32	05	01		052	032	113	036					047		043	1			12		085					19
20	5	27	18	03		092	064	100	037					052		044	1			17		083	·	5			20
21	7	27	12	03		063	047	112	026					051		045	1			4		036					21
22	8	23	18	60		082	073	137	063					054		046	1			96		004					22
23	6	29	26	01		048	027	072	037					056		046	1			124		059	5	5			23
24	8	20	02	63		045	043	053	004					055		050		1	X	19		002	5				24
25	7	29	09	02		039	029	087	000					050		050	1			8		044					25
26	6	25	05	25		045	036	094	026					050		050	1			52		036					26
27	4	25	18	02		086	050	110	043					054		051	1			13		075					27
28	2	23	14	02		074	050	096	038					054		052	1			35		078					28
29	1	25	14	01		070	050	106	044					057		052	1			32		045					29
30	7	20	07	01		025	017	107	004					055		052	1			39		001	5				30
31	5	27	12	02		048	031	062	004					053		053	1			52		050	5				31
Total	—	—	—	—	—	—	—	260.0	50.9	—	—			118.3		124.9	—	—	—	67.4	—	101.8	4	2			—
Mean	—	—	—	—	—	—	—	8.4	1.6	—	—			3.8		4.0	—	—	—	—	—	3.3	—	—	—	—	—

Monthly summary

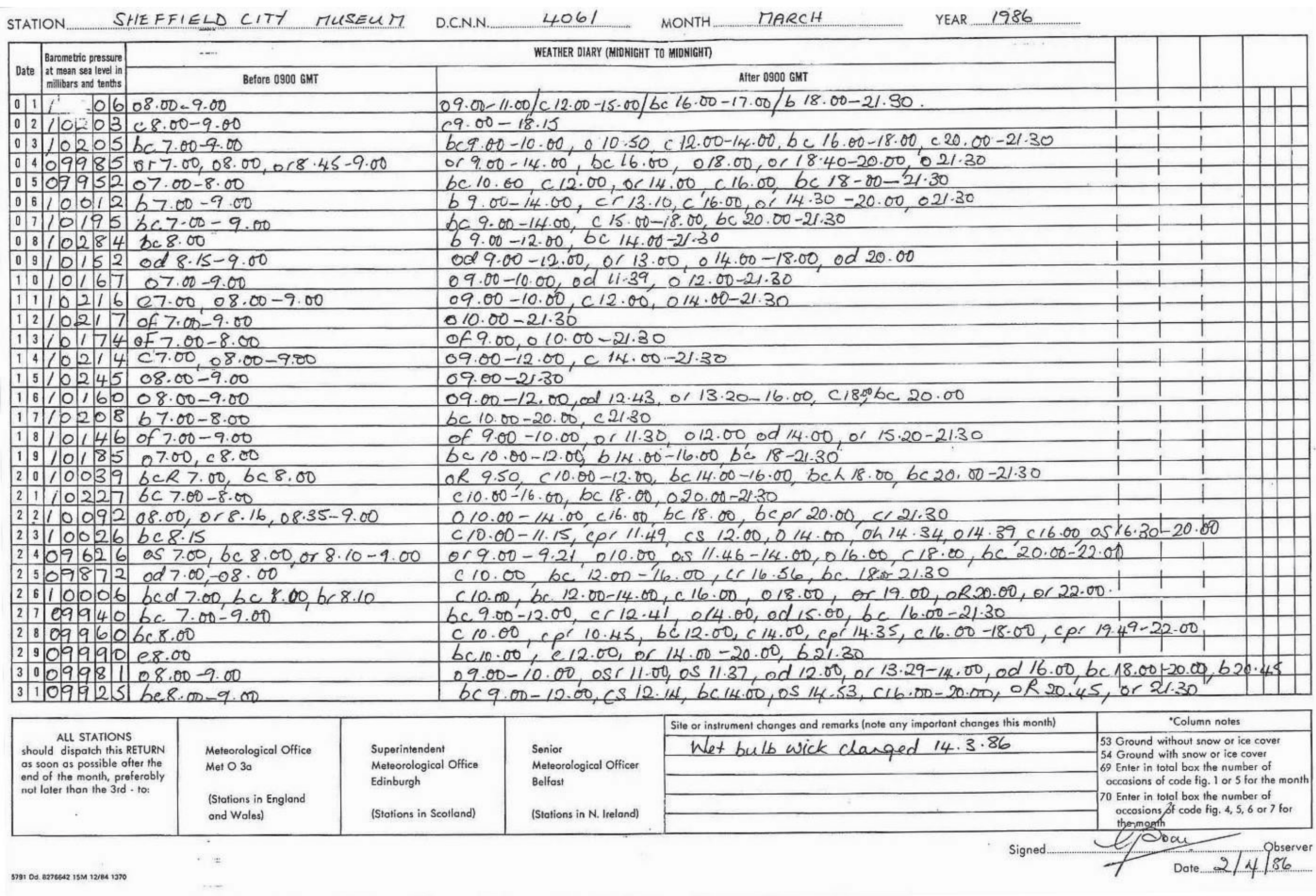
Highest Max. (cols 19-22) 13.7 °C on 22nd (date/s)
Lowest Max. (cols 19-22) 1.8 °C on 1st (date/s)
Lowest Min. (cols 23-26) −6.2 °C on 3rd (date/s)
Highest Min. (cols 23-26) 6.3 °C on 22nd (date/s)

Number of days with:
air min. below 0·0°C (col 23) 6
grass min. below 0·0°C (col 27) —
concrete min. below 0·0°C (col 31) —

Rainfall
Greatest fall in 24 hrs 09-09h 12.4 mm on 23rd (date/s)
No. of days with 0·2mm or more 20
No. of days with 1·0mm or more 17
No. of days with 5·0mm or more 5

*See notes overleaf

Figure 26 Metform 3208B (courtesy of Museums Sheffield)



STATION SHEFFIELD CITY MUSEUM D.C.N.N. 4061 MONTH MARCH YEAR 1986

Date	Barometric pressure at mean sea level in millibars and tenths	WEATHER DIARY (MIDNIGHT TO MIDNIGHT) Before 0900 GMT	After 0900 GMT
01	/[illegible]06	08.00-9.00	09.00-11.00/c 12.00-15.00/bc 16.00-17.00/b 18.00-21.30.
02	/0203	c8.00-9.00	c9.00 – 18.15
03	/0205	bc 7.00-9.00	bc9.00-10.00, o 10.50, c 12.00-14.00, bc 16.00-18.00, c 20.00-21.30
04	09985	or 7.00, 08.00, or 8.45-9.00	or 9.00-14.00, bc 16.00, o18.00, or 18.40-20.00, o 21.30
05	09952	07.00-8.00	bc 10.00, c 12.00, or 14.00, c 16.00, bc 18-00–21.30
06	/0012	b 7.00-9.00	b 9.00-14.00, cr 13.10, c 16.00, or 14.30-20.00, o21.30
07	/0195	bc 7.00 – 9.00	bc 9.00-14.00, c 15.00-18.00, bc 20.00-21.30
08	/0284	bc 8.00	b 9.00-12.00, bc 14.00-21.30
09	/0152	od 8.15-9.00	od 9.00-12.00, or 13.00, o 14.00-18.00, od 20.00
10	/0167	o7.00-9.00	o9.00-10.00, od 11.39, o 12.00-21.30
11	/0216	e7.00, o8.00-9.00	o9.00-10.00, c12.00, o14.00-21.30
12	/0217	of 7.00-9.00	o10.00-21.30
13	/0174	of 7.00-8.00	of 9.00, o10.00-21.30
14	/0214	c7.00, o8.00-9.00	o9.00-12.00, c 14.00-21.30
15	/0245	o8.00-9.00	o9.00-21.30
16	/0160	o8.00-9.00	o9.00-12.00, od 12.43, or 13.20-16.00, c18.00 bc 20.00
17	/0208	b7.00-8.00	bc 10.00-20.00, c21.30
18	/0146	of 7.00-9.00	of 9.00-10.00, or 11.30, o12.00 od 14.00, or 15.20-21.30
19	/0185	o7.00, c8.00	bc 10.00-12.00, b 14.00-16.00, bc 18-21.30
20	/0039	bcR 7.00, bc 8.00	oR 9.50, c10.00-12.00, bc 14.00-16.00, bch 18.00, bc 20.00-21.30
21	/0227	bc 7.00-8.00	c10.00-16.00, bc 18.00, o20.00-21.30
22	/0092	o8.00, or 8.16, o8.35-9.00	o10.00-14.00, c16.00, bc 18.00, bcpr 20.00, cr 21.30
23	/0026	bc 8.15	c10.00-11.15, cpr 11.49, cs 12.00, o 14.00, oh 14.34, o14.39, c16.00, os 16.30-20.00
24	09626	os 7.00, bc 8.00, or 8.10-9.00	or 9.00-9.21, o10.00, os 11.46-14.00, o16.00, c18.00, bc 20.00-22.00
25	09872	od 7.00, o8.00	c 10.00, bc 12.00-16.00, cr 16.56, bc 18.00-21.30
26	/0006	bcd 7.00, bc 8.00, br 8.10	c10.00, bc 12.00-14.00, c 16.00, o18.00, or 19.00, oR 20.00, or 22.00.
27	09940	bc 7.00-9.00	bc 9.00-12.00, cr 12.41, o14.00, od 15.00, bc 16.00-21.30
28	09960	bc 8.00	c 10.00, cpr 10.45, bc 12.00, c 14.00, cpr 14.35, c16.00-18.00, cpr 19.49-22.00
29	09990	e8.00	bc 10.00, e12.00, or 14.00-20.00, b21.30
30	09981	o8.00-9.00	o9.00-10.00, osr 11.00, os 11.37, od 12.00, or 13.29-14.00, od 16.00, bc 18.00-20.00, b20.45
31	09925	bc 8.00-9.00	bc 9.00-12.00, cs 12.14, bc 14.00, os 14.53, c16.00-20.00, oR 20.45, or 21.30

ALL STATIONS should dispatch this RETURN as soon as possible after the end of the month, preferably not later than the 3rd - to:

Meteorological Office Met O 3a (Stations in England and Wales)

Superintendent Meteorological Office Edinburgh (Stations in Scotland)

Senior Meteorological Officer Belfast (Stations in N. Ireland)

Site or instrument changes and remarks (note any important changes this month)

Wet bulb wick changed 14.3.86

*Column notes

53 Ground without snow or ice cover
54 Ground with snow or ice cover
69 Enter in total box the number of occasions of code fig. 1 or 5 for the month
70 Enter in total box the number of occasions of code fig. 4, 5, 6 or 7 for the month

Signed .... Observer

Date 2/4/86

5791 Dd. 8276642 15M 12/84 1370

Figure 27 Reverse of Metform 3208B showing air pressure readings and coded weather diary information (courtesy of Museums Sheffield)

In addition, monthly summary sheets listing each day's readings were prepared at the museum and circulated to a list of subscribers. Weather diary information, observed by the front of house team throughout the month, was also added to the journals and appended as supplementary information on the reverse of Metform 3208B (Figure 27).

Apart from the change to metric thermometers, the other main change to instrumentation during this period was the replacement in March 1980 of the Dines Pressure Tube Anemograph with a Munro Mark 4 Electrical Anemograph. Although the pressure tube anemograph had been 'state of the art' in 1958, it was time consuming to maintain, involving the daily topping-up of ink levels, keeping the instrument arms free of ink, topping-up water in the chamber, changing and writing up the charts and winding the clockwork drum. The mast had steadily been deteriorating over the previous 30 years and there had been numerous discussions with the Meteorological Office about its replacement but no financial assistance could be found. The instrument became rustier and the recording mechanism began to jam, creating errors on the chart for both wind speed and direction. Eventually, in January 1980, the mast was dismantled by intrepid steeplejacks, Harrison & Son of Sheffield (Figure 28) and a new Munro electrical vane and anemometer fixed to a replacement 15 metre steel mast erected on the rooftop of the museum. An electrically powered chart recorder, this time on a continuous monthly chart, was mounted in place of the Dines drum and chart in the main corridor of the museum (Figure 29).

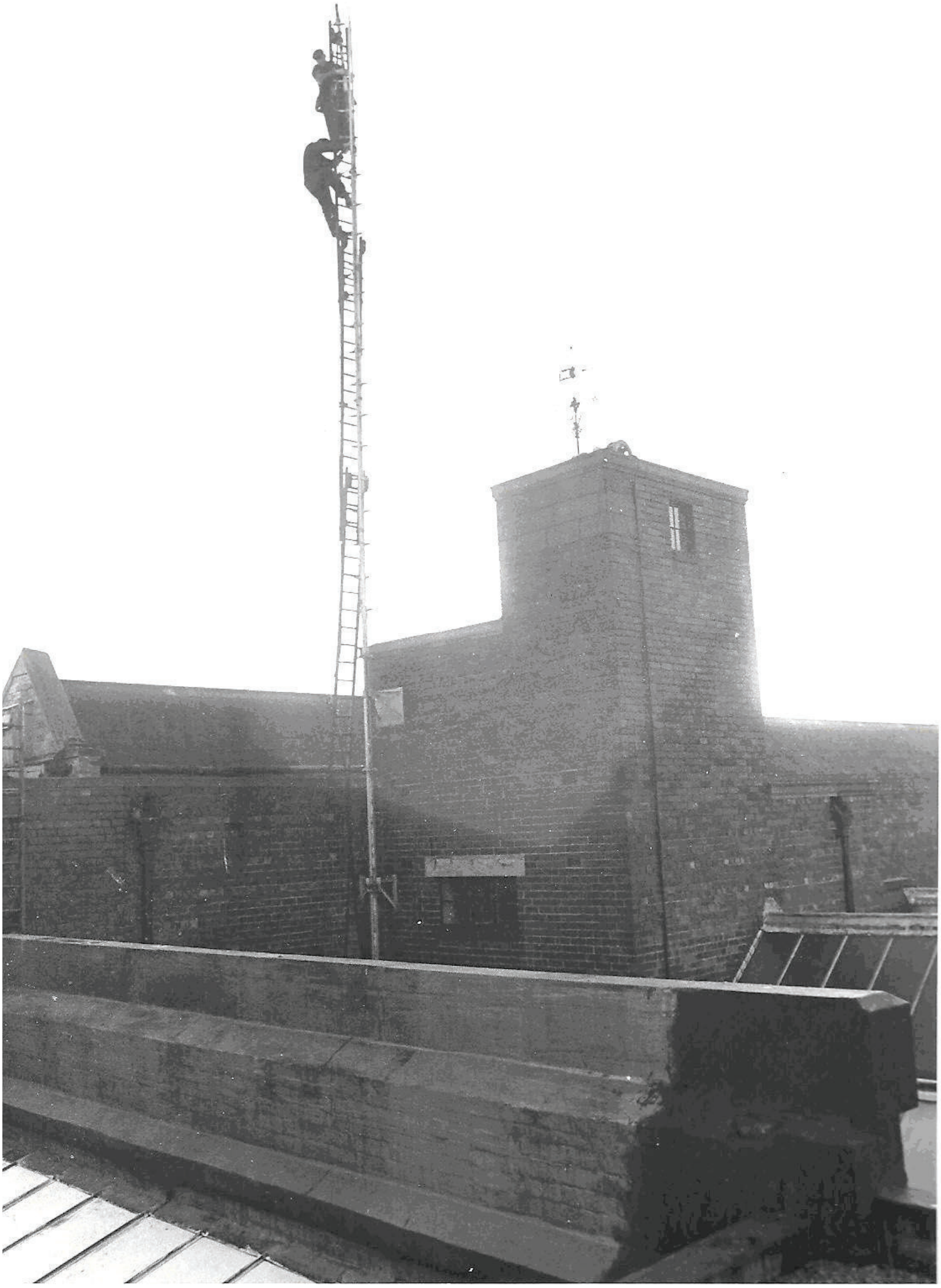


Figure 28 Dismantling of the Dines anemograph mast in January 1980 by Harrisons steeplejacks to make way for the Munro electrical anemograph mast (© Museums Sheffield)

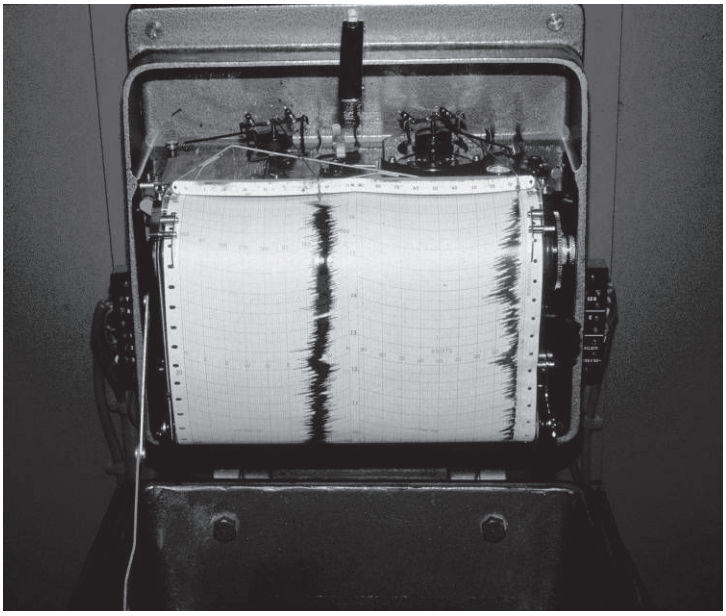


Figure 29   Chart recorder for Munro electrical anemograph showing wind direction to left and wind speed to right (courtesy of Museums Sheffield)

Figure 30   Installation of new mast, guys, anemometer and wind vane, March 1980 (© Museums Sheffield)

In 1985 Steve Garland left the section to take up a new position in Bolton and in November that year the post of Assistant Keeper Meteorology/Earth Sciences was established. Gaynor Boon (one of the authors), a graduate of Earth Sciences, was appointed and remained in post until 31st March 2010 (during this time the post was re-titled 'Curator Earth Sciences/Meteorology'), assisted by deputy weather observers Derek Whiteley (until 2000), Paul Richards (from 1986) and Alistair McLean (from 2001).

Requests for weather data continued to grow at a rapid rate over the next decade with an ever increasing number of enquiries from the insurance, legal and building professions, mostly requiring data in support of claims for inclement weather. There was also much media interest as a spate of new weather records occurred. February 1986 was unusually dry and cold with a mean monthly temperature of -1°C, the lowest February mean since the severe winter of 1947. Mean temperatures in April 1986 were the lowest since 1922 and the August bank holiday that year was one of the wettest on record with a hefty 66.6mm of rainfall in 24hours, the legacy of decaying Hurricane Charley. In January 1987 temperatures plummeted to -9.1°C at night and Sheffield suffered its coldest daytime temperature last century with -5.4°C. 1989 was the sunniest year on record for Sheffield also with the sunniest day on 3rd July with 16.1 hours bright sunshine. Winter 1988/9 was the mildest on record and was followed by another equally mild winter in 1989/90 and winds in excess of 70mph in January. The highest temperature ever recorded at Weston Park Weather Station occurred on 3rd August that year (Figure 31) during a summer that brought melting road surfaces, ruined well dressings and depletion of ice cream stocks. The record-breaking weather extremes generated plenty of new requests for weather data.

Figure 31 Gaynor Boon and Derek Whiteley recording the highest temperature on record at Weston Park Weather Station on the afternoon of 3rd August 1990, accompanied by BBC Radio Sheffield (© Museums Sheffield)

In 1990 a joint project began between the City Council's museums department and pollution control team to improve the efficiency and quantity of wind data retrieval at Weston Park Weather Station. This involved installing the first automatic, climate monitoring system[22] at Weston Park together with PC software to enable immediate download and remote interrogation of wind data. A wind vane and a Vector electronic anemometer (a much smaller, but similar shaped instrument to the Munro anemometer, consisting of three cups attached to a spindle) were installed on the rooftop mast adjacent to the Munro anemometer and the data collected by a field logger unit (CDL – climate datalogger) wired to an office PC that could be downloaded at specified intervals. The logger data was accessed remotely by the city's pollution team using GSM (Global System for Mobile communication – a digital mobile telephone system). This became operational from March 1990 and marked the dawn of a new era of data collection and analysis at Weston Park.

There were also changes to the way in which weather data was archived, gone were the leather-bound handwritten journals (1980-1990 being the last in a run of 11 ten-year volumes) as the electronic spreadsheet came into existence. Work eventually began in 1998 to transcribe the entire archive of weather data (excepting weather diary information) to electronic spreadsheets, a painstaking job that was methodically undertaken by volunteer and local weather observer Malcolm Garland[23]. This work subsequently enabled considerable manipulation of the data and provided the basis for the creation of databases designed to service interactive displays of weather in the museum and to aid efficient processing of enquiries.

The monthly reporting of observations to the Meteorological Office continued as usual, although they were now forwarded as emailed spreadsheets. For a time in the 1990's, returns were made via the Meteorological Office's 'DISCS' [24] program but this rapidly became outdated as computer technology moved on. Monthly data was also provided to Met Office Nottingham (at Watnall) for a few years prior to it closing in spring 1991 where it was used in the preparation of monthly weather summaries for the East Midlands region. Observations were also telephoned daily to Met Office Leeds for many years prior to its closure in September 2001, mainly to service press and TV contracts. Forecast information provided in exchange was included in the daily (weekday) summaries of weather posted up outside of Weston Park Museum, Sheffield Town Hall and a selection of branch libraries around the city. The supply of weekly data to 'Weathernet' began in 1999 and continues at the time of writing, the data in turn being forwarded to a wide variety of enquirers all over the UK.

Other instrument changes included the relocation of the rooftop sunshine recorder in 1996. The sunshine recorder was originally located on the rooftop of the former Mappin Art Gallery but around 1920 was transferred to the parapet directly above the main entrance to the museum, 15 metres above ground level (Figure 32). For many years, however, the exposure of the instrument to the sky was slightly affected by the leafy canopy of a large beech tree at the entrance to the museum. The possibility that this may become a future problem had been brought to the attention of the Museum Director as early as 1952 when Meteorological Office site inspectors had found the angle of elevation from the sunshine recorder to the top of the tree to be just equal to the angle of elevation of the sun at its lowest (winter) ascension. The inspector subsequently advised that any further growth

[22] Manufacturer 'Ventureprise'. Only the anemometer readings were automated at this time due to funding and logistical issues.
[23] Father of Steve P Garland, Weston Park weather observer 1978-1985
[24] Computerised data was copied to a template and returned to the Met Office on floppy disk.

would cause obstruction to bright sunshine reaching the recorder from an east-south-easterly direction. On contacting the Corporation's Parks Department it was concluded that the tree in question would probably die if severely pruned and therefore no satisfactory resolution was achieved. By the 1990s, further investigations by the Meteorological Office concluded that under-recording occurred primarily during mid-morning, on clear autumn days. Summer readings were largely unaffected, due to the sun being at a higher elevation during the summer months. The winter months were also not greatly affected due to the deciduous habit of the tree. A combination of the sun at low elevation and the tree still in leaf, however, typically occurring during a mild late spell, could affect the daily sunshine total by up to 25% on cloud-free days.

The opportunity to relocate the sunshine recorder eventually came in 1996 when it was moved to a new position that allowed full 360^{o} exposure of the recorder to the sky. This was high above the sloping glass roofs of the museum galleries, approximately 60 metres to the NNE of its former position. A long, steel walkway, stairs and platform were specially constructed to provide a safe access to the new site.

Figure 32 Campbell Stokes sunshine recorder sited above the entrance to the museum circa.1900's to 1996 (© Museums Sheffield)

Just as the final stages of installation were progressing in April 1996, disaster struck as the glass sphere of the sunshine recorder was stolen from the rooftop[25]. The expense of the new walkway meant there were no funds to purchase a replacement sphere but undefeated, Keeper of Natural History Derek Whiteley promptly launched a fund-raising appeal (Figure 33)[26]. Within a short time, the generous folk of Sheffield had donated sufficient funds for an upgraded Campbell-Stokes recorder to be purchased, this time complete with locking nuts to keep both base and sphere firmly in place (Figure 34).

[25] With a consequent loss of records for one month.
[26] A replacement sphere was loaned by the Meteorological Office to allow recording to continue during the fund-raising period.

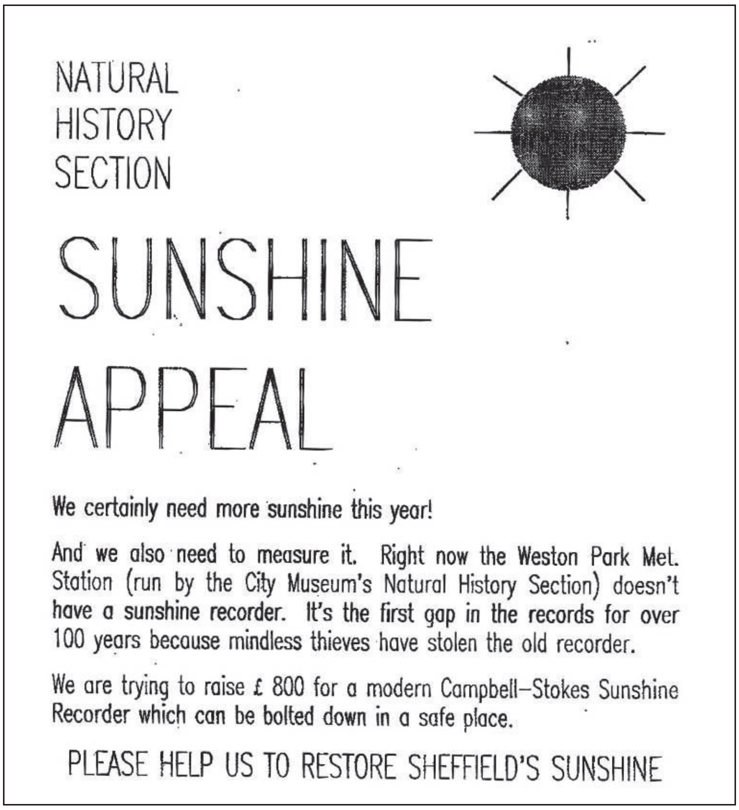


Figure 33 Advertising poster used in the appeal to raise money for the purchase of a new sunshine recorder.

Figure 34 Campbell-Stokes sunshine recorder with locking nuts (courtesy of Museums Sheffield)

At the end of the 1990s, the CDL and software were upgraded. The period was one of rapid technological change with a bewildering array of automatic weather stations (AWS) to choose from. Much careful consideration was given to the upgrade to ensure that the new system would meet Meteorological Office specifications and be able to accommodate additional sensors in the future. An off-the-shelf AWS was selected, manufactured by Campbell-Scientific Ltd[27] and consisting of a CDL with supporting software (PC208W) enabling output of data into user-defined templates. This was superior to the previous system in which the interrogation of automated readings was made by manual methods.

Initially the system was used only for collecting wind data but in 2003 Weston Park Museum closed to undergo a major refurbishment programme and this provided the opportunity to roll-out the automation. It also brought some major logistical problems. A new temporary site was needed for the sunshine recorder that would provide obstacle-free exposure to open sky for a minimum 90-270^{o} compass range. This was eventually found on the rooftop of the Central Library Building on Surrey Street although gaining access to it was not for the faint-hearted since it involved a daily trek up more than 100 steps, followed by the vertical ascent of an iron ladder in all weathers, both hands required, with recording card and pencil clenched between teeth. The anemometer was also moved, this time across Weston Park to the rooftop of the Geography Department, University of Sheffield, the data accessed remotely from a city centre office. The former mast was demolished during the replacement of the museum roof and a new eight metre tall mast installed just before the museum re-opened in 2006.The temporary closure of the museum also meant that improved security was needed for the instrument enclosure in Weston Park. A new fence to a height of 1.8 metres was thus installed and the area of ground inside the enclosure increased to accommodate the extra clearance required around the rain gauge (in respect of the higher fence). Temperature and humidity sensors were positioned inside the Stevenson Screen alongside existing thermometers, an air pressure sensor located in the box containing the CDL (attached to the stand of the Stevenson Screen), and an electronic tipping-bucket rain gauge[28] and temperature sensors to 30cm and 100cm depths installed within the enclosure (Figure 1[29]). Power was provided by a small solar panel alongside the CDL and the data download via GSM to a PC in the city centre office.

Manual observations at 0900hrs daily were maintained as far as possible during the three years that the museum was closed, principally to satisfy the requirements of the Met Office[30], although the co-ordination of simultaneous observations at different sites proved testing at times for the observer and deputies. The part played by the museum's front of house staff was also critical during this transition period and has been of fundamental importance to the continuity of weather records at Weston Park throughout the station's long history. Up until the time of automation, front of house staff have deputised as observers at weekends and Bank Holidays and regularly maintained the grass within the weather enclosure[31]. They now change over the sunshine cards daily and maintain logs of coded weather diary observations, as they have done so throughout most of the recording period.

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[27] Over 30 years of experience and proven reliability in the field of meteorological data capture.

[28] A collecting funnel empties into a double sided bucket on a counterbalance. Once one side of the bucket is filled, it empties, bringing up the empty bucket and moving a magnet past a reed switch, the movement being recorded by the CDL. Each bucket holds 0.2mm rainfall.

[29] The 'bare patch' of earth shown on the photograph is used to assess 'state of ground', a coded observation relating to how wet/dry/snow-covered the ground is at the time of observation. This ceased in 2010 at the same time that the majority of manual observations ceased.

[30] This was also a transition time for the Met Office as they relocated to Exeter in 2003, the Office's co-ordination of climatological data moving to Met Office Edinburgh

[31] Since automation this has been undertaken by the Weston Park grounds maintenance team.

Figure 35 Former museum attendant Alan Wilson recording winter weather observations circa 1980 (© Museums Sheffield)

Since the re-opening of Weston Park Museum in 2006, the Campbell-Stokes sunshine recorder has returned to the museum rooftop where it benefits from 360^o exposure on a new platform to the west of its previous location. The park CDL is supplied with both power (from an outbuilding within the park) and underground data cabling to a server in the museum. The wooden Stevenson Screen has been replaced with a plastic equivalent, thereby reducing maintenance, and the tipping bucket rain gauge (Figure 36) has also been upgraded. Wind data is retrieved by modem from the CDL on the rooftop of the Department of Geography, University of Sheffield. The manual observations were dropped to three days per week and finally ceased in 2010, following Met Office recommendations. The automatic system is, nevertheless, not completely trouble-free and requires regular maintenance, as do the sites and enclosures. Attention is particularly necessary during periods of extreme weather as rain gauges can block easily, difficulties arise with snow and ice and temperature probes are extremely sensitive. These issues are probably minor, however, in comparison to inevitable errors that occur through human error, especially in respect of inconsistencies in reading instruments. At the time of writing the only manual observations to continue are those of sunshine, air pressure and the daily weather log.

Weston Park is unique in the region for its long term sunshine records using a Campbell-Stokes recorder. The automated equivalent is the solarimeter although at the time of writing there are still difficulties in making comparisons between solarimeters and Campbell-Stokes type sunshine recorders, as noted also by weather observers at several other UK weather stations

Calibrated readings of atmospheric pressure are read manually from a Met Office precision aneroid barometer in Weston Park Museum. Other manual observations, maintained since the station's inception but which could not be automated without considerable financial investment include cloud amount and type, present weather and state of ground. Observations of these ceased in March 2010. Data now recorded at the station (to 2010) includes:

- Hourly values of temperature; dry, wet, maximum, minimum, grass minimum, earth 30cm, earth 100cm. (degrees Celsius), precipitation (millimetres), wind speed and direction (knots/degrees).
- Daily values of bright sunshine (hours) and weather diary information (0900-1700 hrs).
- 0900hrs UTC weekdays air pressure (hectopascals).
- Daily summaries of weather are displayed in Weston Park, Town Hall, Hillsborough and Stocksbridge libraries on weekdays (these are not retained).

Archived data within the meteorological archive of Museums Sheffield includes:

- Bound 10-year handwritten ledgers of daily weather readings from 1st September 1882 to 31st December 1990 (the majority of statistical data also now transcribed onto computer spreadsheets and database, excepting weather diary information).
- Computer spreadsheet/database format for all readings from 1991 to present.
- Bound registers & computer files of extreme/mean weather readings.
- Monthly and annual weather summaries from 1962 to present.
- Paper and electronic historical data from other nearby stations including Norton Lees, Rotherham, Dore, rain gauge data from Sheffield City engineers
- Personal historical weather diaries and other sources such as archived correspondence and Met Office site inspection reports.

Figure 36 Tipping bucket rain gauge, part cut away to reveal tipping bucket mechanism beneath collecting funnel (courtesy of Museums Sheffield)

Since 2008, Weston Park Weather Station has also been equipped with a separate Met Office CDL as part of the Met Office's Meteorological Monitoring System (MMS), a new automatic weather monitoring system aimed at bringing weather recording in the UK in line with the requirements of the present century. Weston Park was one of the first sites chosen for installation of MMS equipment. The CDL (manufactured by Campbell Scientific) is powered by a solar panel and collects data from temperature and humidity sensors within the Stevenson Screen and from an independent rain gauge within the enclosure. The data is transmitted directly to Met Office headquarters in Exeter.

Long term weather data is of fundamental importance in quantifying climate change and in assisting the Met Office and others to fine-tune climate prediction models. It is also essential to users at local level and beyond, who may be impacted by extreme weather and a changing climate, especially those working in health, transport, defence, engineering, media and a whole host of other business and commercial organisations. The UK Climate Impacts Programme (UKCIP) considers that it is the impact of extreme weather events that will present the greatest threat to local communities and their councils in the future. The City of Sheffield has undertaken a commitment to address these issues in its policy statements. The archive of weather data from Weston Park weather has been key to producing a Local Climate Impact Profile (LCLIP) for the city[32]. This document, published in 2009, provides a summary of the effects of extreme weather upon the City of Sheffield within the last decade. It also identifies some of the steps that have been taken to mitigate the impacts of such events in the future. Flooding in particular has had the most noticeable impact in recent years, the 2007 floods alone causing £22 million damage to the city's infrastructure and over £120 million damage to businesses.[33] To improve the city's resilience, Sheffield City Council and key partners are undertaking a comprehensive assessment to prioritise the risks. This will result in a Climate Change Adaptation Action Plan for Sheffield.

Maintaining the accurate, continuous record of weather readings at Weston Park Weather Station will ultimately allow future generations to have a deeper understanding of the nature of Sheffield's weather and climate and it is timely to recognise and appreciate the diligence, care and devotion to duty of all weather observers past and present who have contributed to this incredible record. To quote an extract from the Journal of the Royal Meteorological Society, August 2007:

> ***"Sheffield is almost unique in having the foresight to maintain a climatological station in the long term, thus providing the greatest and clearest evidence for the study of climate change"***

[32] *http://www.sheffield.gov.uk/environment/climate-change/local-climate-impact-profile*
[33] Data from Sheffield Chamber of Commerce

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Weston Park Weather Station – Extremes and Ranges

The following table gives some extreme data values (lowest and/or highest, as appropriate) and the dates on which they were recorded at Weston Park Weather Station. Unless otherwise noted, the data relates to the period from the start of Weston Park's records in September 1882 to the end of 2010. Full year data relates to the period 1883-2010.

Highest temperature recorded [1]	34.3°C (93.7°F)	3 Aug 1990
Warmest daily (night-time) minimum [2]	20.1°C (68.2°F)	3 Jun 1966
Warmest day [3]	27.0°C (80.7°F)	3 Aug 1990
Warmest month [4]	20.1°C (68.1°F)	July 2006
Warmest year	10.9°C (51.5°F)	1990 & 2006
Lowest temperature recorded [5]	-14.6°C (5.7°F)	8 Feb 1895
Coldest daily (day-time) maximum [6]	-5.6°C (21.9°F)	6 Feb 1895
Coldest day [7]	-9.2°C (15.4°F)	6 Jan 1894
Coldest month	-2.1°C (28.3°F)	Feb 1947
Coldest year	7.8°C (46.1°F)	1892
Widest daily temperature range	20.1°C (36.2°F) (11 to 31.1°C (51.8 to 88°F))	8 Sep 1911
Widest monthly temperature range	31.7°C (57.1°F) (-8.1 to 23.6°C (17.4 to 74.5°F)	Mar 1965
Lowest grass temperature [8]	-16.6°C (2°F)	24-25 Dec 1962
Highest soil temperature at 30cm	22.1°C (71.8°F)	27 July 2006
Highest soil temperature at 100cm	18.5°C (65.3°F)	31 July, 1&2 Aug 2006
Lowest soil temperature at 30cm	-0.4°C (31.3°F)	4 Mar 1947
Lowest soil temperature at 100cm	2.2°C (36°F)	16, 21 & 22 Mar 1947
Winter with max days[9] air frost [10]	88 days	1887-88
Winter with max days ground frost [11]	167 days	1909-10
Winter with min days air frost	11 days	1960-61
Winter with min days ground frost	60 days	1949-50
Consecutive days with air frost	13 days	10-22 Feb 1947
Consecutive days with ground frost	57 days	19 Jan – 16 Mar 1947

[1] Highest daily maximum temperature.
[2] Warmest night-time temperature is taken as the highest daily minimum.
[3] The daily average, taken as (minimum+maximum) divided by 2.
[4] The monthly average of the daily average.
[5] Lowest daily minimum temperature.
[6] Coldest day-time temperature is taken as the lowest daily maximum.
[7] Daily average as described above.
[8] Grass minimum temperature was recorded from 1898. It was mostly unrecorded between 1975-2006 due to repeated thefts of the grass minimum thermometer.
[9] Total days for 12 months July-June – i.e. covering a full 'winter' rather than a calendar year.
[10] Days with minimum air temperature < 0°c.
[11] Days with minimum grass temperature < 0°c.

Wettest day (highest rainfall)	119.2 mm (4.7”)	15 July 1973
Wettest consecutive 5 days	153.6mm (6”)	4-8 Aug 1922 [12]
Wettest month	285.6mm (11.2”)	June 2007
Wettest year	1085 mm (42.7”)	2000
Driest month	0.6mm (0.02”)	Sept 1959
Driest year	488.5 mm (19.2”)	1887
Consecutive days of rain (>=0.2mm)	39 Days	29 Nov 1993 – 6 Jan 1994
Consecutive dry days (rainfall <=0.2mm)	36 Days	3 Sept - 8 Oct 1986
Consecutive dry days (rainfall = 0mm) [13]	35 Days	14 Aug - 17 Sept 1959
Max. depth of fresh snow in a day[14]	12 cm (4.7”)	3 Feb 2009 & 24 Feb 2005
Max. depth of lying snow in a day	58 cm (23”)	29 Jan 1940
Max. depth of lying snow on Xmas day	29 cm (11.4”)	25 Dec 1981
Consecutive days with lying snow	67 Days	30 Dec 1962 - 6 Mar 1963
Sunniest days [15]	16.1 hrs	3 July 1989 & 30 May 1997
Sunniest month	291 hrs	July 2006
Sunniest year	1724.9 hrs	1989
Dullest month (least hours of sunshine)	5.8 hrs	Jan 1996
Dullest year (least hours of sunshine)	987.7 hrs	1968
Consecutive sunless days	21 Days [16]	25 Nov – 15 Dec 1968
Highest wind speed (gust speed)[17]	84 knots (96mph)	16 Feb 1962

The tables which follow give more detail on month-by-month ranges and lists of the top ten values in a number of categories.

[12] This is the highest 5 day rainfall even though 5th Aug 1922 had no rain!
[13] The UKCP09 definition of ‘dry days’ is where rainfall is less than or equal to 0.2mm. The alternative definition of ‘no rain’ is also commonly used. The 36 days <=0.2mm in 1986 included a single day with 0.1mm of rain!
[14] Measurements of snow depth started in 1937
[15] Hours of bright sunshine were recorded from September 1897
[16] Attercliffe had 27 consecutive sunless days – 7 Dec 1902 – 2 Jan 1903.
[17] Gust data is only available since 1958.

MONTH-BY MONTH DATA RANGES

Air Temperature

	Coldest nights (Lowest Daily Min) [18]	°C	Warmest nights (Highest Daily Min)	°C
Jan	6 Jan 1894	-13.3	16 Jan 1990	10.6
Feb	8 Feb 1895	-14.6	4 Feb 2004	11.9
Mar	4 Mar 1947	-9.3	17 Mar 2005	11.7
Apr	2 Apr 1917	-8.0	20 Apr 1945 & 24 Apr 2007	13.8
May	4 May 1941 & 2 May 1979	-0.7	13 May 1945 & 30 May 1947	16.0
Jun	2 Jun 1989	1.4	3 Jun 1966	20.1
Jul	11 Jul 1888	3.5	3 Jul 2001	19.9
Aug	14 Aug 1887	4.1	24 Aug 1990 & 9 Aug 2004	19.9
Sep	21 Sep 1932	1.7	8 Sep 1898	18.2
Oct	16 Oct 1993	-4.1	1 Oct 1985	17.6
Nov	28 Nov 2010	-7.2	22 Nov 1947	14.1
Dec	30 Dec 1908	-10.0	12 Dec 1994	12.9

	Coldest days (Lowest Daily Max)	°C	Hottest days (Highest Daily Max)	°C
Jan	12 Jan 1987	-5.4	26 Jan 2003	16.7
Feb	6 Feb 1929	-5.6	14 Feb 1998	17.6
Mar	11 Mar 1942	-2.1	29 Mar 1965	23.6
Apr	1 Apr 1911	1.1	16 Apr 2003	24.8
May	12 May 1886	4.9	29 May 1947	29.0
Jun	8 Jun 1888	8.9	22 Jun 1941	31.4
Jul	30 Jul 1892	10.2	31 Jul 1943	31.8
Aug	28 Aug 1919	10.2	3 Aug 1990	34.3
Sep	27 Sep 1974	7.0	2 Sep 1906	32.9
Oct	31 Oct 1934	2.8	1 Oct 1985	26.3
Nov	28 Nov 1969	-1.2	2 Nov 1927	18.9
Dec	25 Dec 1892	-4.7	11 Dec 1994	17.6

	Lowest daily mean	°C	Highest daily mean	°C
Jan	6 Jan 1894	-9.2	3 Jan 1932	12.3
Feb	8 Feb 1895	-8.6	13 Feb 1998	14.2
Mar	4 Mar 1947	-4.2	28 Mar 1965	15.1
Apr	2 Apr 1917	-2.4	4 Apr 1946	18.0
May	5 May 1883	3.0	30 May 1947	22.3
Jun	2 Jun 1975	6.0	3 Jun 1947	24.9
Jul	30 Jul 1888	7.8	12 Jul 1923	24.5
Aug	28 Aug 1919	8.3	3 Aug 1990	27.0
Sep	28 Sep 1919	6.2	1 Sep 1906	25.0
Oct	29 Oct 1895	1.4	1 Oct 1985	21.9
Nov	28 Nov 2010	-3.8	2 Nov 1927	15.9
Dec	20 Dec 2010	-6.5	11 Dec 1994	13.8

[18] These tables are based on the assumption that daily minima represent night-time temperatures, and maxima represent day-time – though not always absolutely correct it a generally true and is a standard convention.

	Lowest monthly mean	°C	Highest monthly mean	°C
Jan	Jan 1940	-0.9	Jan 1916	7.7
Feb	Feb 1947	-2.1	Feb 1998	8.2
Mar	Mar 1883	1.6	Mar 1938	9.9
Apr	Apr 1917	5.1	Apr 2007	11.6
May	May 1902	8.5	May 1992	13.6
Jun	Jun 1916	11.5	Jun 1976	17.2
Jul	Jul 1888	12.9	Jul 2006	20.1
Aug	Aug 1912	12.8	Aug 1975	19.3
Sep	Sep 1952	10.9	Sep 2006	16.5
Oct	Oct 1896	7.0	Oct 1921	13.1
Nov	Nov 1919	3.4	Nov 1994	9.3
Dec	Dec 1890	-0.5	Dec 1934	7.7

Sunshine

	Lowest monthly hours		Highest monthly hours	
Jan	Jan 1996	5.8	Jan 2000	75.9
Feb	Feb 1940	14.3	Feb 2008	121.2
Mar	Mar 1942	36.1	Mar 1995	172.7
Apr	Apr 1920	64.7	Apr 1909	213.5
May	May 1996	32.0	May 1989	283.8
Jun	Jun 1958	95.0	Jun 1940	278.9
Jul	Jul 1968	69.9	Jul 2006	291.0
Aug	Aug 1963	88.5	Aug 1995	255.8
Sep	Sep 1941	62.7	Sep 1999	195.7
Oct	Oct 1915	35.0	Oct 1971	139.3
Nov	Nov 1946	22.5	Nov 2006	107.3
Dec	Dec 1927	8.6	Dec 2001	71.5

Rainfall

	Lowest monthly rainfall	mm	Highest monthly rainfall	mm
Jan	Jan 1997	8.5	Jan 1986	174.1
Feb	Feb 1959	2.2	Feb 1977	201.4
Mar	Mar 1929	3.3	Mar 1981	149.9
Apr	Apr 1957	2.2	Apr 2000	151.5
May	May 1935	9.7	May 1967	172.6
Jun	Jun 1925	2.2	Jun 2007	285.6
Jul	Jul 1911	3.9	Jul 1973	200.6
Aug	Aug 1940	7.7	Aug 1922	197.7
Sep	Sep 1959	0.6	Sep 1918	179.2
Oct	Oct 1978	9.9	Oct 1998	197.9
Nov	Nov 1945	9.9	Nov 1951	199.4
Dec	Dec 1933	14.8	Dec 1965	210.0

TOP TEN DAYS, MONTHS, YEARS AND SEASONS[19]

Air Temperature

Coldest nights (Lowest daily min)[20]	ºC
8 Feb 1895	-14.6
6 Jan 1895	-13.3
10 Feb 1895	-12.9
21 Jan 1940	-11.6
19 Jan 1891	-10.7
18 Jan 1891	-10.7
30 Dec 1908	-10.0
6 Feb 1895	-10.0
14 Feb 1929	-9.7
9 Feb 1895	-9.7

Warmest nights (Highest daily min)	ºC
3 Jun 1966	20.1
9 Aug 2004	19.9
3 Jul 2001	19.9
24 Aug 1990	19.9
3 Aug 1990	19.8
26 Jul 2006	19.6
1 Jul 1968	19.3
22 Jul 2006	19.2
25 Aug 1959	19.1
29 Jul 2001	19.0

Coldest days (Lowest daily max)	ºC
6 Feb 1895	-5.6
12 Jan 1987	-5.4
6 Jan 1894	-5.1
13 Feb 1929	-4.8
25 Dec 1892	-4.7
15 Feb 1929	-4.6
12 Feb 1929	-4.5
20 Dec 2010	-4.4
20 Jan 1940	-4.4
1 Feb 1956	-4.4

Hottest days (Highest daily max)	ºC
3 Aug 1990	34.3
9 Aug 1911	33.5
2 Aug 1990	33.4
2 Sep 1906	32.9
1 Sep 1906	32.8
8 Aug 1975	32.6
31 Aug 1906	32.3
9 Aug 1975	32.3
31 Jul 1943	31.8
12 Aug 1953	31.7

Coldest 24 hrs (Lowest daily mean)	ºC
6 Jan 1894	-9.2
8 Feb 1895	-8.5
10 Feb 1895	-8.5
6 Feb 1895	-7.8
12 Jan 1987	-7.2
13 Feb 1929	-7.0
15 Feb 1929	-6.7
20 Dec 2010	-6.5
7 Feb 1895	-6.5
30 Dec 1908	-6.3

Warmest 24 hrs (Highest daily mean)	ºC
3 Aug 1990	27.0
28 Aug 1930	25.1
9 Aug 1911	25.1
1 Sep 1906	25.0
3 Jun 1947	24.9
2 Aug 1990	24.8
9 Aug 1975	24.8
12 Jul 1923	24.5
2 Sep 1906	24.5
26 Jul 2006	24.4

[19] 'Season' data in these tables follows the standard meteorological convention defining Spring as March to May, Summer as June to August, Autumn as September to November, and Winter as December to March (quoted giving the year in which the season ends).
[20] These tables are based on the assumption that daily minima represent night-time temperatures, and maxima represent day-time – though not always absolutely correct, it a generally true and is a standard convention.

Coldest months (Lowest mean)	ºC
Feb 1947	-2.1
Feb 1895	-1.2
Feb 1986	-1.0
Feb 1963	-1.0
Jan 1940	-0.9
Jan 1963	-0.8
Dec 1890	-0.5
Jan 1895	0.0
Feb 1929	0.0
Feb 1942	0.0

Warmest months (Highest mean)	ºC
Jul 2006	20.1
Jul 1983	19.4
Aug 1975	19.3
Jul 1995	19.1
Aug 1995	18.7
Aug 1997	18.7
Jul 1976	18.6
Aug 1947	18.6
Jul 1934	18.5
Aug 1990	18.4

Coldest years (Lowest mean)	ºC
1892	7.8
1888	8.1
1885	8.3
1891	8.4
1919	8.4
1887	8.4
1963	8.4
1886	8.5
1922	8.6
1962	8.6

Warmest years (Highest mean)	ºC
2006	10.9
1990	10.9
1959	10.7
1999	10.7
2004	10.7
2007	10.7
2003	10.6
1989	10.6
2005	10.6
2002	10.5

Warmest springs	°C
1945	10.3
2007	10.2
1990	10.1
1999	10.1
2003	10.0
1893	9.9
1943	9.9
2009	9.9
1992	9.9
1959	9.8

Warmest summers	°C
1976	17.8
2006	17.7
1995	17.4
2003	17.4
1933	17.3
1975	17.2
1947	17.2
1959	17.0
1983	16.9
1911	16.8

Warmest autumns	°C
2006	12.5
1978	11.7
1959	11.6
2005	11.5
1898	11.4
1999	11.4
1995	11.3
1949	11.3
1945	11.3
2009	11.3

Warmest winters	°C
1989	6.7
2007	6.5
1998	6.3
1935	6.1
1975	6.1
1990	6.0
1899	5.9
1898	5.8
1943	5.7
1925	5.6

Coldest springs	°C
1891	6.1
1887	6.3
1888	6.4
1941	6.6
1883	6.6
1886	6.6
1951	6.7
1962	6.7
1917	6.7
1885	6.8

Coldest summers	°C
1888	13.1
1907	13.5
1922	13.5
1892	13.6
1902	13.8
1954	13.9
1920	13.9
1912	14.0
1956	14.0
1890	14.0

Coldest autumns	°C
1887	8.0
1993	8.0
1919	8.1
1952	8.1
1885	8.3
1896	8.3
1905	8.4
1882	8.4
1892	8.5
1923	8.6

Coldest winters	°C
1963	0.2
1947	1.2
1979	1.3
1895	1.5
1940	1.6
1917	2.0
1929	2.0
1891	2.0
1886	2.2
2010	2.4

Sunshine

Sunniest months	hrs
Jul 2006	291.0
Jul 1911	286.3
Jul 1976	285.2
Jul 1989	284.9
May 1989	283.8
Jun 1940	278.9
Jun 1957	275.7
Jul 1990	273.8
Jun 1960	261.8
Jul 1900	260.8

Dullest months	hrs
Jan 1996	5.8
Dec 1927	8.6
Dec 1933	10.9
Dec 1989	12.9
Jan 1917	14.1
Feb 1940	14.3
Dec 1934	14.3
Dec 1958	14.3
Dec 1987	14.3
Jan 1950	14.3

Sunniest years	hrs
1989	1724.9
2003	1640.6
1999	1632.6
2006	1606.0
2009	1595.8
2007	1593.6
1995	1585.9
1997	1580.7
2005	1561.6
1911	1542.7

Dullest years	hrs
1968	987.7
1954	1047.9
1932	1060.5
1912	1072.3
1920	1081.3
1927	1086.8
1958	1088.5
1944	1088.7
1966	1091.0
1913	1101.6

Sunniest springs	hrs
1990	558.4
2003	548.8
1995	547.0
1997	546.4
1982	537.7
2009	520.0
1989	518.2
1909	512.0
2007	503.1
1948	502.3

Sunniest summers	hrs
1989	780.9
1976	751.0
1911	702.8
1996	698.8
1995	667.8
1984	660.5
1975	660.2
1959	648.1
1933	637.5
1901	633.7

Sunniest autumns	hrs
1999	389.5
2006	375.2
1971	365.8
1986	351.2
2007	343.5
1929	343.2
1921	342.6
2005	329.2
2003	325.4
2009	324.8

Sunniest winters	hrs
2000	229.0
1907	220.2
2007	208.7
2002	205.3
2008	204.2
1999	201.3
2001	199.9
1998	194.8
2005	194.5
2004	192.9

Dullest springs	hrs
1932	250.3
1928	274.9
1930	283.2
1941	283.4
1969	294.8
1983	302.3
1926	307.4
1981	309.9
1954	315.2
1991	321.8

Dullest summers	hrs
1912	333.5
1954	343.2
1968	343.9
1958	376.1
1956	382.0
1944	388.0
1965	388.7
1966	398.2
1980	400.7
1920	406.1

Dullest autumns	hrs
1941	146.6
1968	167.5
1946	168.0
1945	175.8
1993	185.5
1944	194.7
1984	195.4
1920	195.8
1939	197.2
1901	200.9

Dullest winters	hrs
1917	70.5
1929	70.7
1940	79.0
1996	80.6
1942	83.2
1913	86.2
1993	86.4
1904	89.1
1948	90.0
1921	90.6

Rainfall

Wettest days	mm
15 Jul 1973	119.2
14 Jun 2007	88.2
10 Jun 2009	88.1
09 Aug 2004	77.0
22 Jun 1982	66.6
25 Aug 1986	66.5
07 Aug 1922	62.1
30 Jun 2003	60.9
21 May 1932	59.4
14 Sep 1994	58.9

Driest months	mm
Sep 1959	0.6
Feb 1891	1.9
Jun 1925	2.2
Apr 1957	2.2
Feb 1959	2.2
Mar 1929	3.3
Jul 1911	3.9
Feb 1985	4.7
Apr 1938	4.8
Mar 1931	5.4

Wettest months	mm
Jun 2007	285.6
Jun 1982	225.0
Dec 1965	210.0
Dec 1978	207.9
Feb 1977	201.4
Jul 1973	200.6
Nov 1951	199.4
Dec 1912	198.2
Oct 1998	197.9
Aug 1922	197.7

Driest years	mm
1887	488.5
1975	559.3
1921	570.1
2003	591.7
1953	598.7
1959	609.4
1905	620.2
1934	626.8
1933	633.8
2010	633.9

Wettest years	mm
2000	1085.0
2002	1051.6
1965	1048.1
1960	1035.3
1986	998.1
1912	994.5
1946	985.9
1954	984.1
2008	981.3
1966	975.8

Wettest springs	mm
1979	346.6
1981	325.7
1983	313.9
1886	313.6
1889	297.5
1969	295.1
1932	294.0
1947	286.8
1986	273.1
1967	263.1

Wettest summers	mm
2007	425.7
1912	374.0
1956	369.9
1931	361.1
2009	359.4
1958	337.2
1982	323.2
1922	313.1
1973	302.6
1927	300.4

Wettest autumns	mm
2000	425.3
1960	403.9
1935	380.4
1965	342.4
1944	331.3
1903	326.4
1984	325.2
1885	320.3
1968	314.9
1940	314.2

Wettest winters	mm
1966	412.5
1990	403.0
1977	391.1
1984	382.1
1916	378.9
1994	371.5
1979	368.8
1995	361.5
1915	351.7
1928	339.3

Driest springs	mm
1990	66.4
1938	79.1
1929	81.3
1957	87.8
1911	90.4
1974	91.6
1915	95.7
1900	99.5
1956	101.1
2010	102.8

Driest summers	mm
1995	45.9
1976	50.8
1887	76.5
1959	83.0
1983	83.3
1934	90.4
1933	91.2
1913	92.3
1940	92.3
1994	92.7

Driest autumns	mm
1975	90.4
1884	101.1
1904	101.4
1948	102.5
1964	103.4
1908	106.1
1920	108.3
1978	108.7
2007	109.7
2003	120.8

Driest winters	mm
1964	70.5
1891	77.8
1934	91.0
1932	114.6
1929	114.8
1905	115.2
1927	117.0
1909	119.4
2006	122.2
1985	125.3

Is Sheffield's Weather Changing?

INTRODUCTION

Most discussions of 'Climate change' refer to global temperature anomalies that are not easy to relate directly to local trends and, therefore, to local impacts. In this section we will compare this global view with UK and local temperature data and extend the discussion to other data collected at the Weston Park Weather Station over the last 127 years. The data shown here was updated in January 2011 to include annual and summer charts for 2010 and data for the winter of 2009-10 (shown on charts as 2010).

The discussion does not attempt to look into the future where likely trends are dependent on many factors such as global emission of greenhouse gases – so called anthropogenic emissions. The evidence for the likely trends, and their possible causes, is well documented elsewhere[1].

As well as data taken from Weston Park Weather Station records, these notes draw on time series data provided via the internet by the Met Office Hadley Centre and the Climate Research Unit (CRU) at the University of East Anglia, and, in the later section covering the area surrounding Sheffield, on gridded data provided as part of UKCP09 via the Met Office web site.

GENERAL NOTES

Data Smoothing

As will be seen in the time series charts that follow, weather records show a high level of variation from year to year as well as the changes observed from day to day. In many cases this variation is of great interest in highlighting specific events or periods. However, if we are looking for trends it is beneficial to apply some smoothing to the data. By identifying these trends, we can move the discussion from that of 'weather' towards that of 'climate'.

The smoothing applied to such data can vary from a simple moving average to a polynomial statistical regression line. All such methods have their advantages and drawbacks and a discussion of them would be beyond the scope of this study.

In the following charts we have adopted a smoothing algorithm called 'Triangular Kernel Smoothing' (TKS) which is easy to apply and gives results comparable with those published by UKCP09, Hadley Centre, and other sources. The period of smoothing in annual data varies between publications but +/-7 years (as used here) is a common period that does not totally eliminate the shorter period variations, but still highlights any underlying trends.

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[1] Internationally, the Intergovernmental Panel on Climate Change (IPCC) (*http://www.ipcc.ch/*) is the scientific body tasked to evaluate the risk of climate change caused by human activity, but major research on past and future climate trends is carried out here in the UK and brought together by The Met Office Hadley Centre (*http://www.metoffice.gov.uk/climatechange/science/hadleycentre/*), the Climate Research Unit (CRU) at the University of East Anglia (*http://www.cru.uea.ac.uk/*), and the UK Climate Impacts Program (UKCIP) (*http://www.ukcip.org.uk/*). UKCIP have recently published UKCP09 which brings together the latest UK climate projections (*http://ukclimateprojections.defra.gov.uk/*).
A useful and readable summary of the underlying science is provided in Dessler & Parson (2010).

The TKS algorithm[2] calculates a weighted average of a data point and its near neighbours, much like a moving average, but with the nearest neighbours carrying greatest weight. This gives a smoother line that a simple moving average.

One caveat concerns the end points in each graph since the smoothed value is then only based on a partial set of data – e.g. 2010 smoothed annual data is based only on 2003-2010 since 2011-2017 are not yet available and may change the shape of the 'tail' of the graph. This effect can be seen in several charts which include the extreme weather seen in the 2010 – we cannot say that this is the start of a 'trend' or simply a short term change.

Long Term Averages

As with most published work on climate change, data has been compared with an average for the period 1961-1990 – often called the 'long term average ' or LTA. This baseline period continues to be a standard used by the World Meteorological Organisation (WMO) (*http://www.wmo.int/*) and provides consistency between many sources such as the IPCC and UKCP09. 'Anomalies' from this 'LTA' are the basis of many published charts.

Statistical Significance

No attempt has been made in this work to assign any numeric statistical significance to the values and trends seen in the charts. Statistical terms such as 'significant increase' should only be read in the broad sense based on inspection of the charts and data.

Chart Scales

Readers are asked to take careful note of the vertical scale in the charts which follow. In most cases the scales have been adjusted so as to emphasise the variation in the plotted values. In some cases this gives a false impression of the overall scale of the variations. The range of variation should always be considered in the context of the actual data values – e.g. a 10mm increase in rainfall would probably not be considered significant if it were from 1000mm to 1010mm, but would be more so if it were from 20mm to 30mm.

GLOBAL TEMPERATURES

Global Temperatures are the basis of most discussions of climate change. They bring together data from many sources, and those sources have changed over time. Coverage varies widely, being denser over more populated land areas such as the USA and Europe. Much of the development work for this data has covered the issues of consistency and homogeneity of the data across the globe and through time, and bringing together data from land and sea-surface observations.

A variety of observational temperature data sets are provided by the Hadley Centre (*http://hadobs.metoffice.com/*) and CRU (*http://www.cru.uea.ac.uk/cru/data/temperature/*), and individual station details are now available at *http://www.metoffice.gov.uk/climatechange/science/monitoring/subsets.html* .

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[2] The basis of the TKS algorithm for annual data with a smoothing period of +/-N years is as follows …

> For year Y, vary Y' from Y-N to Y+N, weight data for each year Y' by a factor of (N-abs(Y-Y')), sum the weighted values and divide by the sum of the weightings.

The data includes a dataset known as 'HadCRUT3' which provides data for each month since January 1850 on a 5 degree grid covering much of the globe. The dataset is a collaborative product of the Hadley Centre and CRU (see Brohan et al (2006) and the above CRU web-link for discussions about the data).

The dataset is a combination of a CRU land-surface air temperature dataset and a Hadley Centre sea-surface temperature dataset. It is based on data from many locations varying in both latitude and altitude, and therefore has to be expressed as anomalies from local base data for the period 1961-90. The resulting data is therefore only quoted as anomalies, not in terms of absolute temperatures.

As well as the gridded data, the data has also been averaged for the northern and southern hemispheres, and globally. It is these datasets which have been used here. The datasets provided by CRU give monthly and annual data from January 1850 to the present day, and are updated monthly.

Figure 1 shows global anomalies (from the 1961-90 base) in a form commonly seen in many publications on climate change. Since 1970 the overall trend of global temperatures has been upwards with the highest temperatures in the series occurring in the last 20 years.

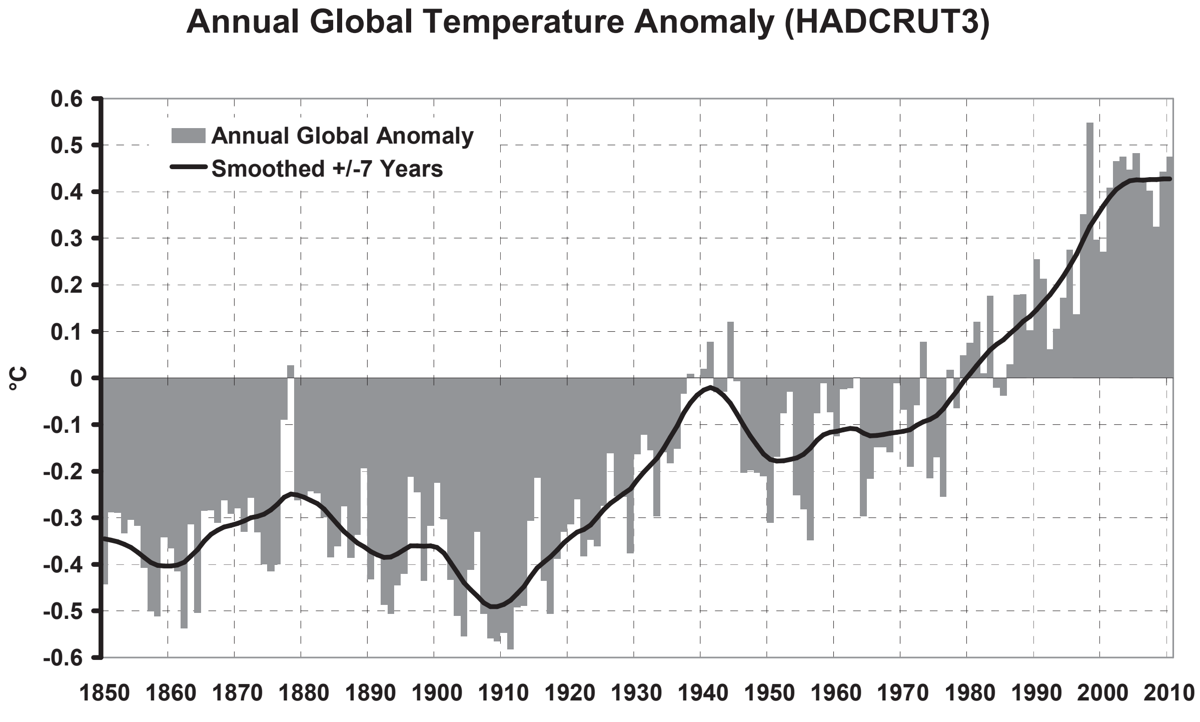


Figure 1 Annual Global Temperature Anomaly (HADCRUT3)

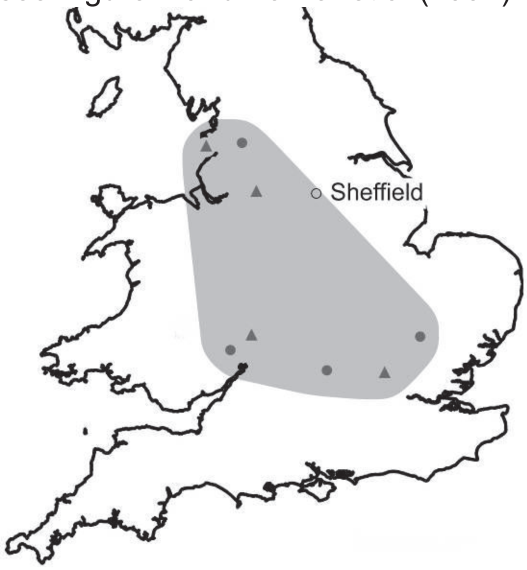
CENTRAL ENGLAND TEMPERATURES

Figure 1 gives a global picture that may not be representative of a narrower local area. It is, therefore, useful to look at a similar set of data that has been brought together by the Hadley Centre and known as CET or HadCET – The Hadley Centre Central England Temperature dataset (see Parker et al (1992) for details of the data and a discussion of the adjustments applied).

CET brings together data from a number of weather stations in a roughly triangular area from central Lancashire, south to the southern edge of the Midlands near Malvern and east to Rothamsted, north of London (see Figure 2 and Parker et al (1992) for details).

Figure 2 Stations used since 1878 in creating the HadCET Central England Temperature data.

● prior to 1959
▲ since 1959



This dataset not only provides a more local view, but also provides a much longer record of instrumental data – monthly data is available from 1659, and daily data from 1772 to the present day. Older data is inevitably less dependable since it is based on fewer locations and is less consistent in the measurement methodology.

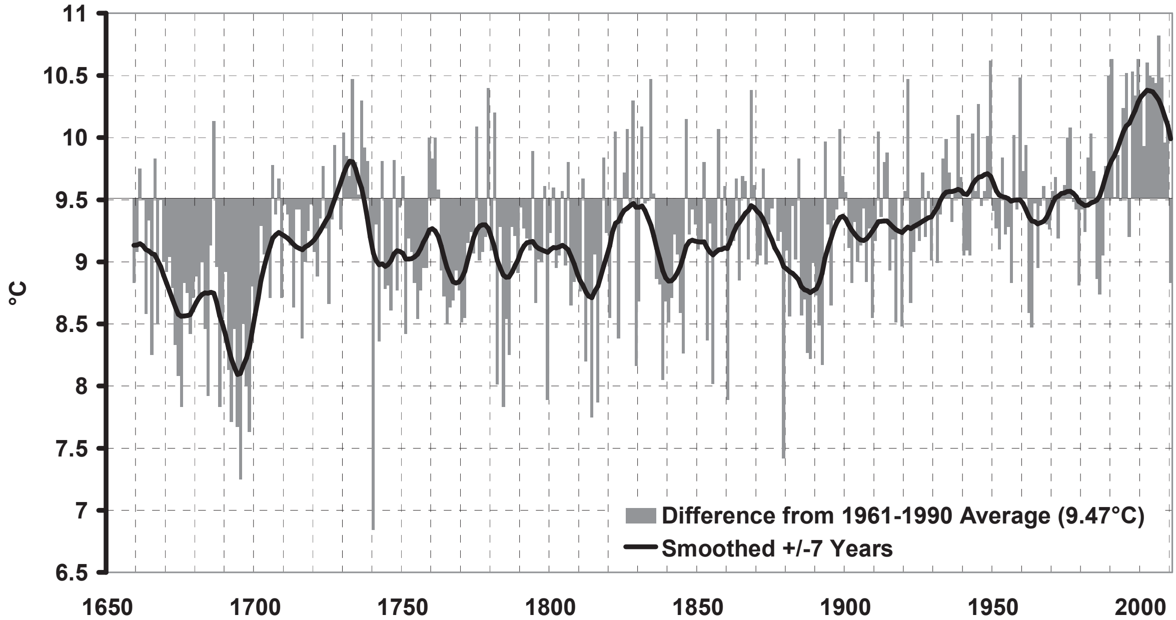


Figure 3 Annual Mean Central England Temperature (CET)

Because we are looking at a smaller area, it is meaningful to show the data (as in Figure 3) as actual temperatures averaged for each year, but for comparison it is also beneficial to show these temperatures against the 1961-90 average.

It is possible to identify specific events in this data such as 1740 when there was sea ice in East Coast ports and the Thames froze for several weeks, and 1879 when there were ice flows in the Thames. The average for 2010 (8.8°C) includes the cold weather at the end of the winter of 2009-10 as well as the record breaking start to the winter of 2010-11. Such events can be seen even better by charting separate data for the summer and winter months (as in Figures 4 and 5).

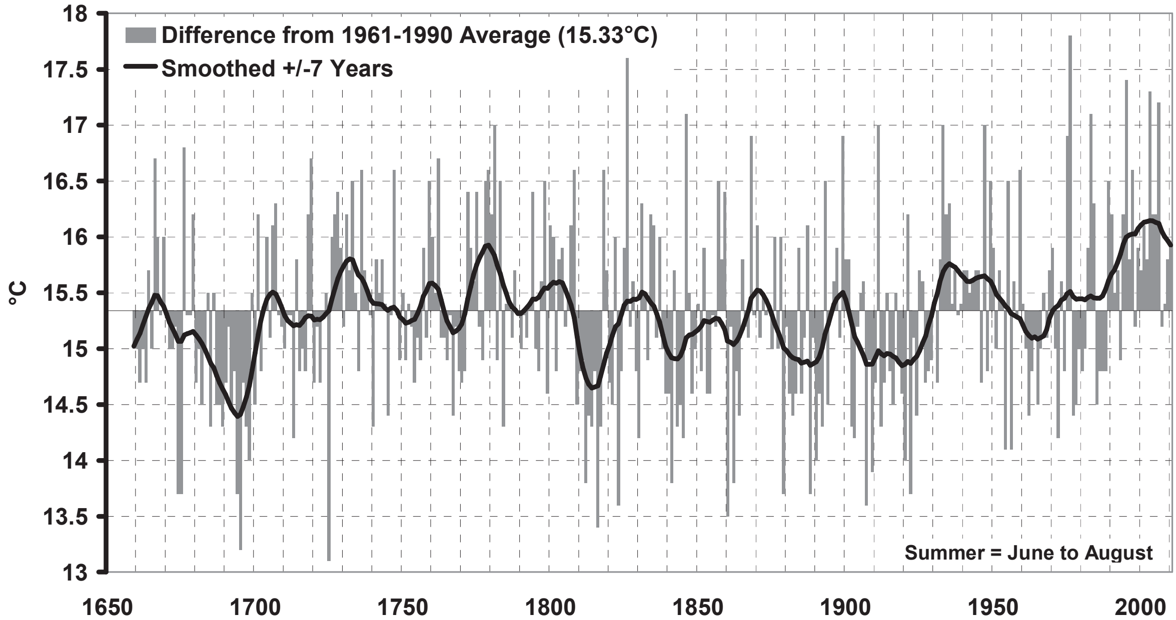


Figure 4 Summer Mean Central England Temperature (CET)

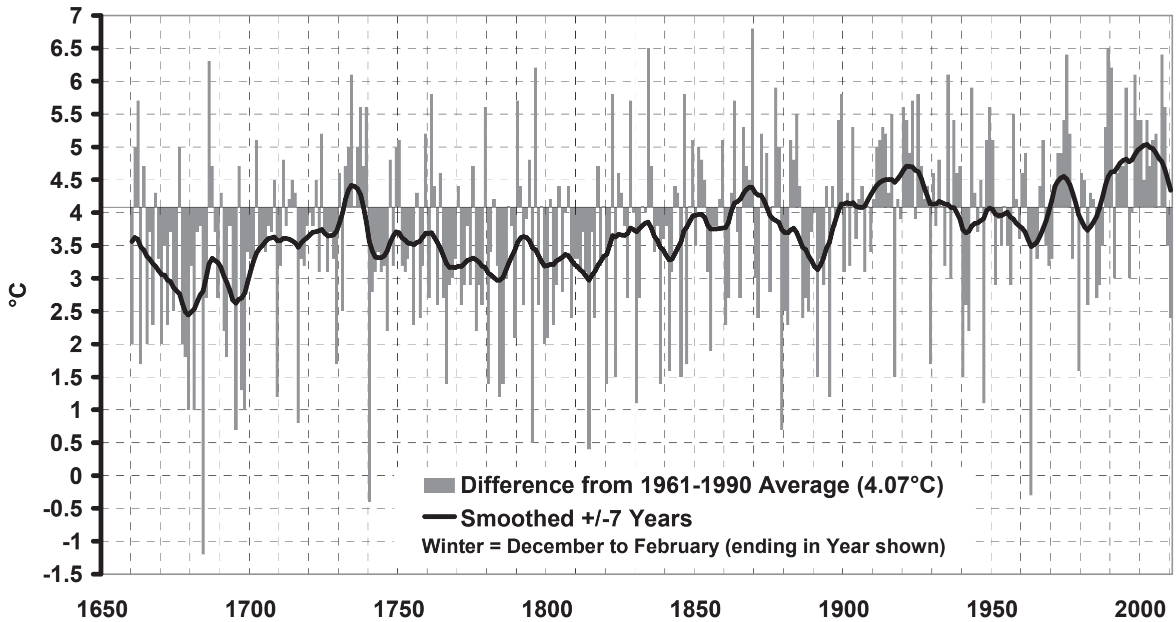


Figure 5 Winter Mean Central England Temperature (CET)

WESTON PARK – MEAN TEMPERATURE

Records of temperature at Weston Park have been taken at 09:00 GMT each day (with a few minor exceptions!) since September 1882. These include the air temperature at 09:00 GMT and the maximum and minimum temperatures for the preceding 24 hours. Since 1898 they have included soil temperatures taken at 09:00 GMT. The 'grass minimum temperature' has also been recorded for much of this period but with significant gaps between 1975 and 2004. Conventionally, a daily average temperature is taken as the mean of the maximum and minimum, though since the advent of automation on 2006, it would now be possible to obtain an average from the hourly readings.

Figure 6 shows the annual mean (here taken as the annual mean of the daily means calculated from the max and min temperature data). 1882 has been omitted (from this and other charts) since the data is incomplete, observations beginning from 1st September 1882.

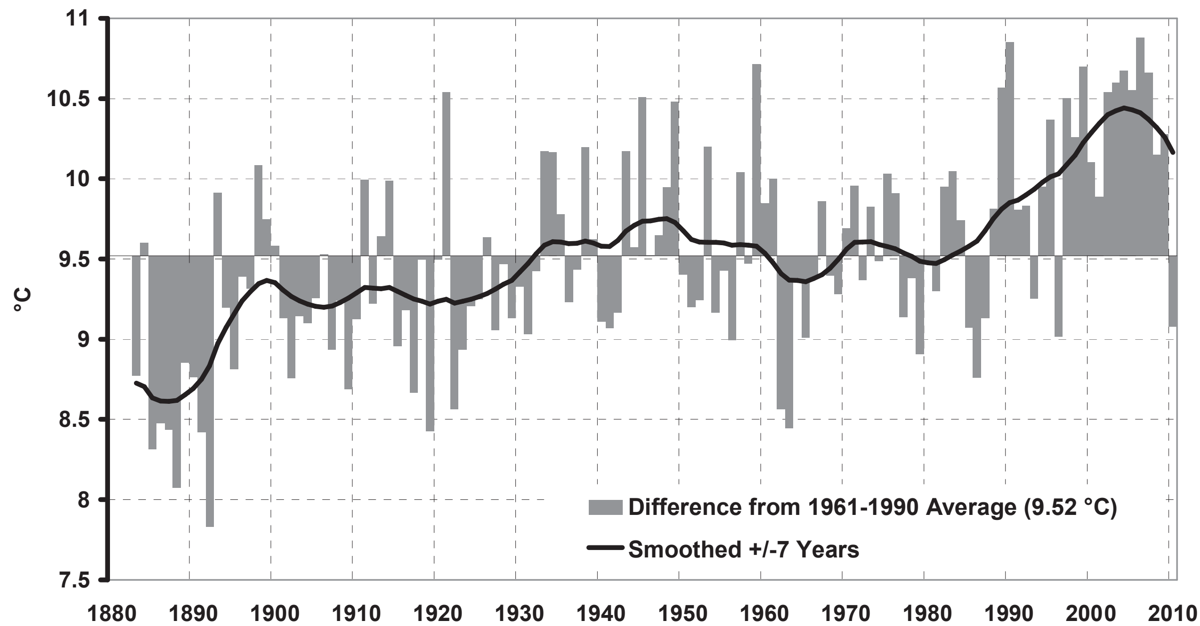


Figure 6 Weston Park – Annual Mean Temperature (°C)

The differences ('anomalies') from the 1961-90 averages can be compared (in Figure 7) with the global data, the northern hemisphere, and central England …

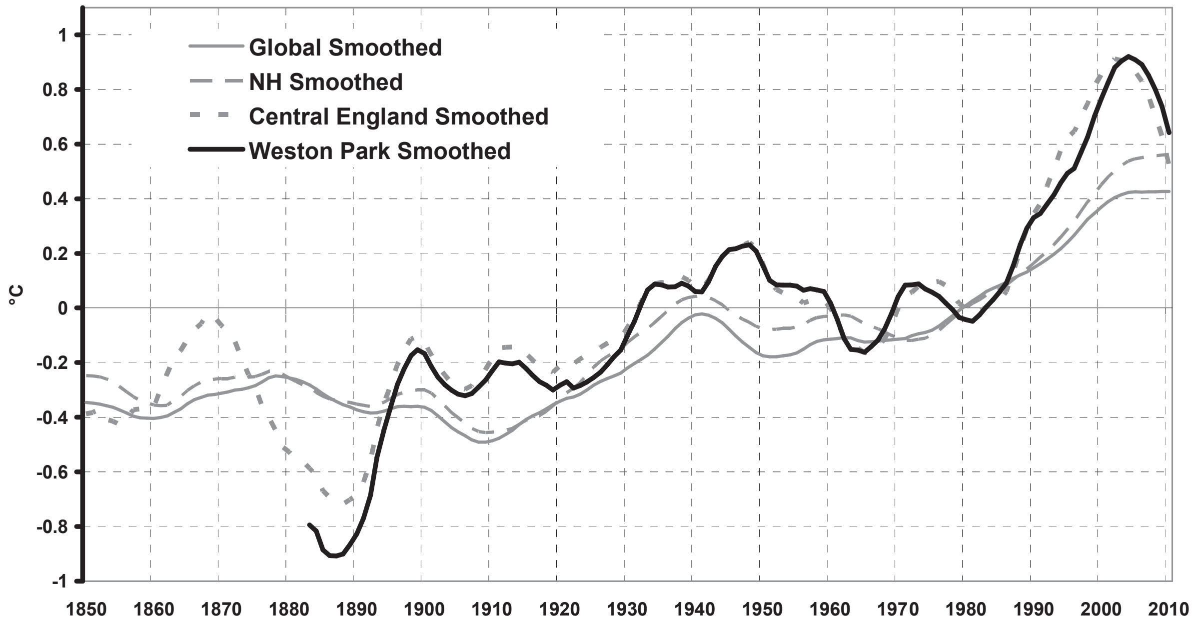


Figure 7 Annual Global and other Temperature Anomalies (Smoothed +/-7 Years)

Global and northern hemisphere data show much lower increases in the last 30 years due to the moderating effects of sea temperatures. Sheffield data (Weston Park) closely reflects the central England series, including the notable dip in the smoothed values caused by the low averages in the last three years, emphasising that these have been regional rather than global effects.

Given that we have full details of the daily data, it is possible to analyse the Weston Park data in much more detail. A comparison of summer and winter temperatures (Figures 8 and 9) highlights specific events and interesting contrasts

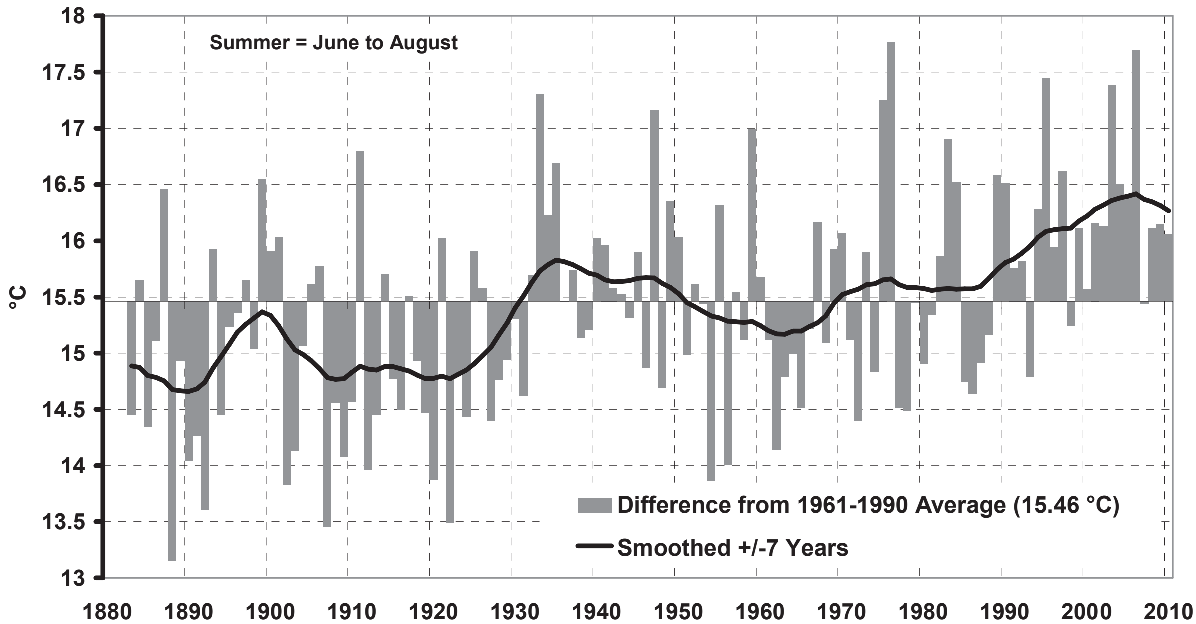


Figure 8 Weston Park – Summer Mean Temperature (°C)

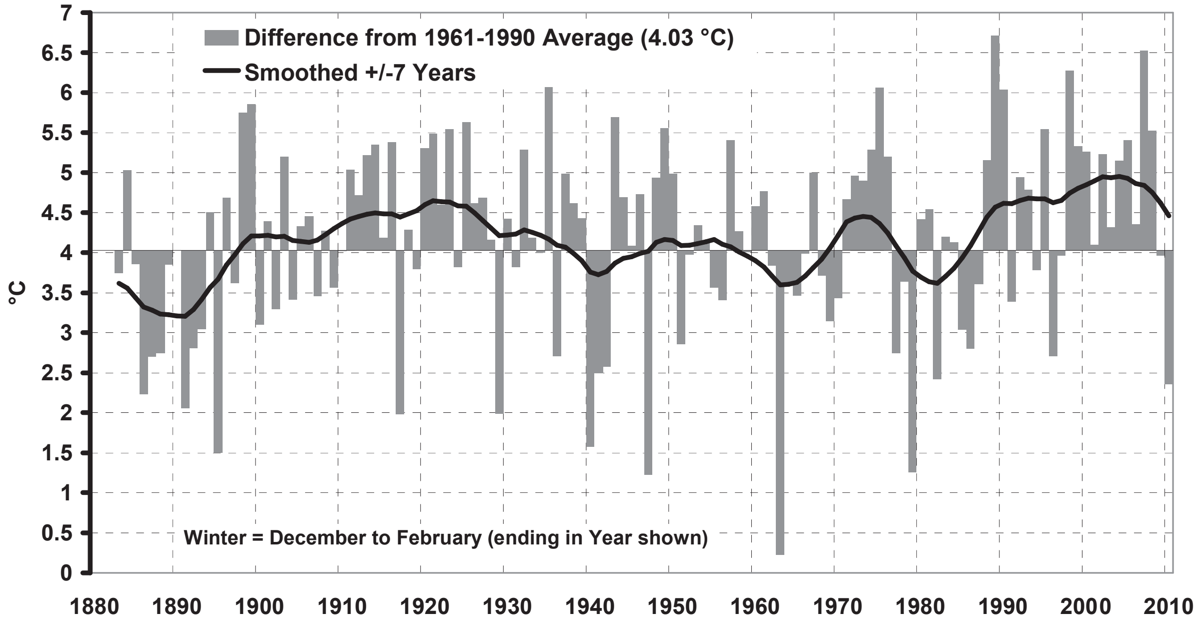


Figure 9 Weston Park – Winter Mean Temperature (°C)

Summer temperatures show that there have been notable hot summers throughout the record – these include 1911 when the drought emptied Redmires reservoir, 1959 when the ruins of the village of Derwent could be seen in Ladybower reservoir, and 1976 when there was a drought across much of Britain (see images in section 'Weather Events in and around Sheffield'). Even with the wide variation in the summer means, recent 'low means' (i.e. cool summers) have been notably warmer than in (say) the 1960s.

Winter temperatures also show some notable years such as 1895 when quarrymen at Grenoside built houses from the snow to highlight their difficulties (see images in section 'Weather Events in and around Sheffield'), 1947 when Cowburn Tunnel was blocked with snow and ice, and 1963 when sub-zero temperatures affected much of Europe. Including the cold winter of 2009-2010 (shown as 2010) significantly reduces the smoothed value in the most recent years, though it is not possible to say whether this is the start of a trend. Winter 2009-2010 (and to the time of writing, the a severe start to the winter of 2010-2011) follows a batch of notably warm winters and could be a short-term variation as can be seen in other years such as 1917, 1929, 1963 and 1979.

Comparing summer and winter we see that in the early 20th century, cool summers often coincided with warm winters, while around 1890 temperatures were low for the whole year. Since 1990, there seems to be a tendency for both summer and winter temperatures to have increased in spite of exceptional individual years.

WESTON PARK – MINIMUM AND MAXIMUM TEMPERATURE

Figures 10 to 13 show the lowest and highest temperatures in the summer and winter of each year.

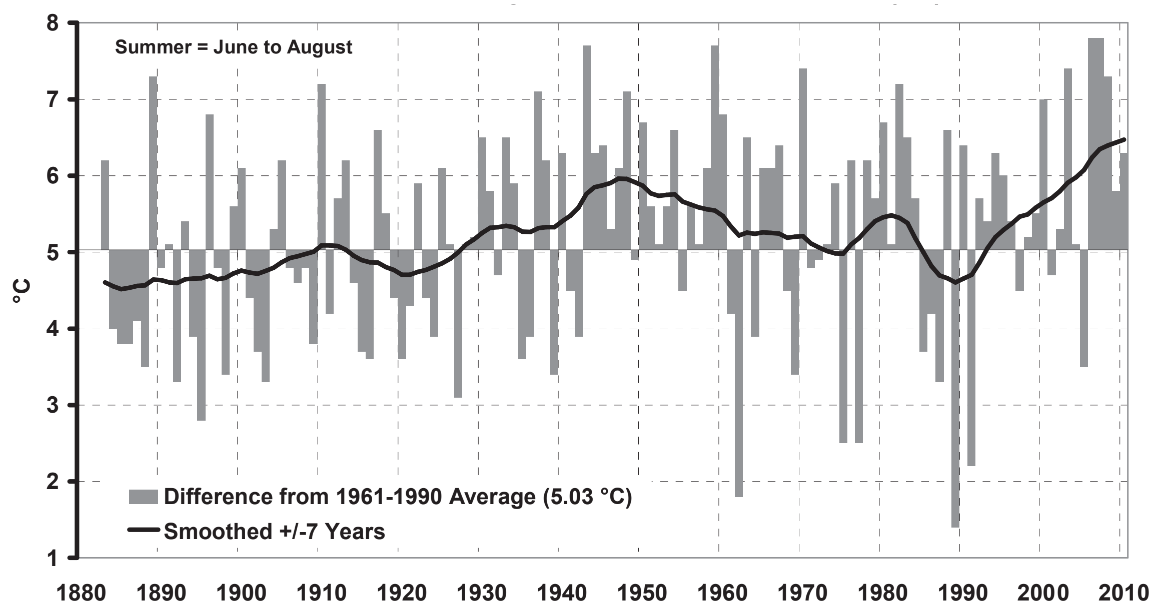


Figure 10 Weston Park – Summer Lowest Daily Minimum Temperature (°C)

In general, these minima relate to night-time temperatures. The smoothed summer minima show a marked increase in recent years (2°C since 1990) relating to the cluster of high values indicating warmer nights. These follow a number of low values around 1990.

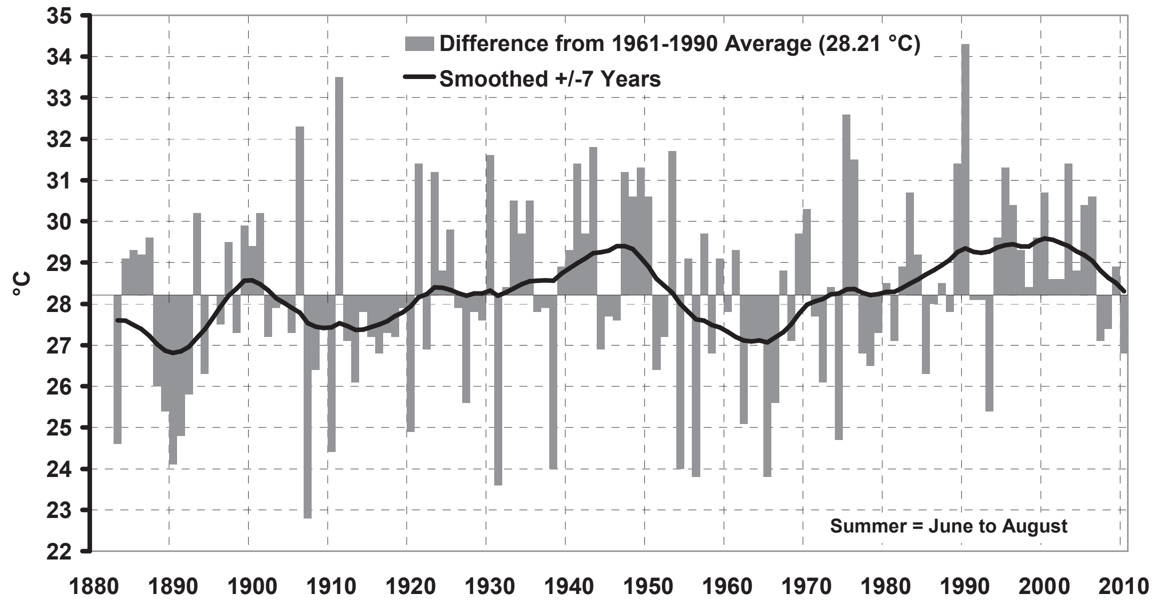


Figure 11 Weston Park – Summer Highest Daily Maximum Temperature (°C)

The summer maxima (generally daytime maxima) also show a rise through the 1980s and 1990s but low values in 2007 and 2008 have brought down the smoothed line – it remains to be seen whether this is the start of a trend.

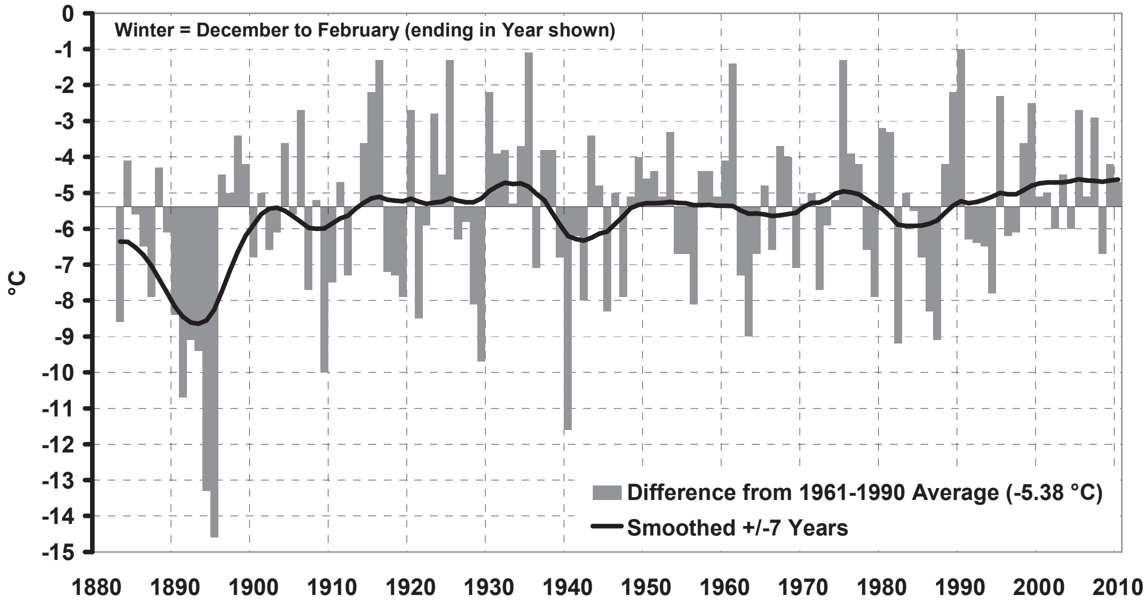


Figure 12 Weston Park – Winter Lowest Daily Minimum Temperature (°C)

The winter minima (again generally night-time temperatures) also show an increase in recent years, though less so that summer minima. Through the 20th century we have seen some very low values (e.g. 1939-40 -11.6°C, 1962-3 -9°C), though none compare with 1894-5 (-14.6°C). Recent years have generally shown relatively modest minima, even in the recent 'bad' winter of 2009-10 (-4.7°C) [3].

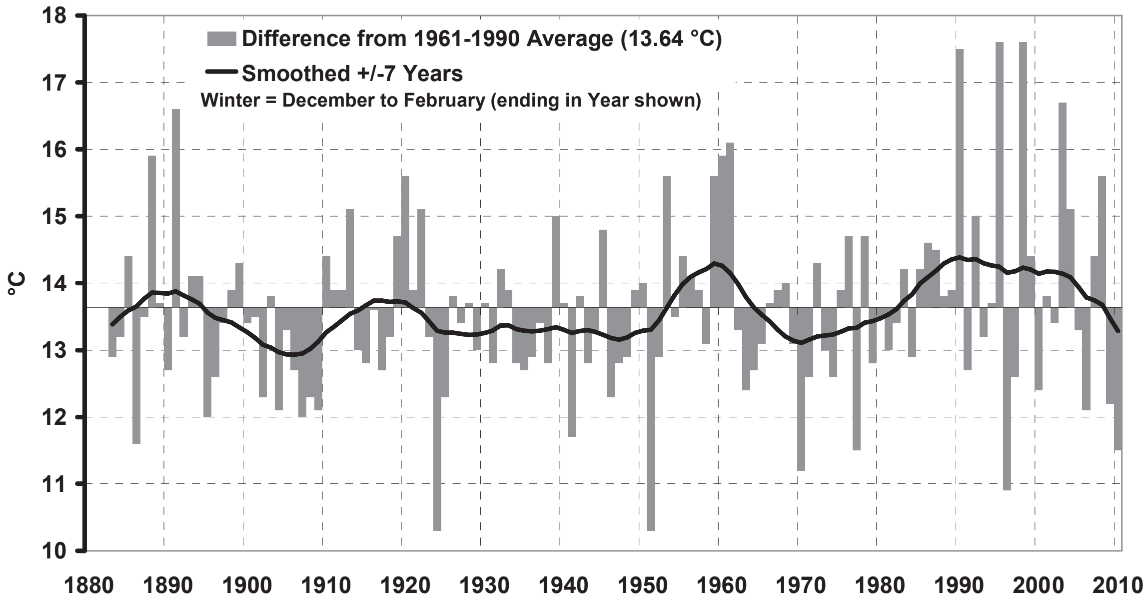


Figure 13 Weston Park – Winter Highest Daily Maximum Temperature (°C)

Winter maxima also show a rise through the 1980s, and the 1990s saw several notably high maxima (e.g. 17.6°C in 1995 and 1998, which is higher than most mean summer temperatures). Recent years have seen a fall in the winter maxima and in 2009-10 the temperature only reached 11.5°C, the 5th lowest winter maximum in the record.

[3] The early weeks of winter 2010-11 produced a minimum of -7.2°C not included in this chart.

WESTON PARK – GROWING SEASON

Plant growth is not only dependent on the actual temperature on each day, but also on the temperature being above a base figure for a continuous period. The gridded data provided by UKCP09 (and used later in looking at trends across the region) include an analysis of the 'Growing Season Length' defined as:

> 'the period bounded by daily mean temperatures >5°C for >5 consecutive days and daily mean temperatures <5°C for >5 consecutive days (after 1 July)'

There are variants of this definition (e.g. taking the longest period within the year that is bounded by these conditions, or using 5.5°C as the base), but using the above simple, though arbitrary, definition gives us a close comparison with the gridded data.

Using this definition, taking the beginning of the growing season as the first day of the 'start ' period and the end of the growing season as the day prior to the 'end' period, the 'length of growing season' has been calculated for the Weston Park data (Figure 14). This does give anomalies as can be seen, particularly in the 'end' date (e.g. in 1983, 1986, 1997 and 2004) when there were several periods of four or five consecutive days below 5°C late in the year but none long enough to trigger the theoretical 'end' of the growing season. Equally there are years when the season 'starts' in the first week of the year due to a warm spell early on. Even allowing for these anomalies, the data does highlight interesting trends using the smoothed data.

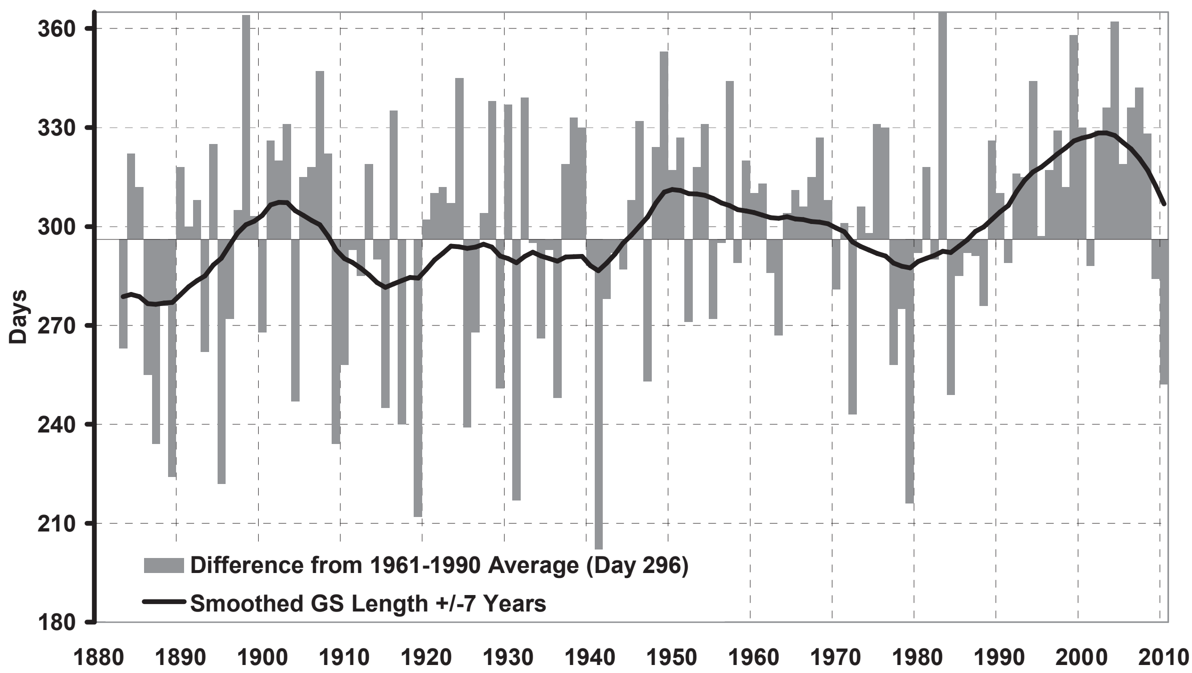


Figure 14 Weston Park – Length of Growing Season

The first and last frosts of the season can also affect plants, insects and in consequence gardeners and farmers. These have also been derived (where the daily minimum air temperature was below 0°C) and are plotted in Figures 15-18 with the growing season start/end data for comparison.

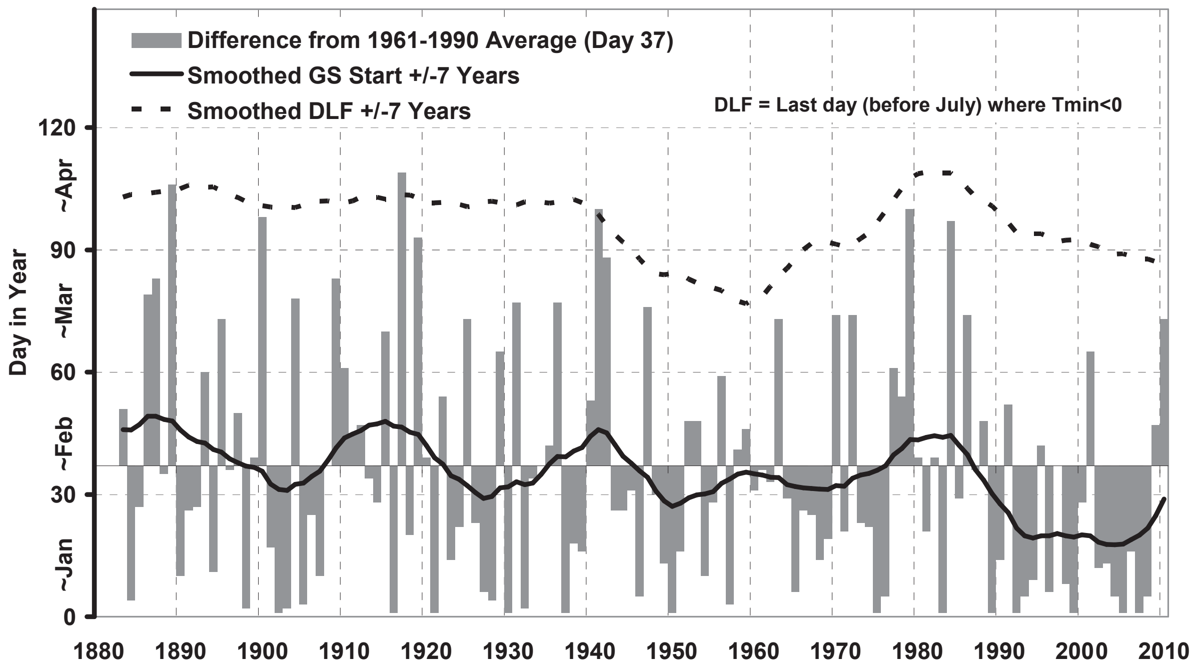


Figure 15 Weston Park - Start of Growing Season

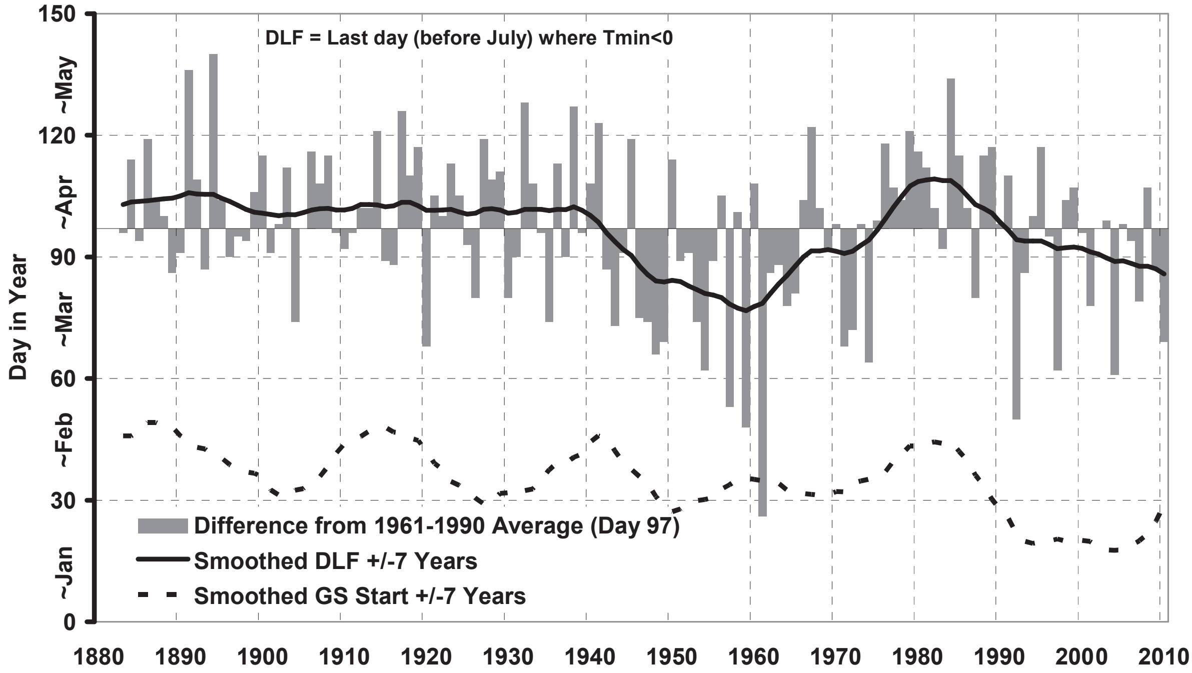


Figure 16 Weston Park - Date of Last Frost

The start of the growing season has varied between early January and mid April through the period from 1883 until about 1990 with a smoothed value falling within February. Since 1990 the season has started earlier and in the last decade has generally been within January. 2009 and 2010 have been noticeably later.

The last frost, however, has been up to two months later than the start of the growing season, confirming the gardener's maxim of not buying bedding plants when they first appear in the shops! Though the last frost has also tended to be earlier in the last twenty years, the trend has not been as marked as that of the growing season, and is rivalled by early dates seen throughout the series and especially around 1960. Data for 2010 shows the date of the last frost as day 69 (11/3/2010), earlier than the theoretical 'start of the growing season' (day 72), though the last date where the minimum temperature was equal to 0°C (as opposed to <0°C) was over two months later (day 132, 13/5/2010).

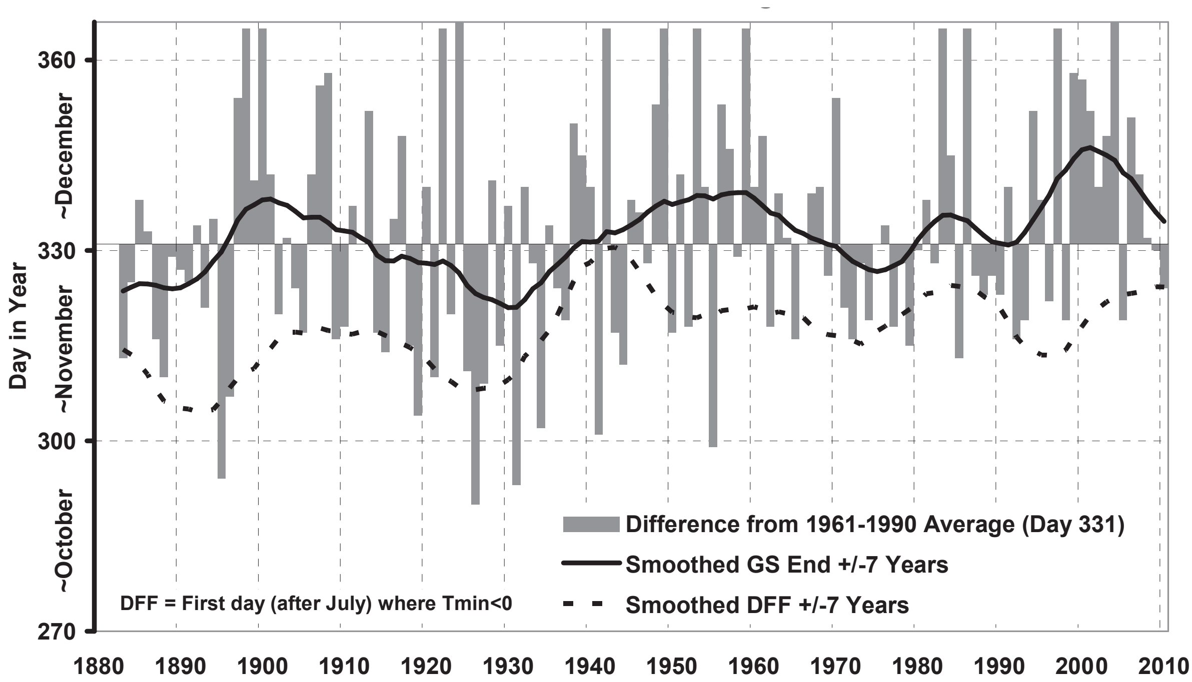


Figure 17 Weston Park – End of Growing Season

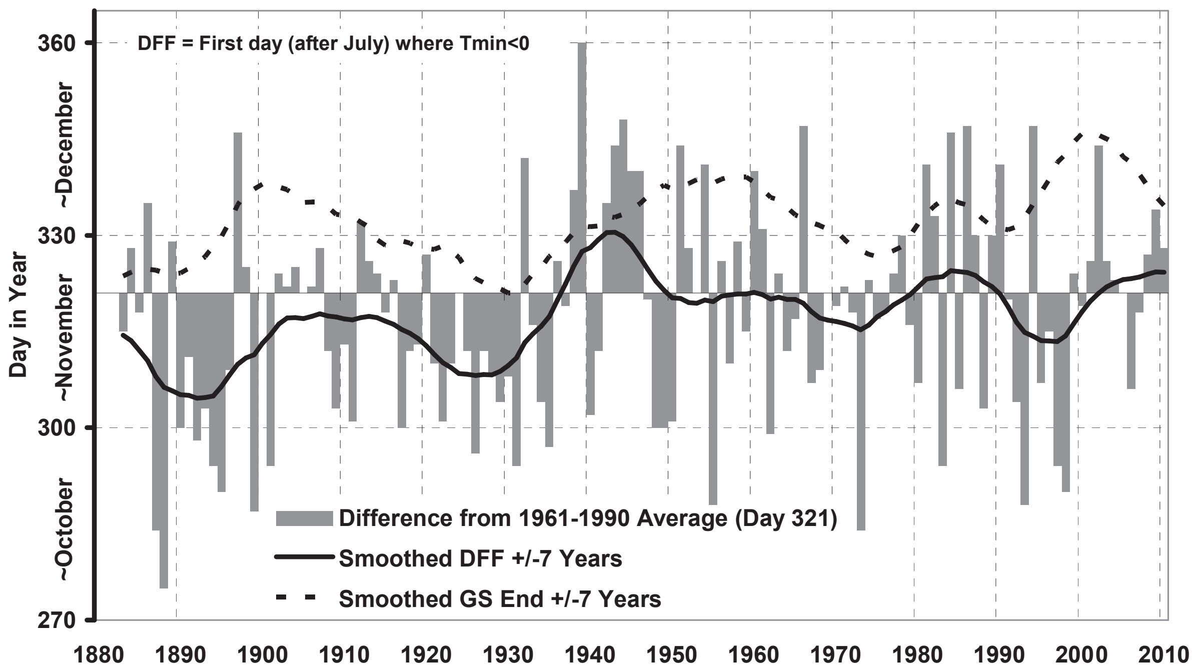


Figure 18 Weston Park – Date of First Frost

The end of the growing season also shows wide variations, occasionally extending (theoretically) through to the end of the year, the year-end being an artificial boundary not acknowledged by the plants! Though the season would often end in late October or early November, in the last twenty years there has been a general extension of the season into December (excluding 2009 & 2010). The first frosts tend to occur before the end of the growing season, but the difference is less marked that at the start of the season.

WESTON PARK – DAYS OF AIR FROST

Figures 15-18 show the dates of the first and last frosts of the year, but give no indication of the extent or intensity of the frosts.

'Days of Air Frost' shown in the Figure 19 has been taken as the number of days where the daily minimum temperature (i.e. air temperature) was below 0°C.

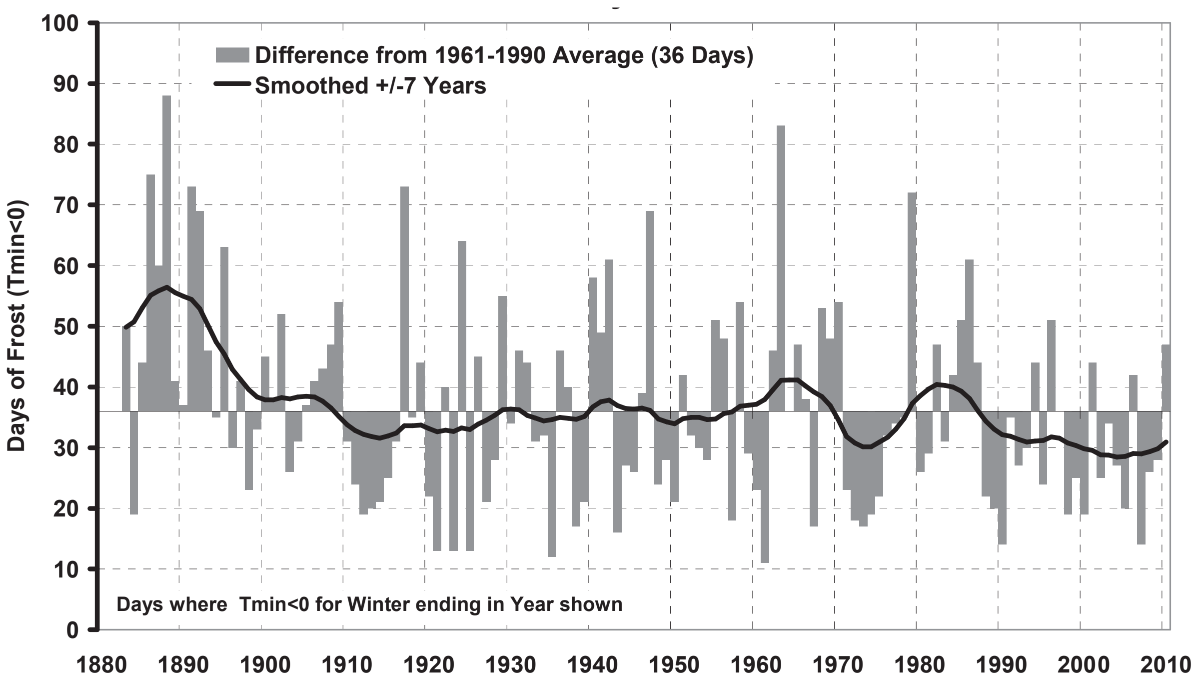


Figure 19 Weston Park – Days of Air Frost

Following the high numbers of frost days in the last years of the 19th century, the smoothed counts have been fairly consistent through the 20th century, though this does obscure the wide annual variations, and some particularly frosty years such as 1963. In the last twenty years the trend has seen a reduction in the number of frost days.

WESTON PARK – DAYS OF GROUND FROST

The air temperature described above refers to the temperature at about 1.25m above ground. Ground frost relates to the 'grass minimum temperature' – i.e. measured at grass height over level ground. Unfortunately this data is incomplete through parts of the Weston Park records, particularly through the 1970s, 80s and 90s, largely due to the repeated thefts of thermometers and the consequent decision to cease readings. Grass minimum readings were reinstated once the station became automated and data is now available. The data is plotted in Figure 20, with an indication of where it is incomplete or missing.

Between 1961-2006, gridded data[4] is available for the 5km square SK38NW which includes Weston Park, and this can be used as a proxy to estimate the data at Weston Park. Based on correlation for the small overlap between the two sets of data, an estimate has been included in the Figure 20.

[4] This gridded data is explained in more detail in the later section 'Climate Trends in the Region'.

Because of these data issues, no 1961-90 baseline has been drawn, but an average would be approximately 100 days.

For comparison, the smoothed value of the Days of Air Frost has also been included in the chart.

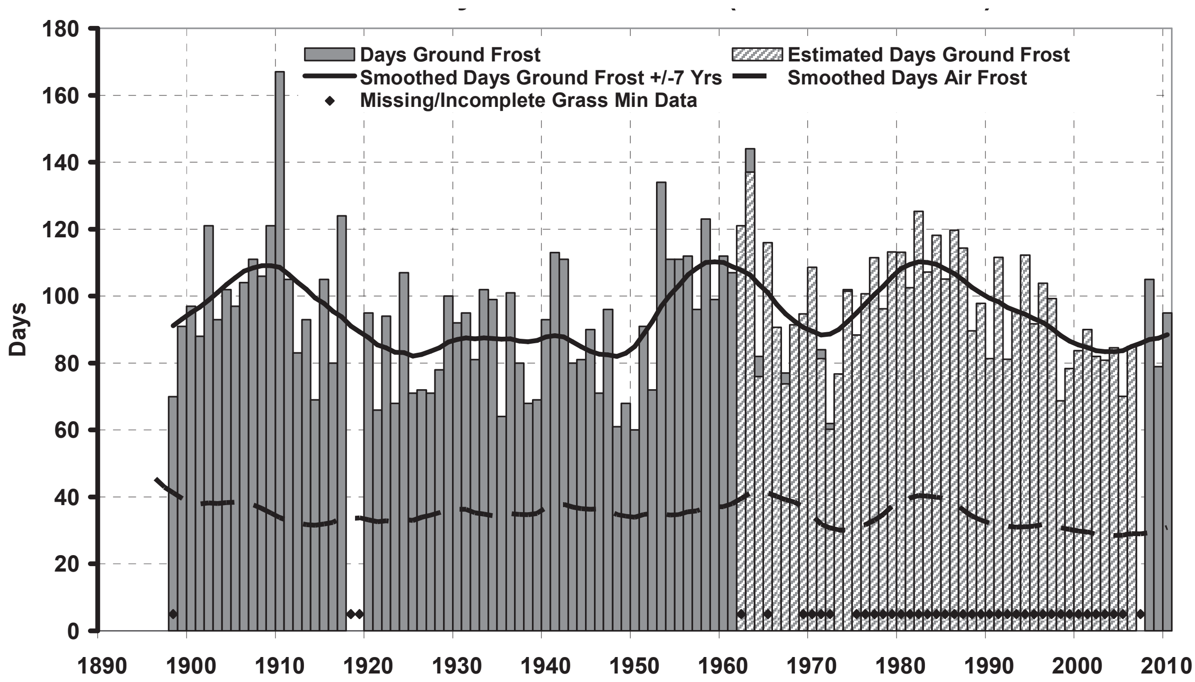


Figure 20 Weston Park – Days Ground Frost (Grass Min <0°C)

WESTON PARK – RAINFALL AND RAIN DAYS

Rainfall (mm)

Daily rainfall has been recorded since a few days after the opening of the weather station and is shown in the following charts as annual and seasonal totals. The data also allows analysis of the number of days where the daily rainfall exceeds a given level, and a variety of other measures, some of which are discussed below.

Prior to 1999, where no rain was recorded it is not possible to tell whether there was no rain, or whether the record was simply not made – such ‘blank’ data has been taken as ‘no rain’.

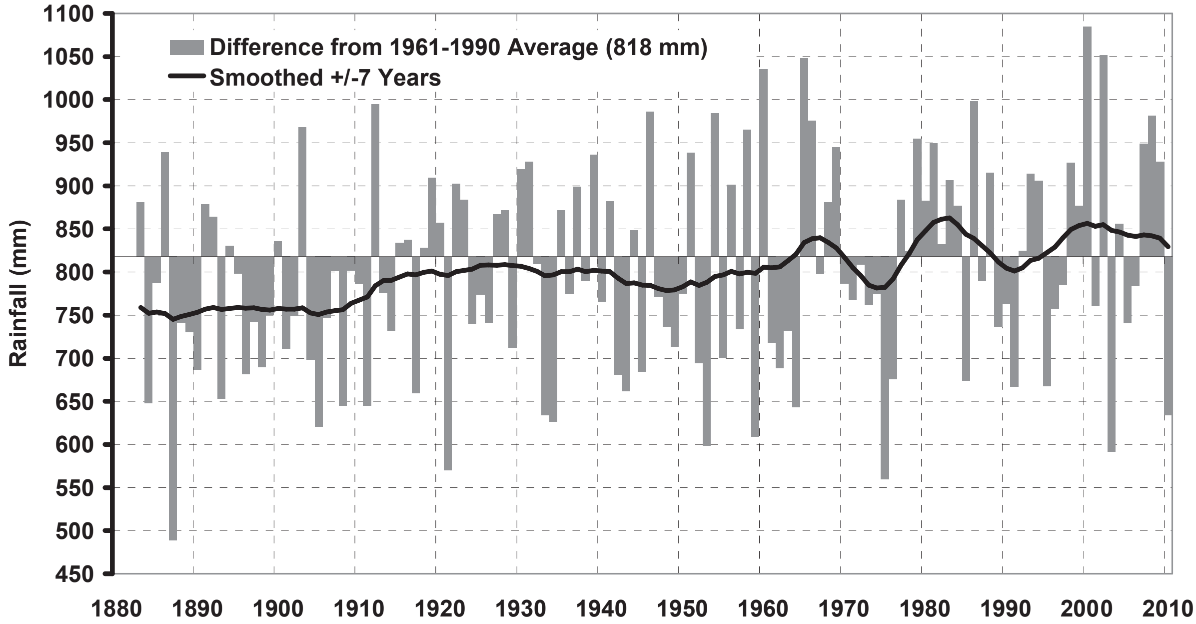


Figure 21 Weston Park – Annual Rainfall

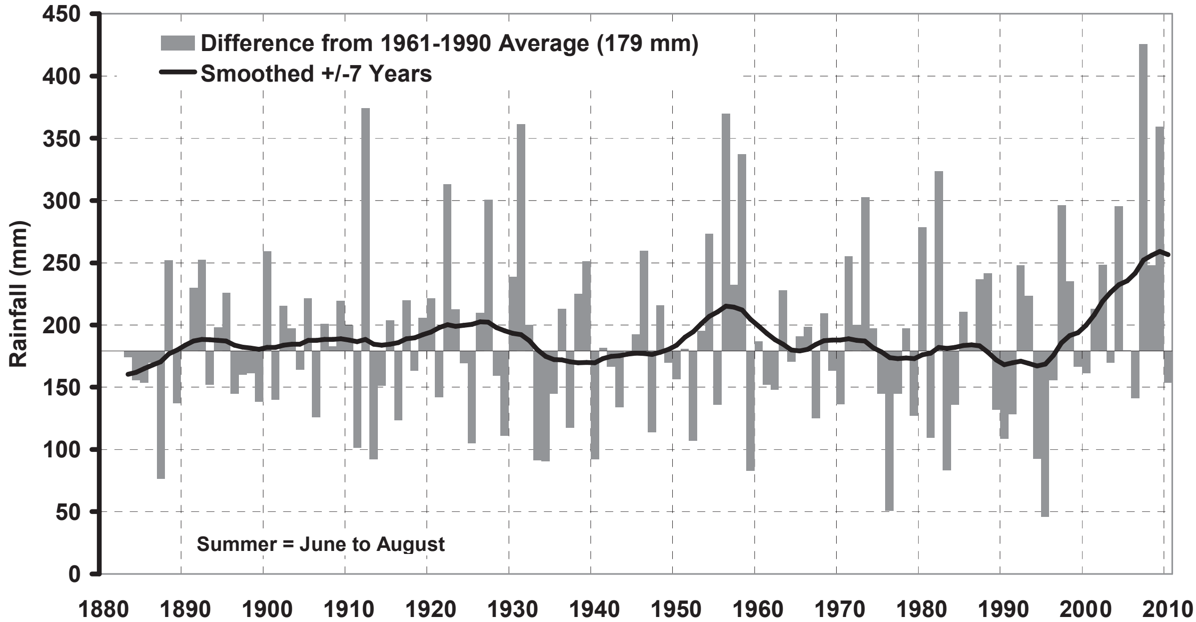


Figure 22 Weston Park – Summer Rainfall

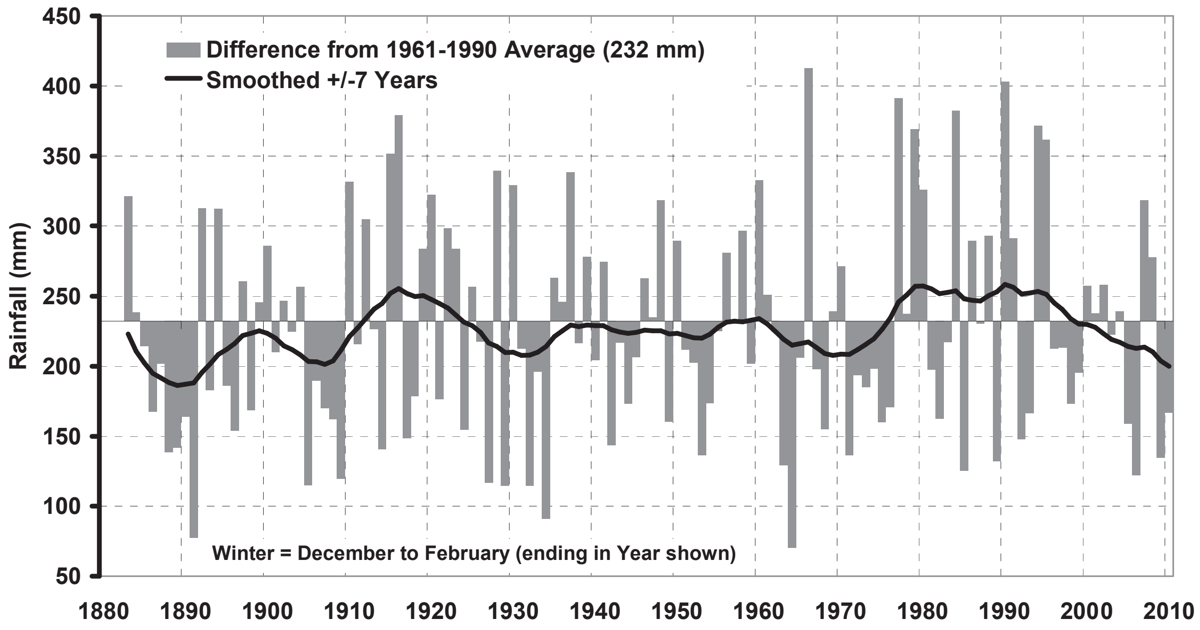


Figure 23 Weston Park – Winter Rainfall

Annual and seasonal rainfall amounts vary widely due to the variable positions of weather systems over any given period. Annual rainfall can be seen in Figure 21 to have risen slightly over the last century, with some notably wet years and the occasional notably dry years in the last ten years. 2010 was one such dry year with only 633.9mm of rain.

The recent variations in annual rainfall hide the particular rise in summer rainfall seen in Figure 22 where the flood year of 2007 shows the highest summer rainfall in the record. This contrasts with a tendency for a reduction in winter rainfall (seen in Figure 23) following some high values in the 1990s.

The spectacular rainfall events seen in recent years and throughout the last century (see 'Sheffield's Weather' and 'Weather Events around Sheffield') are masked when we look only at annual and seasonal rainfall amounts, but can be seen more clearly by looking at days where rainfall exceeded specified amounts. In Met Office terminology there are several standard measures for such days based on different daily rainfall amounts, including 'rain days' (>=0.2mm), 'wet days' (>=1.0mm), and 'wetter days' (>=5.0mm). Other standard measures are >=10.0mm (used along with >=1mm in gridded data from UKCP09 used in a later section), and >=25.0mm (i.e. ~1 inch).

Rain Days

The data for 'rain days' (as shown in Figures 24-26) omits days when the total daily rainfall has been less than 0.2mm. This therefore excludes days when a 'trace' of rain has been recorded (less than 0.1mm, often attributable to dew deposition - consistently noted from around 1920) and also rainfall values of 0.1mm, logged since 1971 when data began to be recorded in metric units.

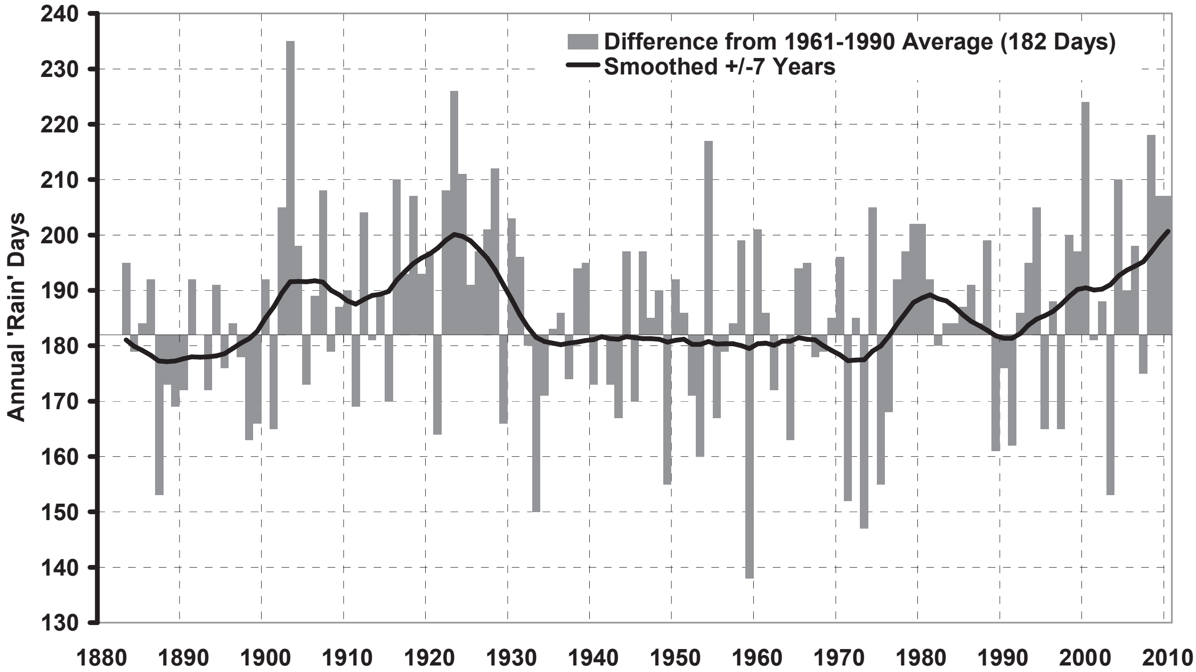


Figure 24 Weston Park – Annual 'Rain Days' (>=0.2mm)

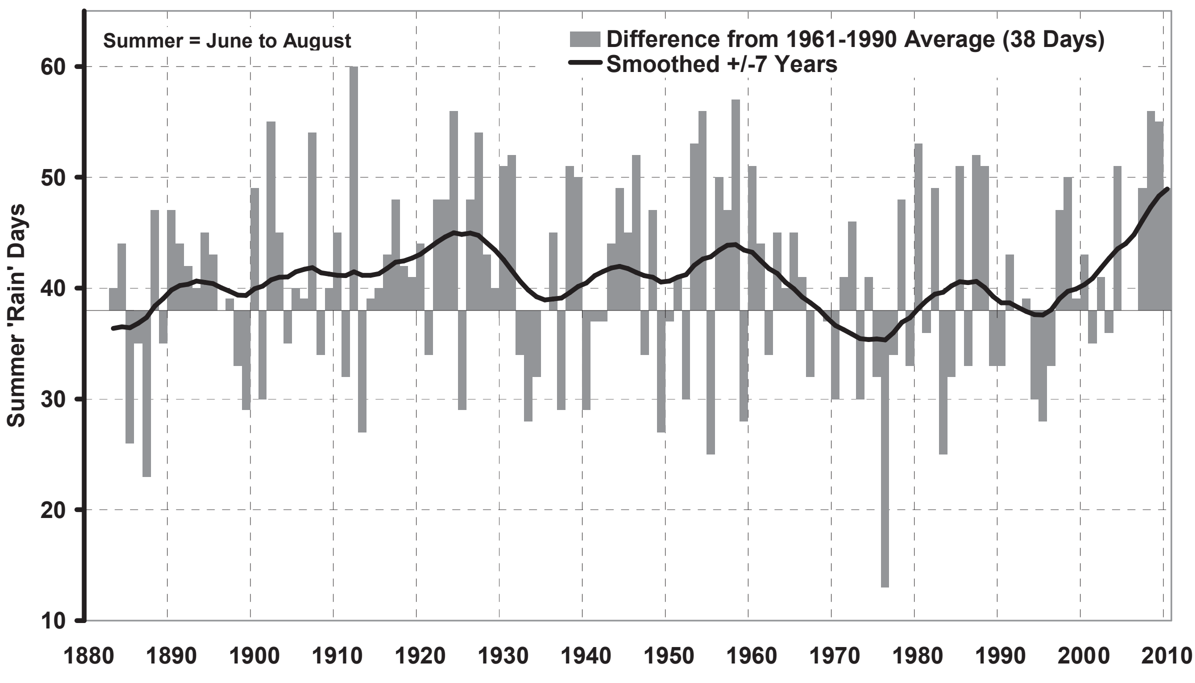


Figure 25 Weston Park – Summer 'Rain Days' (>=0.2mm)

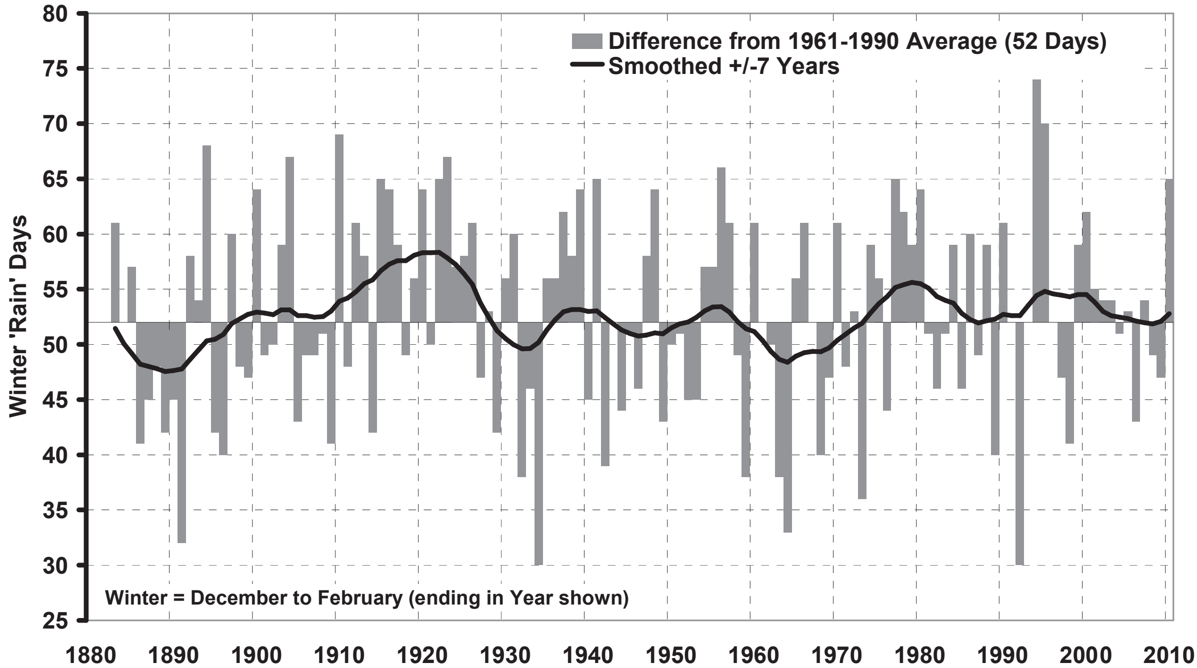


Figure 26 Weston Park – Winter 'Rain Days' (>=0.2mm)

Though the number of 'rain days' varies widely, they have tended to increase in recent years, closely paralleling the overall rainfall. The high number of 'rain days' in the early years of the 20th century are not always reflected in the overall rainfall amounts.

Considering higher daily rainfall amounts we again see wide variations, but we can highlight specific years and some trends. Figures 27 and 28 show the summer and winter rainfall amounts from days where the daily rainfall equals or exceeds 5mm, 10mm and 25mm.

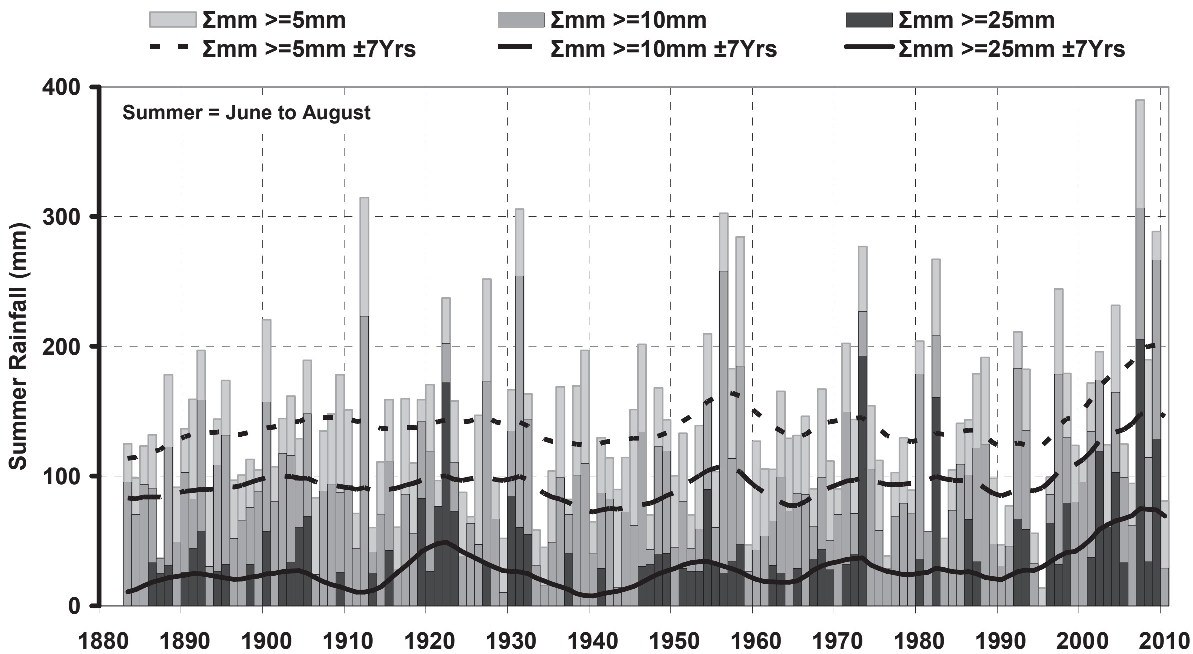


Figure 27 Weston Park – Summer Rainfall (mm) from high rainfall days

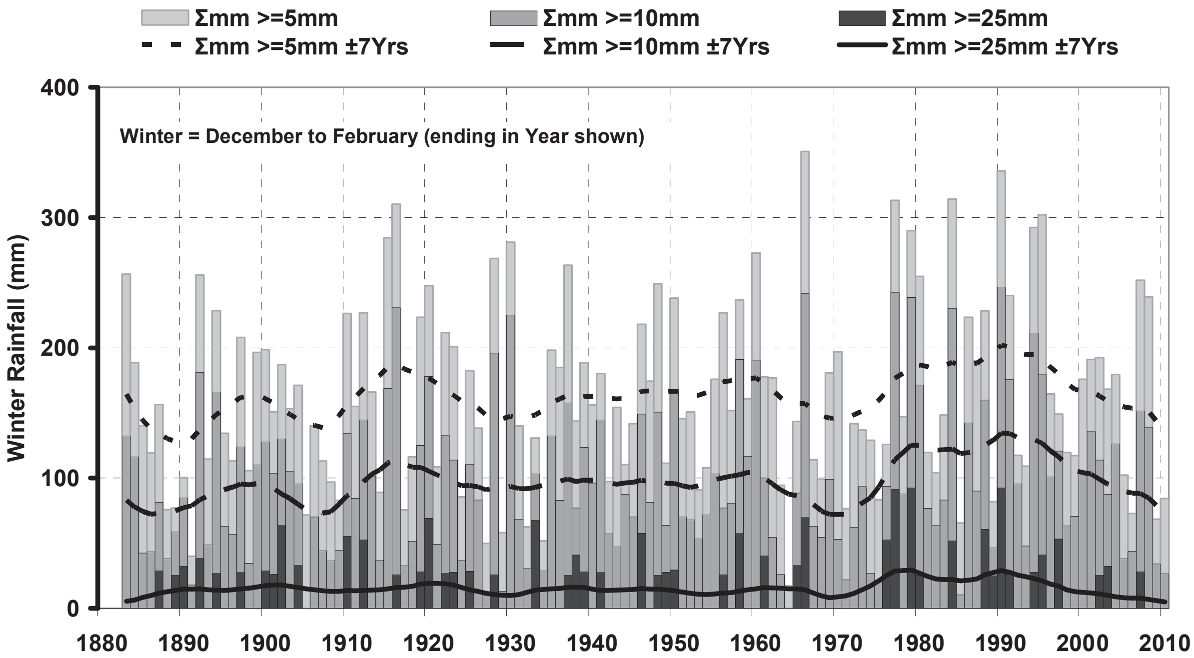


Figure 28 Weston Park – Winter Rainfall (mm) from high rainfall days

Comparing these charts with the overall rainfall shown earlier, about 40-50% of the total rainfall is on days with >=10mm, with about 10-20% occurring on the small number of days with >=25mm. Through the records, the annual percentages (not shown) have only increased slightly over the years, but have varied widely in summer and winter, reflecting the changes seen in the total amounts.

Summer rainfall from high rainfall days shows some notable highs – e.g. for rainfall >=25mm, in 1922 (172mm), 1973 (193mm), 1982 (161mm) and 2007 (206mm) and showing an increasing trend since 1990. 2007 also gave the highest summer rainfall >=10mm (307mm), >=5mm (390mm), >=1mm (420mm), and overall (426mm).

Winter rainfall from days with >=5mm and >=10mm has generally been comparable with or slightly higher than summer values, but at the 25mm level the higher values have often been in summer. In recent years the winter figures have tended to fall and are now well below the summer values, with only the occasional day showing 25mm or more.

Maximum 5-day Precipitation

As well as rainfall on individual days it is also possible to consider consecutive days to identify intense periods of rain which may lead to flooding.

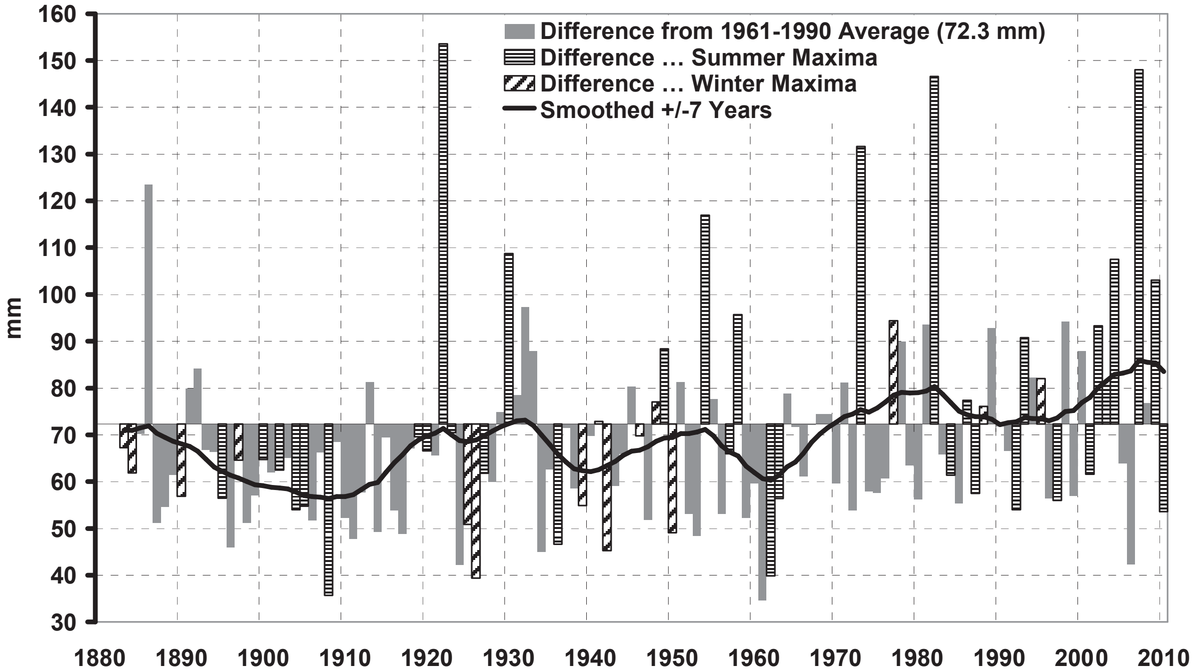


Figure 29 Weston Park – Maximum 5-day Precipitation (mm)

Figure 29 shows the maximum consecutive 5 day rainfall by year. Notably high values are seen in 1922, 1954, 1973, 1982 and 2007 – all these years had severe floods in the Sheffield area. Inspection of the annual data, along with the smoothed trend, suggests a general increase in the values and in the frequency of high values in recent years.

In this chart the vertical bars representing the 'maximum consecutive 5 day rainfall' have been shaded to show those maxima that occurred in summer and winter. Most of the high maxima occurred in summer, including the flood years noted above, and this applies to most of the maxima in recent years.

Consecutive Dry Days

The converse of high rainfall is potential drought conditions. In the UK the formal definition of a drought was abandoned in the mid-1980s after prolonged debates in the media as to when droughts had ended. One such definition quoted by the BBC[5] was 15 consecutive days with less than 0.25mm of rain each day.

'Consecutive dry days' is still useful as a means of year-on-year comparison and has been used by UKCP09 in producing gridded data (see later section). The UKCP09 definition takes 'dry days' as days with <=0.2mm. Confusingly, a value equal to 0.2mm is taken as a 'dry day' here and as a 'rain day' in other Met Office analyses!

The annual 'maximum consecutive dry days' for Weston Park are shown in Figure 30, based on the UKCP09 definition.

[5] *http://www.bbc.co.uk/weather/features/understanding/drought.shtml*

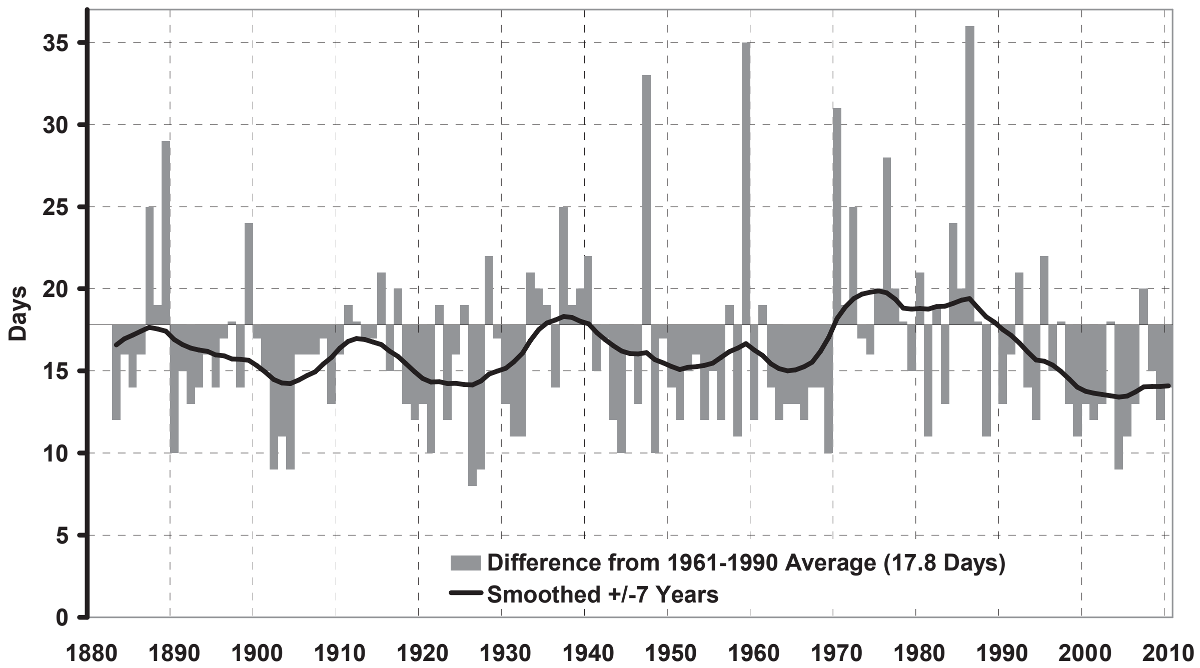


Figure 30 Weston Park – Annual Maximum Consecutive Dry Days

Some of the notably high values relate to years in which there were drought conditions – e.g. 1959 when the ruins of Derwent Hall could be seen in the dried bed of Ladybower reservoir, and 1976 when stand-pipes were set up throughout the area (see images in section 'Weather Events in and around Sheffield').

Recent years have shown relatively low values since the high in 1986.

As would be expected, most of the 'high' values of 'maximum consecutive dry days' occur in summer or autumn, as in 1986 (36 days in September-October). Very occasionally the annual maximum can occur in winter, but the maximum is then generally 'low' (e.g. 2008 – 15 days in February).

Taking a tighter definition of a 'dry day' as one with 0mm rain (and thus also excluding 'trace' records), the 1986 run of 'dry days' is broken by a single day with 0.1mm (21 Sept), and the record then goes to 1959 with 35 days with 'zero' rain (August-September).

WESTON PARK – DAYS WITH LYING SNOW

'Lying snow', defined as over 50% of the area around the weather station being covered by snow, is included in the Weston Park weather records from 1937, though only as a 'Beaufort symbol'. Actual measurements of snow depth are available from the 1950s onwards. Figure 31 shows the number of days on which lying snow was recorded.

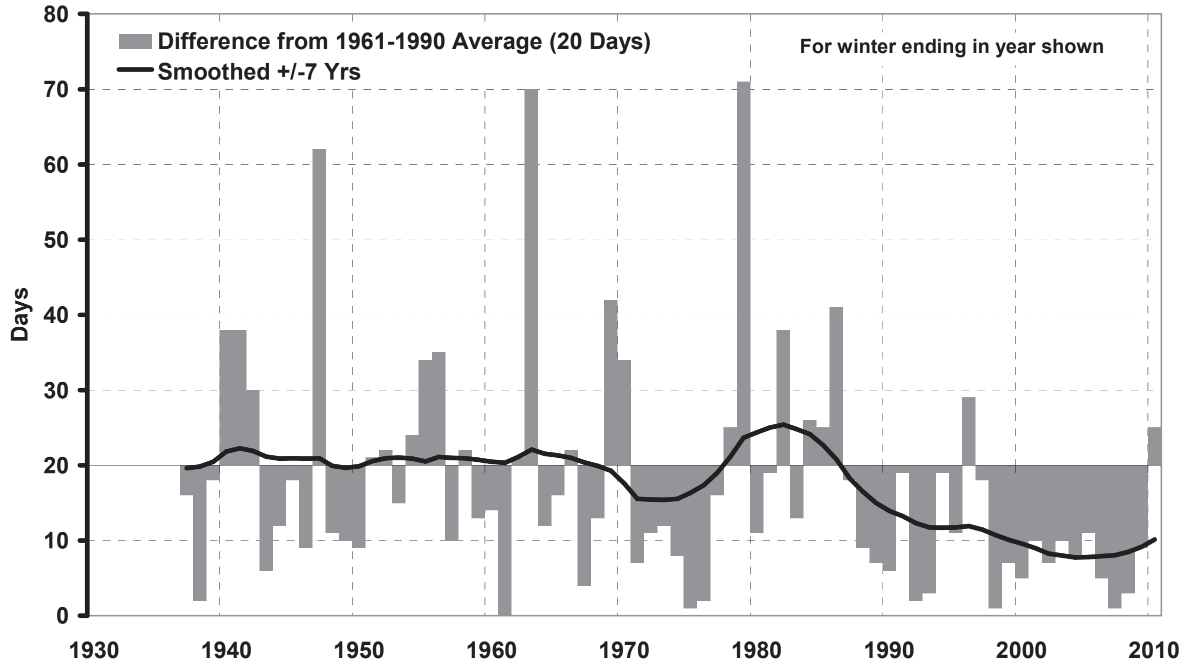


Figure 31 Weston Park – Days with Lying Snow

In spite of several years with high numbers of days, the smoothed average was fairly consistent until 1970. Since the 1980s there has been an overall reduction in the days of lying snow. Note that the 25 days with lying snow shown for 2010 relate to the winter of 2009-10, and do not include the extreme snow of November and December 2010.

WESTON PARK – SUN HOURS

The daily hours of 'Bright Sunshine' have been recorded at Weston Park since September 1897 using a Campbell-Stokes sunshine recorder. The recorder uses a daily 'sun card' which has to be manually interpreted, hence there have been 13 years where data has been missed for one or more days – one day was missed in 6 of those years, and no more than 7 days have been missed in any year except 1996 when 31 days were missed. To compensate for this missing data, the total annual recorded hours as been adjusted pro-rata to represent the actual length of the year/season.

No adjustment has been made for the possible low recording of sunshine hours prior to the relocation of the recorder in 1996 (see section 'A History of Weston Park Weather Station').

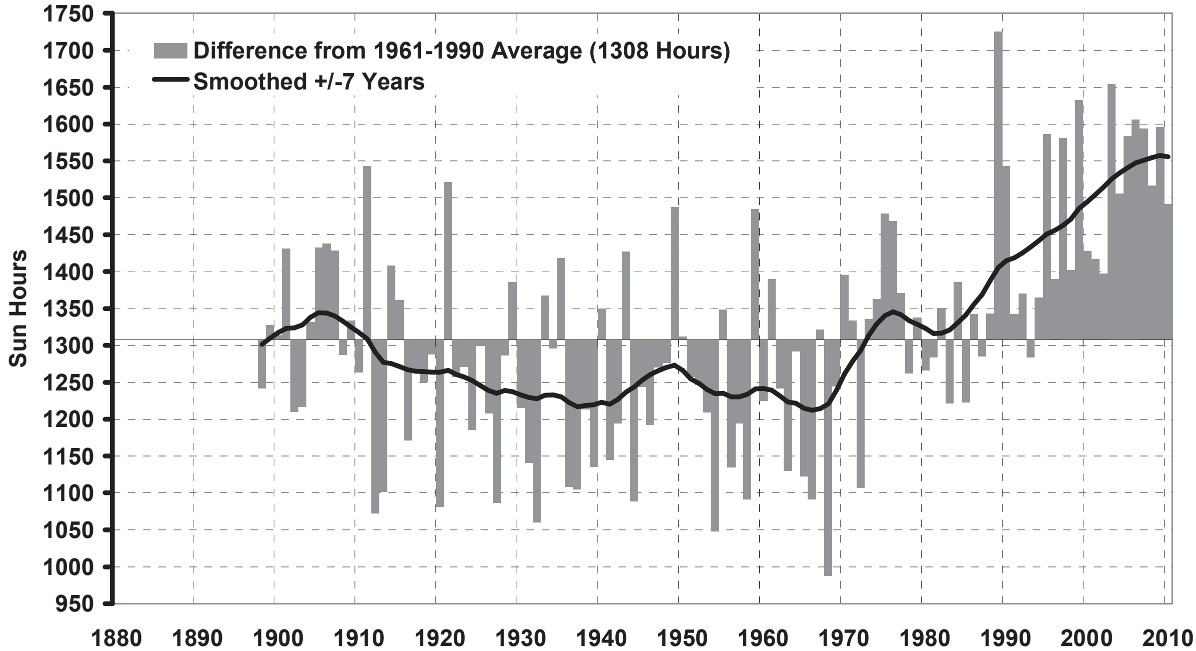


Figure 32 Weston Park – Annual Sun Hours

The most obvious trend seen in Figures 32-34 has been an increase in the hours of sunshine in the annual, summer and winter charts. The annual increase begins in the late 1960s and relates to Clean Air legislation which came into force in 1956 and 1968. This general increase begins with the increase in summer sunshine, but in the last 15 years the annual rise mirrors a rise of almost 50% in the hours of winter sunshine.

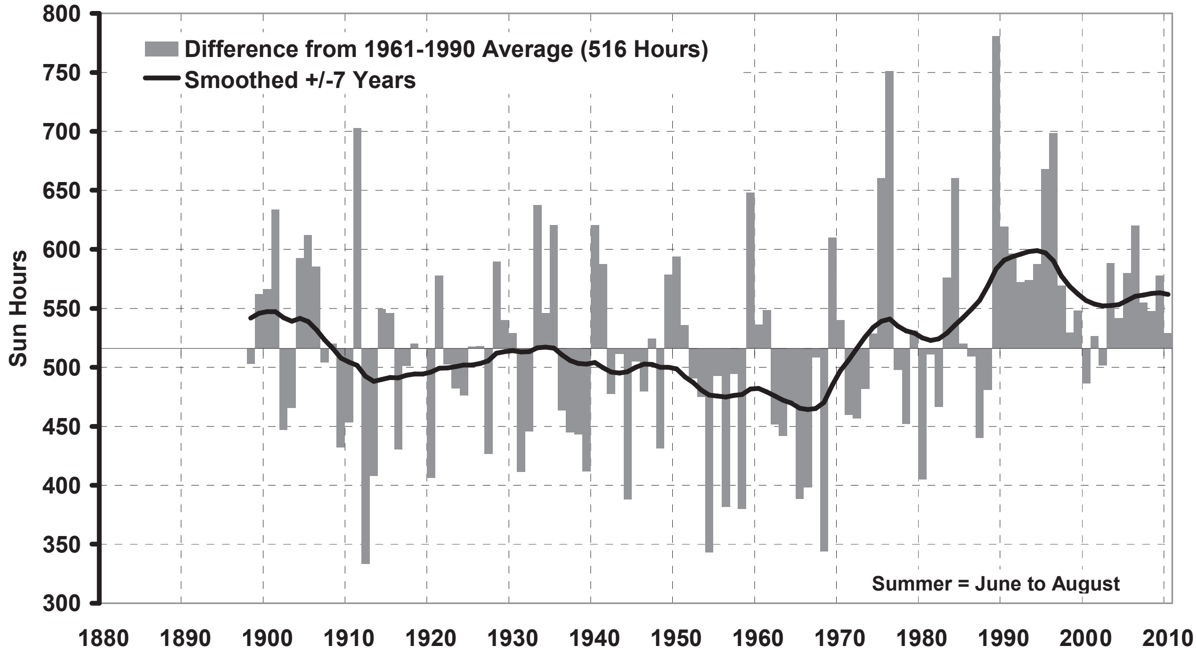


Figure 33 Weston Park – Summer Sun Hours

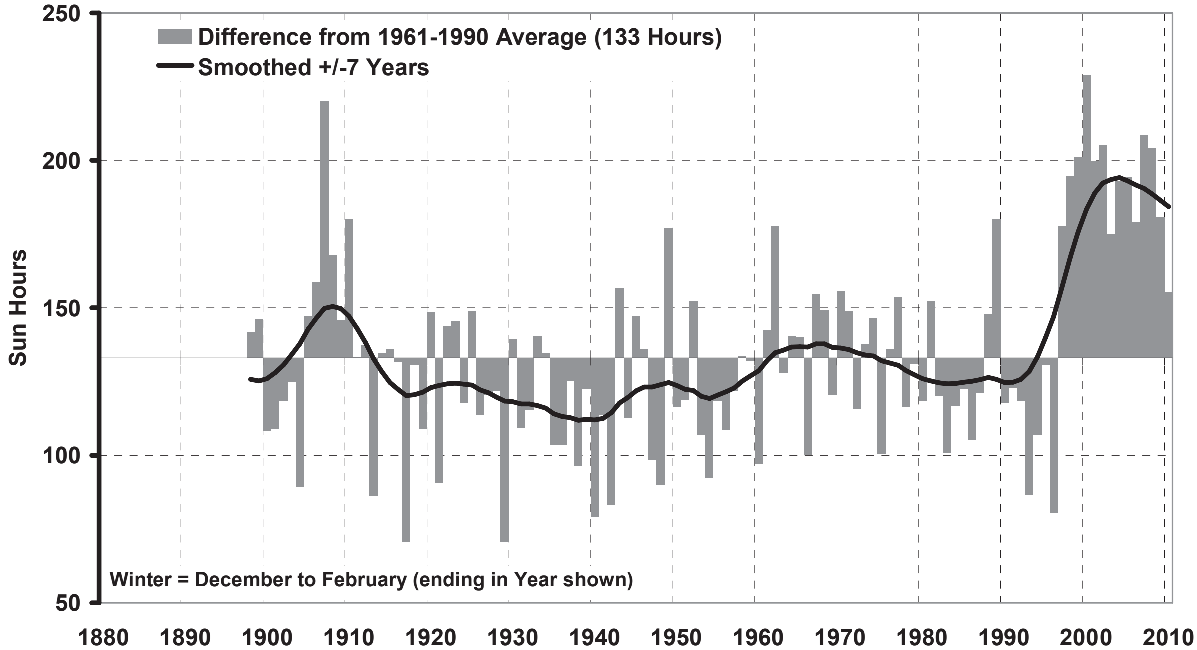


Figure 34 Weston Park – Winter Sun Hours

Weston Park, which has an urban location, can be compared with data provided by the Met Office web-site[6] for a selection of other stations. This sunshine data has been converted to annual hours and is charted below (in Figures 35-37) as smoothed values for the following stations …

> Sheffield (Weston Park) – SK339872 [7]
> Bradford (Lister Park) – SE149352
> Waddington (RAF Waddington, Lincolnshire) – SK988653 [8]
> Shawbury (RAF Shawbury, Shropshire) – SJ552221 [9]
> Sutton Bonington (University of Nottingham Campus) – SK507259

Sheffield and Bradford are urban sites, though Lister Park is more central to the urban area while Weston Park lies west (and up-wind) of the main urban and industrial centre. The other sites are in rural locations.

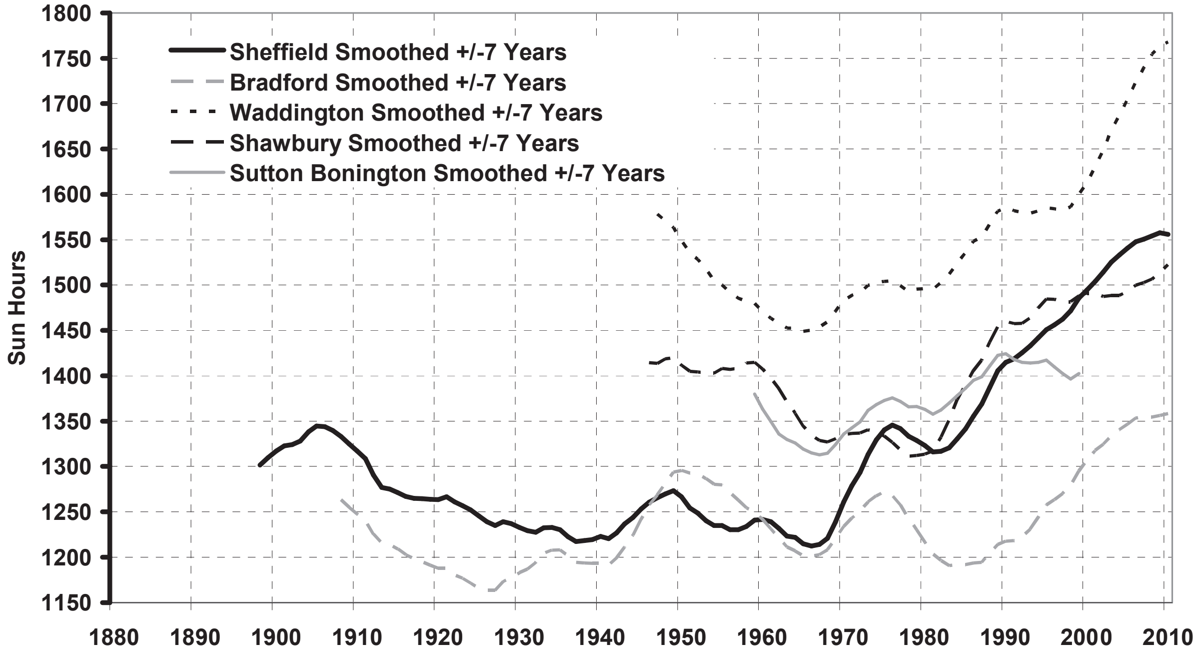


Figure 35 Weston Park – Annual Sun Hours v Other Stations

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[6] at *http://www.metoffice.gov.uk/climate/uk/stationdata/*
[7] Weston Park data is plotted from original records since the Met Office web-site only provides its data from 1929.
[8] Data from Waddington (for 2007-2009) and Shawbury (for 2002-2009) required adjustment to convert data from automated ‘Kipp and Zonen’ sensor data to match data from ‘Campbell-Stokes’ sunshine recorders as used by the other stations and by these stations in earlier years. The basis of this adjustment is taken from Kerr and Tabony (2004).
[9] See previous footnote.

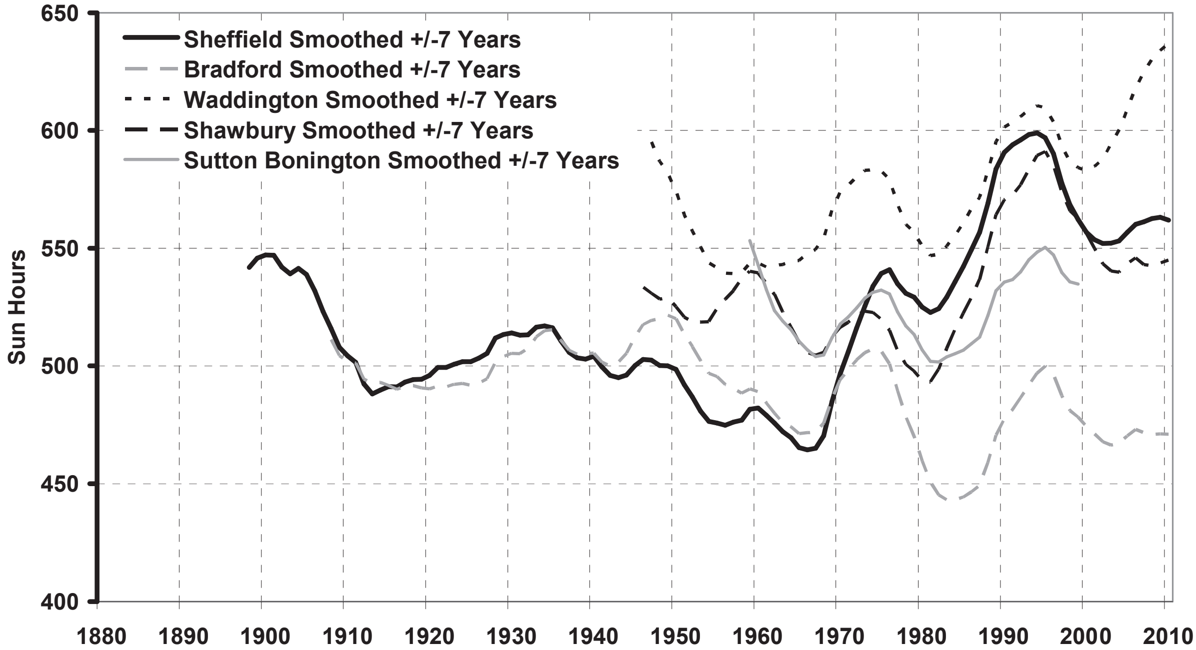

Figure 36 Weston Park – Summer Sun Hours v Other Stations

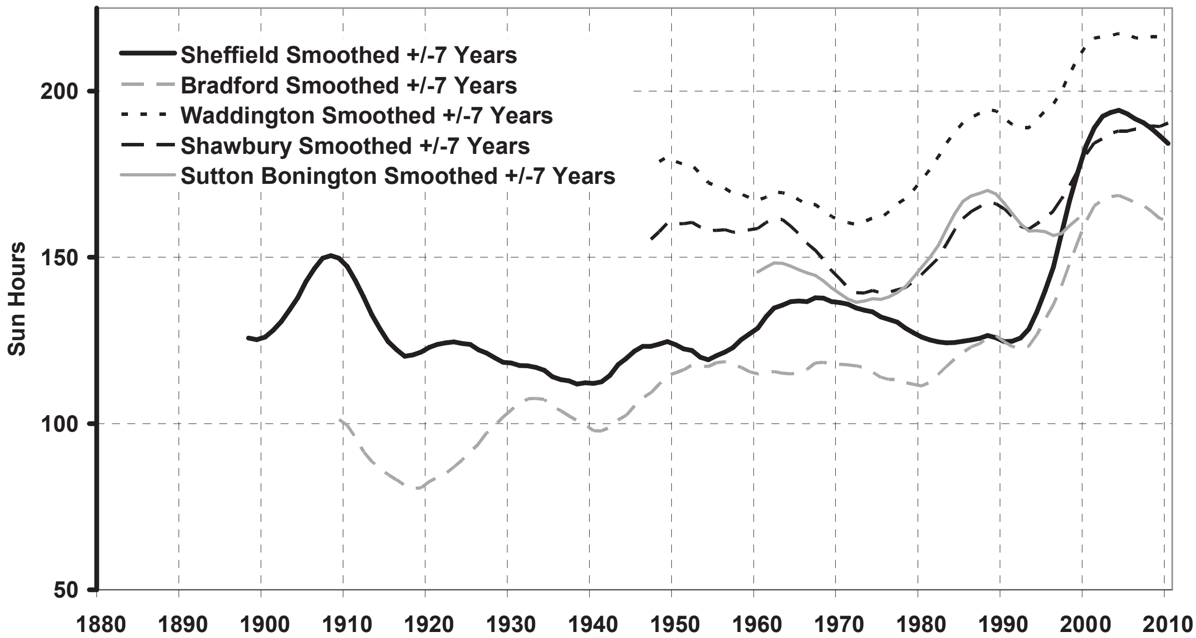

Figure 37 Weston Park – Winter Sun Hours v Other Stations

Sheffield and Bradford both show a gradual fall in annual and summer sun hours through the early years of the 20th century and both show lower sunshine hours than the rural stations in the 1950s (unfortunately data for the rural sites is not available before 1947). Though winter sunshine in Sheffield begins to increase into the 1960s, the rise is small compared to the sudden rise in summer (and annual) sun hours seen around 1970. Since 1970 all of the sites have shown an increase in sunshine, but the rise in Bradford did not begin until the mid-1980s when summer sunshine levels began to increase. Bradford's winter sun hours did not increase until the 1990s in a rise that mirrors that seen in Sheffield.

Sunshine hours for Weston Park are now comparable with the rural stations and significantly higher than the values for Bradford Lister Park, perhaps reflecting its location well away from the industrial centre of the city. The sudden rise in the 1970s may therefore relate to Weston Park's location within the residential area of the city which was an early target of the Clean Air legislation.

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Dessler, A. and Parson, E.A. (2010), **The Science and Politics of Global Climate Change – A Guide to the Debate**, 2nd ed. CUP, Cambridge.

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Plate 3

Top ‘Mamma’ cloud at rear of a Cumulonimbus cloud at sunset, Woodhouse, 8th April 2006 (© G.Boon)

Bottom Cumulonimbus cloud with anvil top, Woodhouse, 27th October 2008 (© G.Boon)

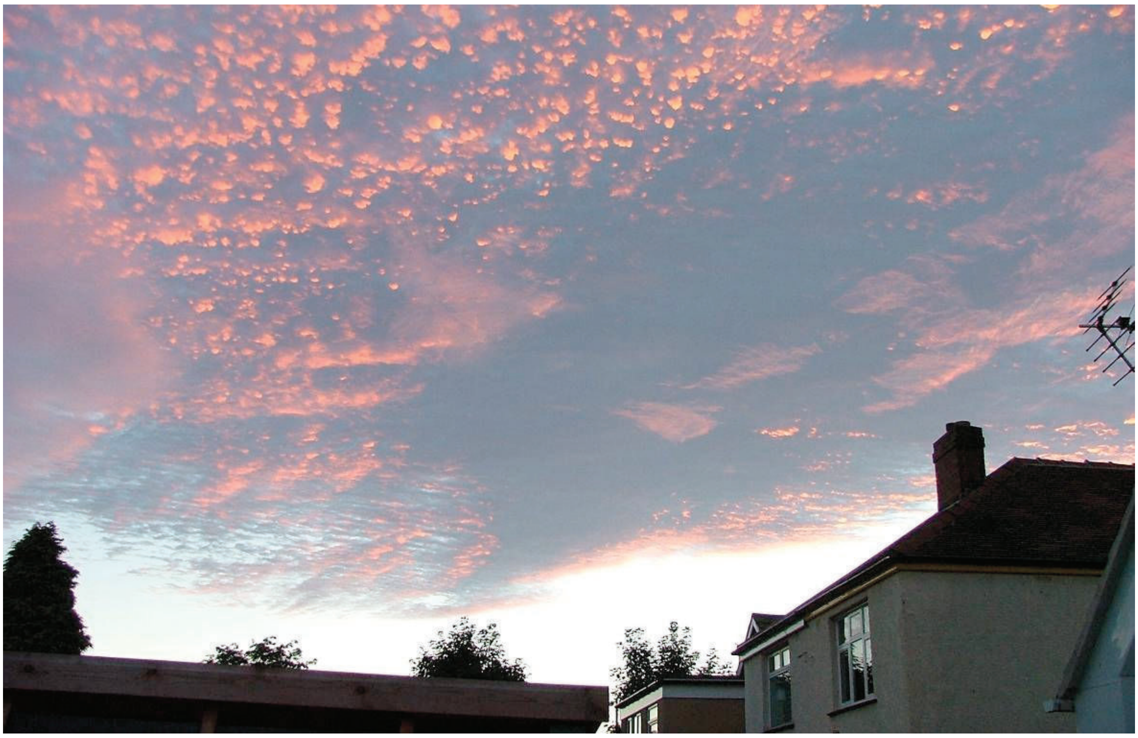

Plate 4

Top — Altocumulus cloud at sunset, Greenhill, Sheffield, 14th September 2005 (© A.D.Middleton)

Bottom — Lightning at Walkley, 7th August 1996 (courtesy of Sheffield Newspapers)

Climate Trends in the Region

INTRODUCTION

Having looked at local trends using historic data available from Weston Park Weather Station, the data should inevitably raise the question of how the weather has varied across the surrounding area.

The UK Climate Impacts Program UKCP09 project has addressed this question across the whole of the UK by assembling 'gridded' data based on the archive of UK weather observations held at the Met Office. The methods used to generate the grids are described in Perry and Hollis (2005), and Perry, Hollis and Elms (2009).

Because the data has been interpolated from original station data, the values for a specific grid square should only be seen as an approximate guide to the weather across the square. The source data and interpolation were based on daily data, but, when combined as monthly or annual values, any local and short term variations will tend to be masked. This should not present a problem in the context in which the data has being used here – i.e. to investigate broad 'climatic' trends over longer time periods, typically up to 30 years.

The gridded data is provided as daily, monthly and annual data sets. Monthly and annual datasets have been used here – Monthly for basic statistics (converted to annual means or totals), and annual for some derived variables. UKCP09 provide most data for a 5x5 km grid (as used here), though some data is also provided for a 25x25 km grid for compatibility with their forward looking forecasts (not used here).

UKCP09 provide monthly data based on a 5km grid for the following variables (# indicates variables discussed in this section) :

Variable	Definition	From	To
Mean daily maximum temperature	Average of the daily highest air temperatures from 0900-0900 (°C)	1914	2006
Mean daily minimum temperature	Average of the daily lowest air temperatures from 0900-0900 (°C)	1914	2006
Mean air temperature #	Average of mean daily maximum and mean daily minimum temperatures (°C)	1914	2006
Days of air frost #	Count of days when the air minimum temperature is below 0°C	1961	2006
Days of ground frost #	Count of days when the grass minimum temperature is below 0°C	1961	2006
Sunshine duration #	Duration of bright sunshine during the month (hours per day)	1929	2006
Total precipitation #	Total precipitation amount (mm) during the month	1914	2006
Days of rain ≥1mm #	Number of days with ≥1mm precipitation (0900-0900)	1961	2006
Days of rain ≥10mm #	Number of days with ≥10mm precipitation (0900-0900)	1961	2006
Days of sleet or snow falling #	Number of days with sleet or snow falling	1971	2000
Days of snow lying #	Number of days with greater than 50% of the ground covered by snow at 0900	1971	2006

Mean wind speed at 10m	Hourly mean wind speed (knots) at a height of 10 m above ground level averaged over the month	1969	2006
Mean sea-level pressure	Hourly (or 3-hourly) mean sea-level pressure (hPa) averaged over the month	1961	2006
Mean relative humidity	Hourly (or 3-hourly) relative humidity (%) averaged over the month	1961	2006
Mean vapour pressure	Hourly (or 3-hourly) vapour pressure (hPa) averaged over the month	1961	2005
Mean cloud cover	Hourly (or 3-hourly) total cloud cover (%) averaged over the month	1961	2004

UKCP09 have also reworked their source data to provide the following derived variables on an annual basis, again for a 5km grid :

Variable	Definition	From	To
Heating degree days	The day-by-day sum of any deficiency of daily mean temperature below a base value of 15.5°C [1]	1961	2006
Cooling degree days	The day-by-day sum of any excess of daily mean temperature above a base value of 22°C	1961	2006
Growing degree days	The day-by-day sum of any excess of daily mean temperature above a base value of 5.5°C	1961	2006
Extreme temperature range	Annual maximum temperature minus annual minimum temperature	1961	2003
Growing season length #	Period bounded by daily mean temperature >5°C for >5 consecutive days and daily mean temperature <5°C for >5 consecutive days (after 1 July)	1961	2003
Summer 'heatwave' duration	Sum of days with daily maximum temperature more than 3°C above 1961–90 daily normal for ≥5 consecutive days (May–Oct)	1961	2003
Winter 'heatwave' duration	As summer heat wave but for Nov–Apr	1961	2003
Summer 'cold wave' duration	Sum of days with daily minimum temperature more than 3°C below 1961–90 daily normal for ≥5 consecutive days (May–Oct)	1961	2003
Winter 'cold wave' duration	As summer cold wave, but for Nov–Apr	1961	2003
Maximum number of consecutive dry days #	Longest spell of consecutive days with precipitation ≤0.2mm during the year	1961	2004
Greatest 5-day precipitation total #	Greatest total precipitation amount (mm) for 5 consecutive days during the year	1961	2004
Rainfall intensity	Total precipitation on days with ≥1mm divided by count of days with ≥1mm during the year	1961	2004

In this section, the main emphasis has been to provide maps showing how key measures have varied across the area around Sheffield, reflecting the local topography and its interaction with the prevailing weather systems that cross the UK. The maps and charts are constrained by the scope of the UKCP09 data.

[1] Though the above table shows the basic definition of 'degree days', the calculation does in fact use a slightly more complex set of conditions bringing in the daily minimum and maximum temperatures.

The main area chosen is the 'recording area' covered by the Sorby Natural History Society. This is defined by the OS National Grid and ranges (in kms) from eastings 400 to 470 and northings 350 to 420 (i.e. with corners defined by SK000500, SK700500, SE000200 and SE700200). The area is centred on Sheffield and extends in the north to the edge of Wakefield, in the south to Ambergate, in the west to include Buxton and Glossop, and in the east to bring in Doncaster, Worksop and Sherwood. The topography ranges from the hills of the Peak District and the Dark Peak almost to sea level around Thorne.

The maps show annual values of each variable averaged for the period 1961-1990, and for the later period 1991-2006 (or less for some variables where the data is not available). The 1961-1990 period is the' long term average' (LTA) baseline period adopted as a World Meteorological Organization (WMO[2]) standard and provides consistency between many sources such as the IPCC and UKCP09. A further map is then shown of the 'anomalies' from this 'LTA', commonly the basis of many published graphs and discussions. Where appropriate the anomalies are also shown as a percentage of the 1961-90 values.

The base map used in each case shows the rivers of the area as a reference, together with a shaded area showing the Sheffield Metropolitan District, and a star showing the location of the Weston Park Weather Station. In discussions, the grid squares are referenced in the same way as the OS 1:10,000 map sheets – Weston Park is therefore located in grid square SK38NW (i.e. the NW quadrant of the 10km square SK38).

A further chart has been included showing the variation in each variable across a west to east section of the UK from near Liverpool, through Sheffield, and on to the Lincolnshire coast. This is based on 5km grid data for a northings value of 385km which includes the grid square containing Weston Park Weather Station. These charts include an altitude profile for reference.

Note should be taken of the scales used in each map and chart to assess the significance of the variations relative to the actual values. The scales and symbols used have been chosen to emphasise the variations. No attempt has been made to establish whether these 'anomalies' are statistically significant, hence they should be treated as indicative of changes and should be examined in context, e.g. comparing the size of any 'anomaly' against the variation one would normally expect in the variables and against the range seen across the area.

[2] *http://www.wmo.int/*

MEAN TEMPERATURE

Gridded monthly mean temperature data (°C) is available from 1914-2006. Figure 1 shows the average data by grid square for 1961-90 and 1991-2006.

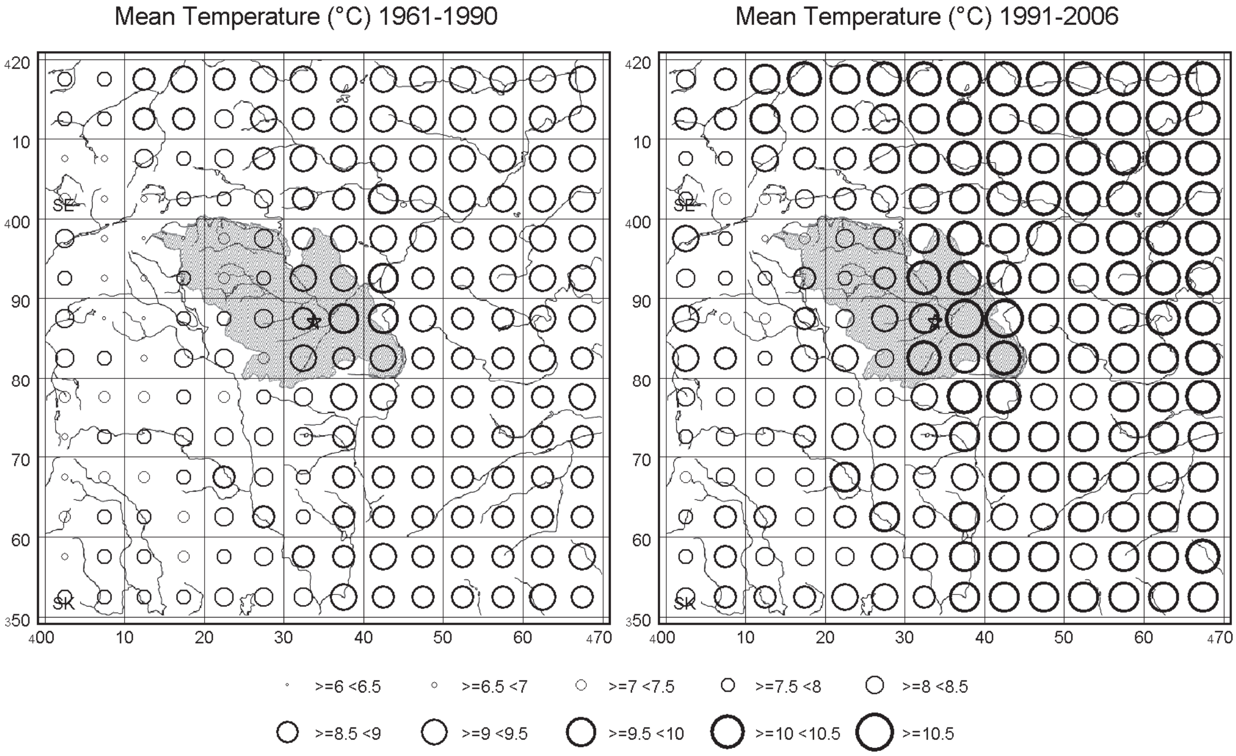

Figure 1 Mean Temperature - Averages for 1961-90 and 1991-2006

The general pattern of temperatures reflects the difference in altitude between the Dark Peak and Peak District in the west and the lower ground to the east, with an overall difference of ~4°C. The highest temperatures are found around the built-up area of Sheffield (SK48NW (Catcliffe) 9.8°C for 1961-90, SK38NE (Attercliffe) 10.6°C for 1991-2006), possibly reflecting the effect of the ‘Urban Heat Island’.

The lowest temperatures are found in the Dark Peak (SK19NW (Bleaklow), 6.2°C 1961-90, 6.9°C 1990-2006).

The differences between the periods are more clearly seen in Figure 2, where all grid squares show an increase in average temperatures ranging from 0.7°C (SE10SW above Dunford Bridge) to 1.1°C (SK08SE Chapel-en-le-Frith).

The Weston Park data gives an increase of 0.66°C (9.5 to 10.2°C) for these periods (taken to 2006) while the increase for its grid square (SK38NW), which includes higher ground west of Weston Park, is 0.8°C (8.8 to 9.6°C).

Comparing these periods (and prior periods) across the country in Figure 3 clearly shows the relationship between temperature and altitude.

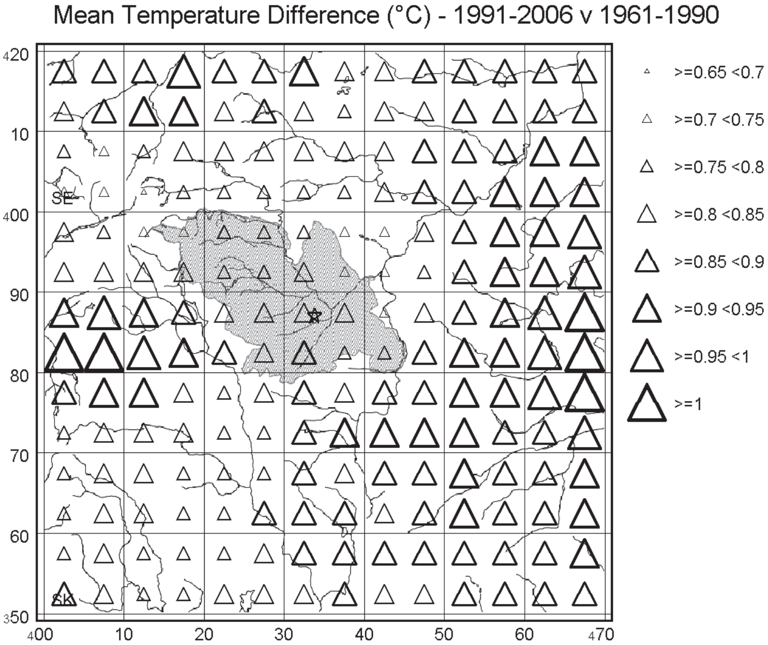

Figure 2 Mean Temperature - Changes from 1961-90 to 1991-2006

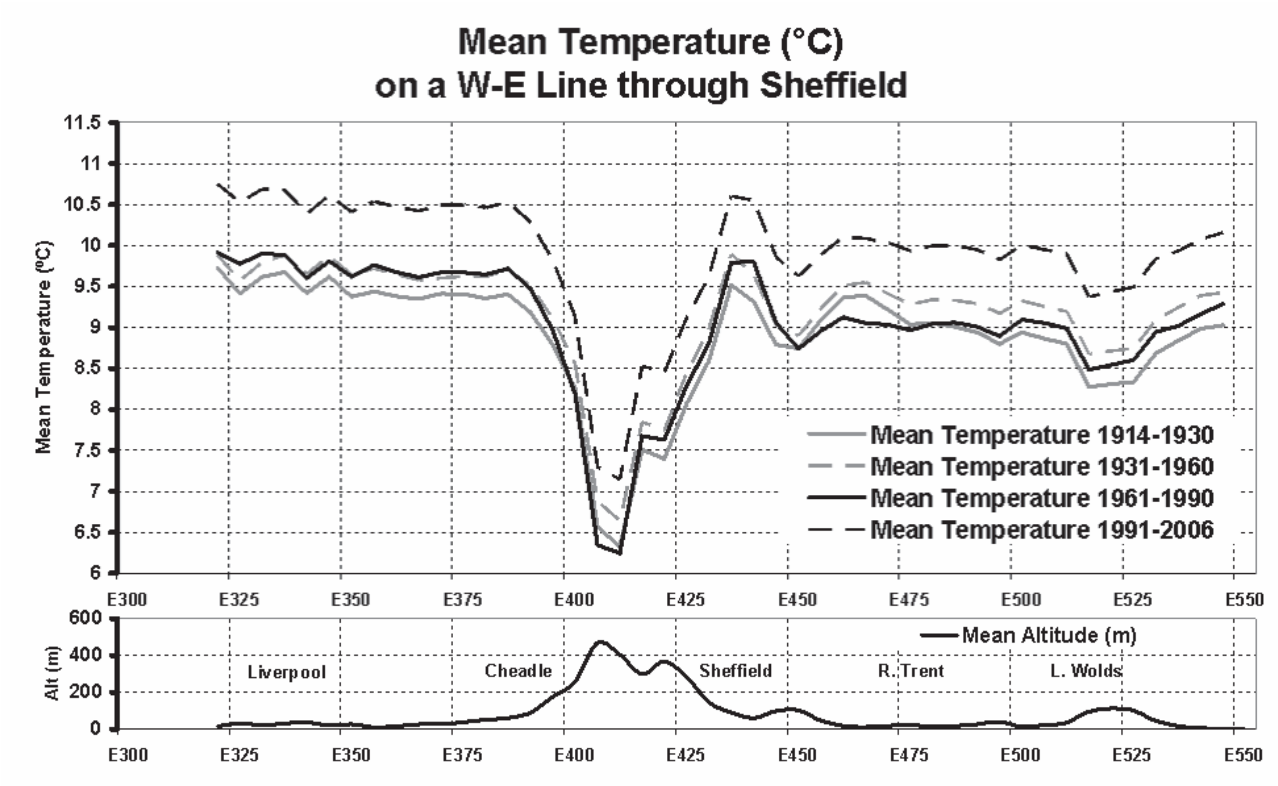

Figure 3 Mean Temperature on a West-East Line through Sheffield

Figure 3 also shows the difference in temperatures between the western and eastern sides of the Pennines (~0.5°C), the high temperatures around Sheffield, and the general increase since 1961-90. In the highest areas (eastings 405-410, SK08NE and SK18NW), and in the east of the Sorby area (E 460-465, SK68NW&NE) the 1961-90 average was lower than for the two earlier periods, perhaps contributing to the large increases seen in these areas in the 'difference' map in Figure 2.

GROWING SEASON LENGTH

In UKCP09, the annual 'growing season' data is defined as 'the period bounded by daily mean temperatures >5°C for >5 consecutive days and daily mean temperatures <5°C for >5 consecutive days (after 1 July)'. The data is available (as days per year) for 1961-2003. Averages for the base period of 1961-90 and the available data since 1990 are shown in Figure 4, together with the differences between the periods in days and as a percentage of the 1961-90 values in Figure 5.

As would be expected, the general pattern in the period data reflects the mean temperature data and the topography, with a difference of 90 days between the lowest growing season values in the Dark Peak (SK19NW (Bleaklow) 205 days 1961-90, 226 days 1991-2003) and the highest around the centres of Sheffield and Rotherham (e.g. SK48NW (Treeton) 303 days 1961-90, 325 days 1991-2003). An interesting pocket of 'high' Growing Season Length is seen in SK26SW north of Matlock – a square which has included a number of plant nurseries at least since the late-19th century!

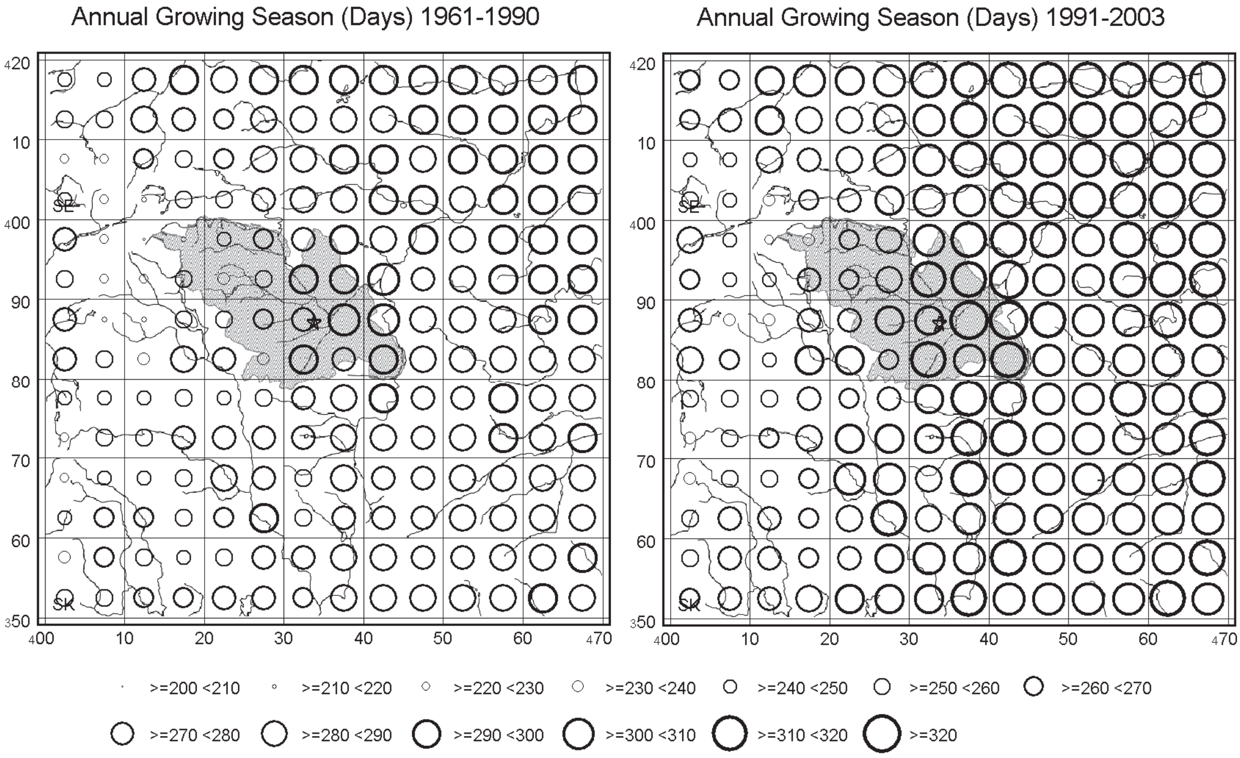

Figure 4 Annual Growing Season (Days) - Averaged for 1961-90 and 1991-2003

Most of the area has seen an increase in growing season of about 20 days (~8%), but in parts of the Peak District, the increase has been as low as 6.4 days (2.5%) (in SK07SE (Buxton)). Other areas south of Chesterfield (SK36SW&SE and SK46SW) have seen increases of 30.5 days (12%). The percentage increases largely reflect the absolute increases.

Many of the above features can also be seen in the section across the country shown in Figure 6.

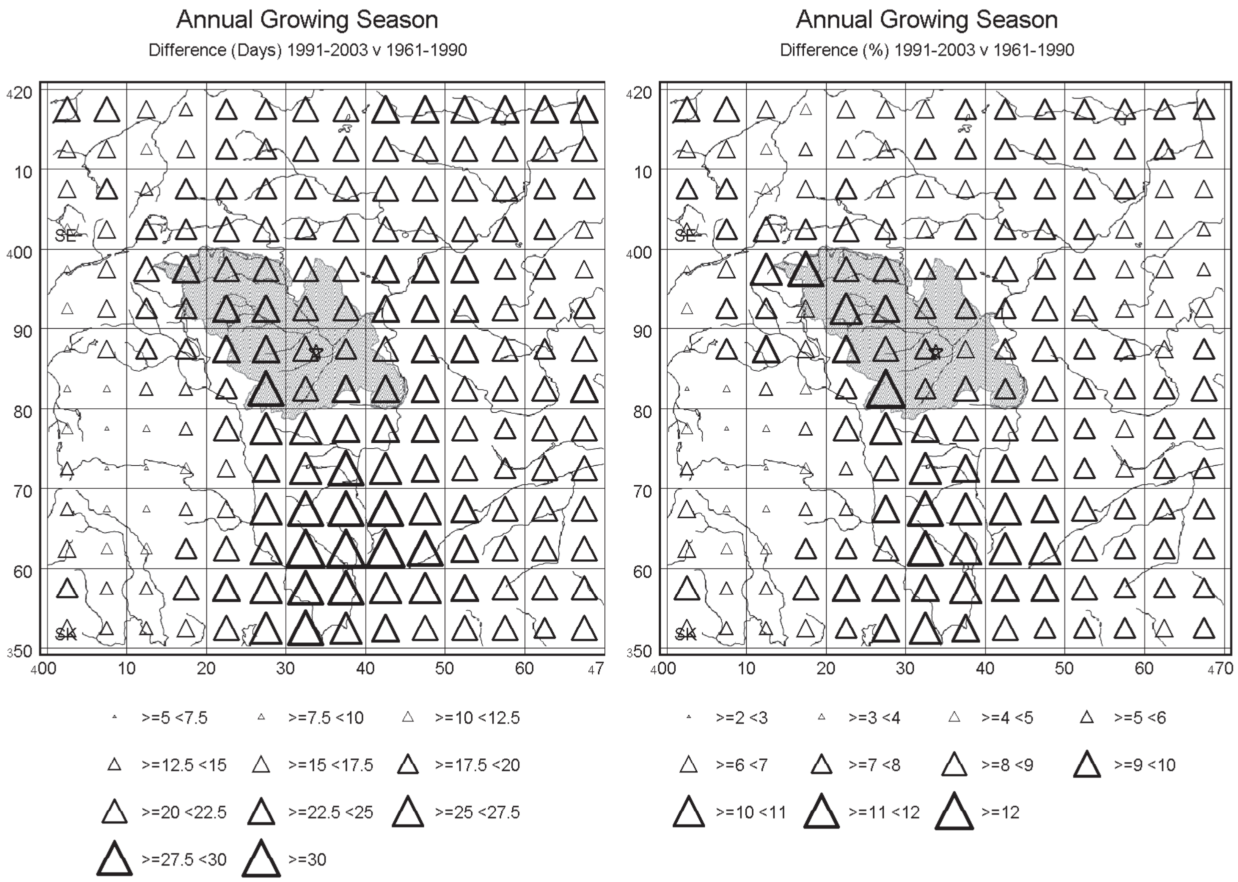

Figure 5 Annual Growing Season - Changes from 1961-90 to 1991-2003

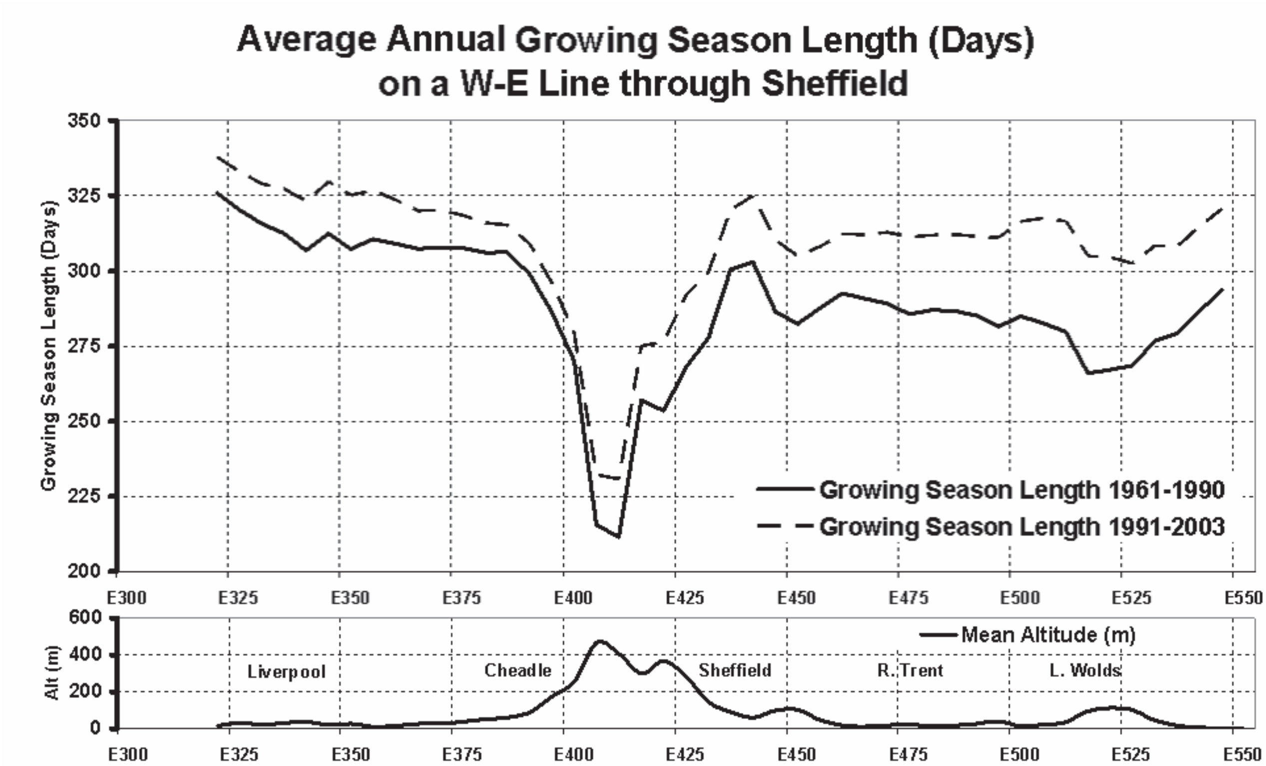

Figure 6 Annual Growing Season on a West-East Line through Sheffield

In Lincolnshire (beyond the Sorby area) the increases in growing season have been as high as 39 days (14.7%) (in TF18NE near Market Rasen).

DAYS OF AIR FROST

'Days of air frost' is defined as the number of days where the minimum air temperature is lower than 0°C. Data is available as monthly gridded data for 1961-2006, which has been summed to produce annual values for the winter period ending in a given year. These were then averaged to produce data shown Figure 7 and differences in Figure 8.

The data largely reflects the mean temperature data, with lower values in the east of the area, though the lowest number of days is shown around the centre of Sheffield (40.6 days for 1961-90 and 34.2 days for 1991-2006 in SK38NE). The highest values are seen around Bleaklow (96.8 days for 1961-90 and 78.7 days for 1991-2006 in SK19NW). Note also the slightly high values around SK6070 in the Dukeries compared to surrounding areas – these contrast with the ground frost data discussed later.

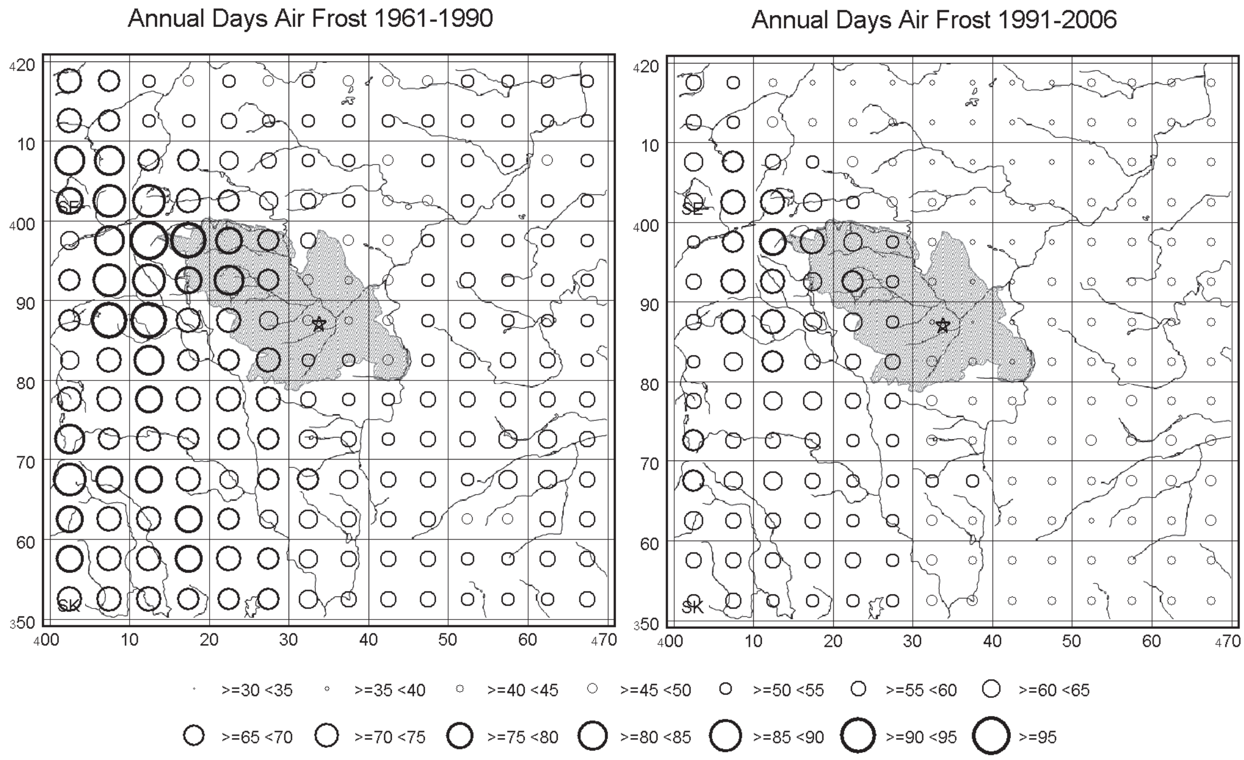

Figure 7 Annual Days of Air Frost - Averaged for 1961-90 and 1991-2006

Whether we consider the decrease in days of air frost as a number of days or as a percentage (as in Figure 8), the extent of the decrease has varied widely over the area, and the patterns do differ. The highest fall in terms of days (20.7 days seen in SK05NW, near Leek) is reflected in the percentage fall (26%), but the relatively high decreases seen in the Dark Peak (e.g. SK18NW 17.5 days) were from relatively high values in 1961-90 (SK18NW from 92.1 days i.e. 19%). Mid-range decreases (in terms of days) seen in the north of the area around Barnsley and Wakefield gave rise to some of the highest percentage decreases (SE41SW 13.9 days, 26.8%).

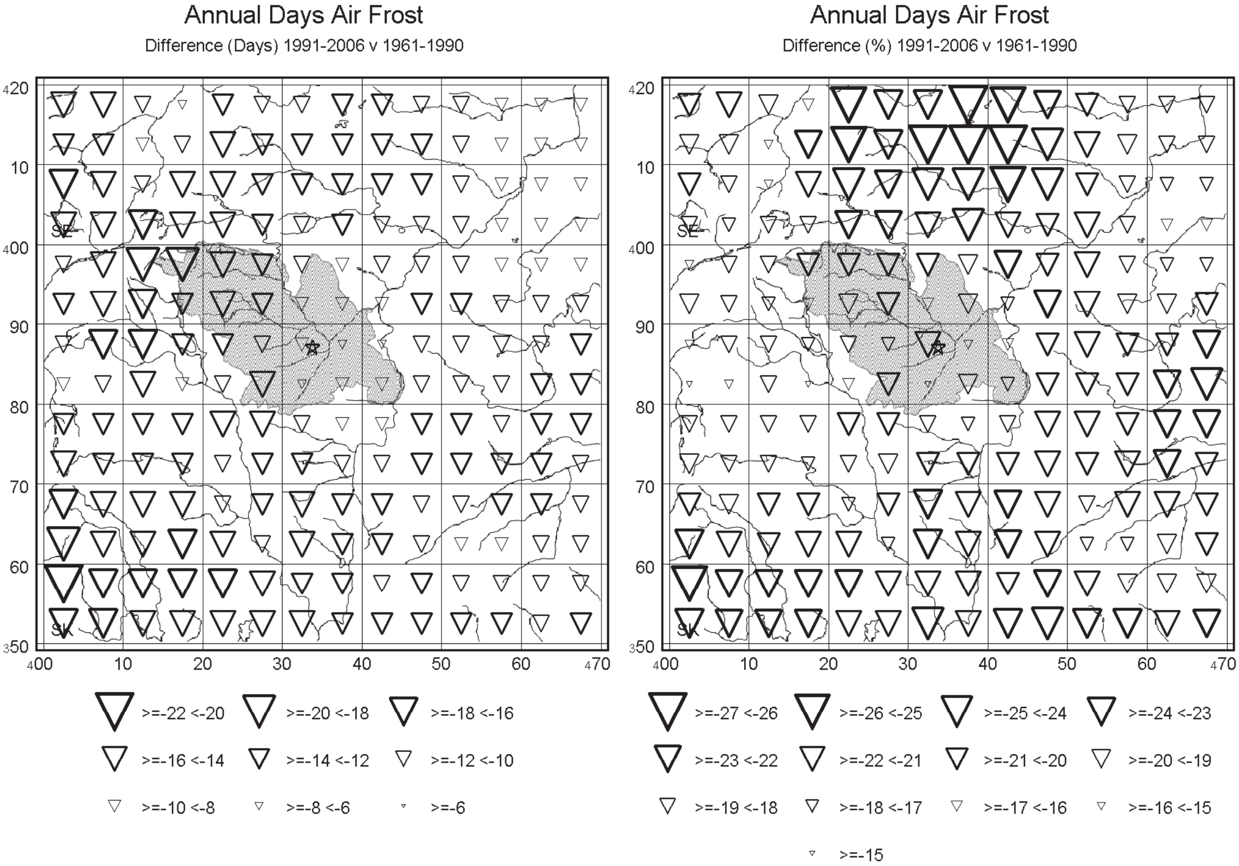

Figure 8 Annual Days of Air Frost - Changes from 1961-90 to 1991-2006

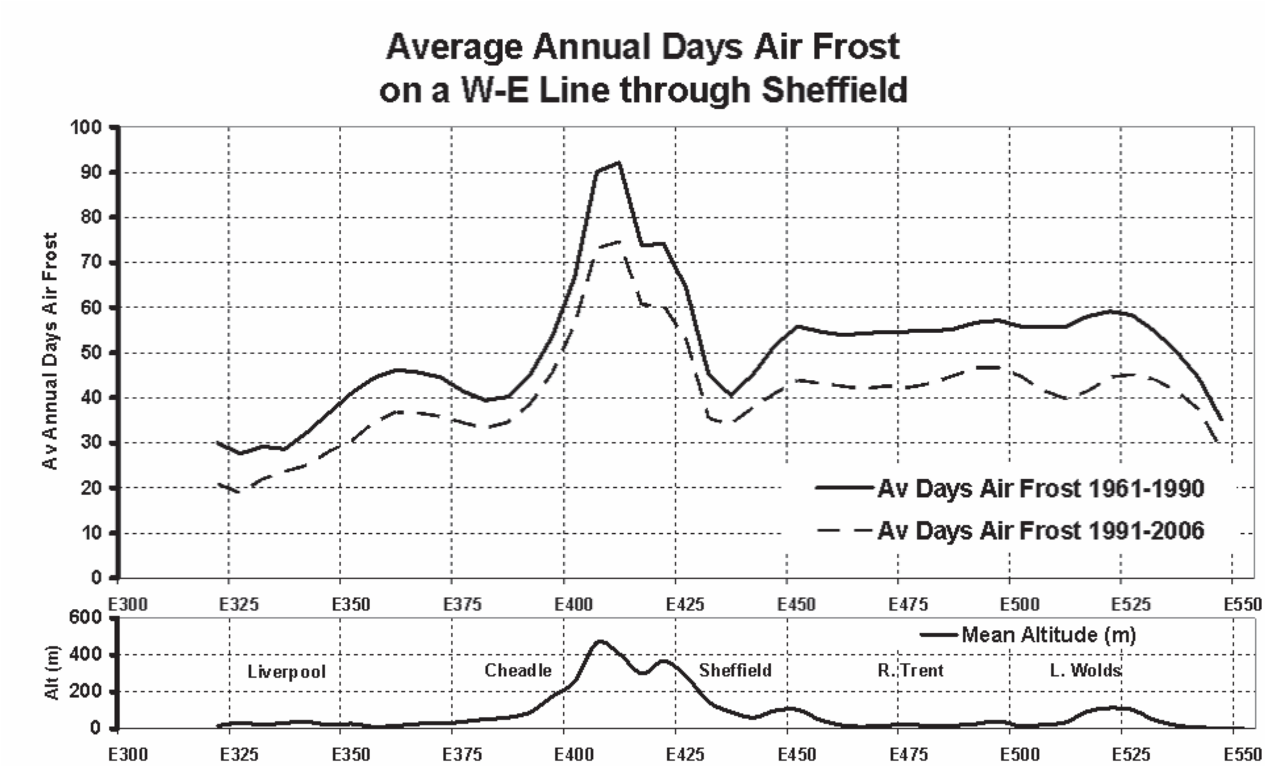

Figure 9 Annual Days of Air Frost on a West-East Line through Sheffield

The west-east profile seen in Figure 9 shows the lower values for days of air frost to the west of the Pennines, in urban areas, and towards the coast. The fall in these values between the periods has been particularly marked in the Lincolnshire Wolds (e.g. TF18NW 16.6 days, 28.7%) as well as the Dark Peak (as noted above).

DAYS OF GROUND FROST

As with air frost, 'days of ground frost' (defined where the minimum grass temperature was less than 0°C) are provided as monthly gridded data (1961-2006) which has been summed to produce annual values for the winter period ending in a given year, and from these the averages shown in Figure 10.

When compared with the data for air frost, the values for days of ground frost are significantly higher ranging through 95.2 – 141.4 days of ground frost in 1961-90, compared with 40.6 – 96.7 days of air frost in the same period. High values are found in the Dark Peak and other upland areas. Note, however, that the area in the Dukeries showing slightly high air frost values have the highest ground frost values in the area (141.4 Days in SK57SE in 1961-90, and 114 Days in 1991-2006). This could relate to a local microclimate created by its sandy soils (see 'Sheffield's Weather').

Though low values are again seen in the centre of Sheffield, they are not the lowest in the area. In 1961-90, these are seen around SE41NE (94.4 Days, near Pontefract), while in 1990-2006 they are seen around SE21NW (81.6 Days, near Mirfield), both in the north of the area around the Went and Calder valleys.

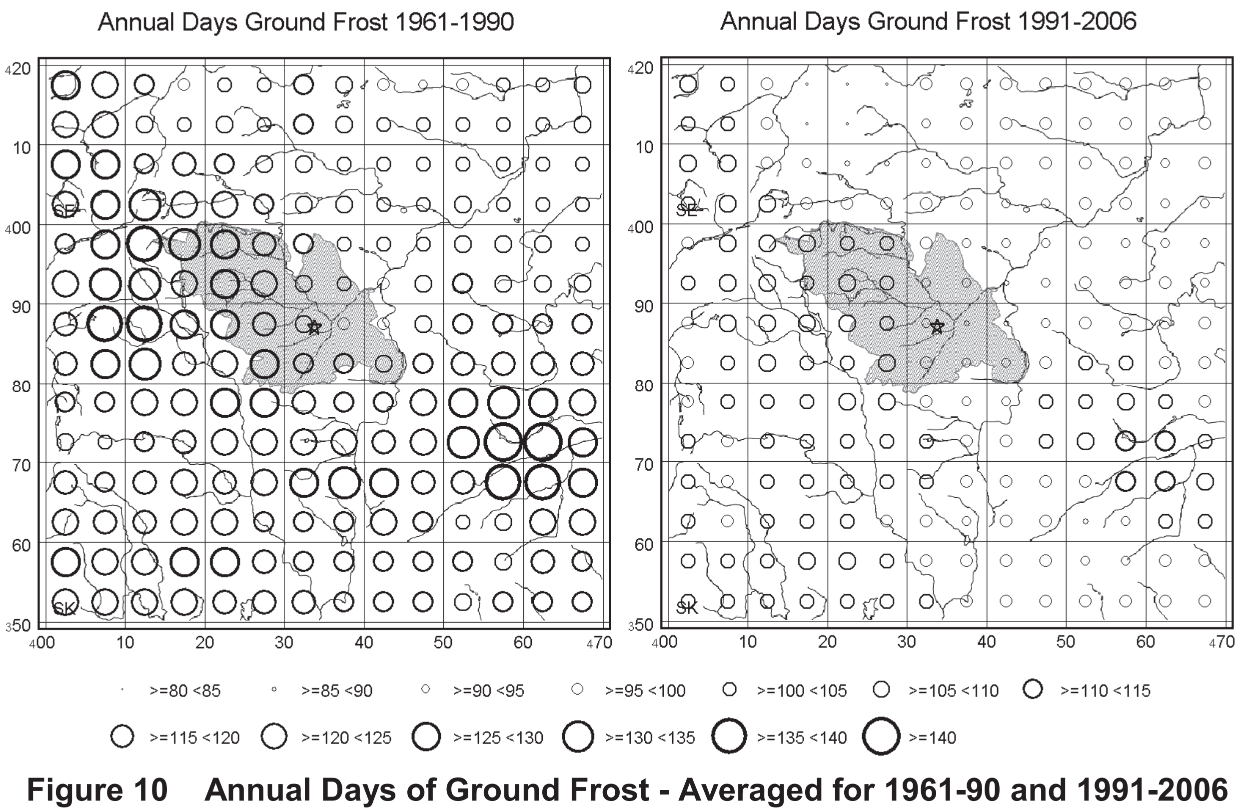

Figure 10 Annual Days of Ground Frost - Averaged for 1961-90 and 1991-2006

Though there has been a general decrease in values between the two periods, in many parts the decrease has been small and a slight increase is seen in the north of the area (solid 'delta' symbols). Considering the changes as days or as percentages (in Figure 11) shows the same patterns. The largest decrease was in SK36NE (Wingerworth, 33.9 days, 25.3%)

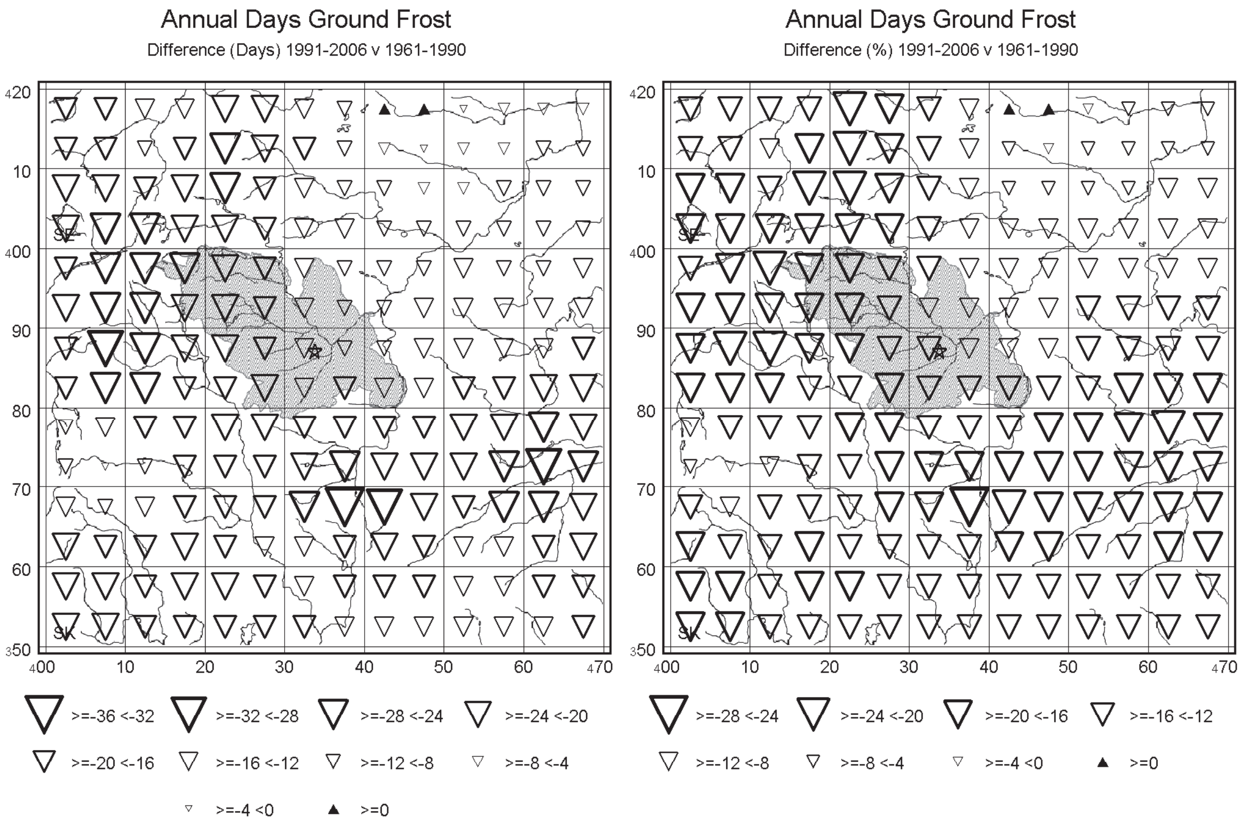

Figure 11 Annual Days of Ground Frost - Changes from 1961-90 to 1991-2006

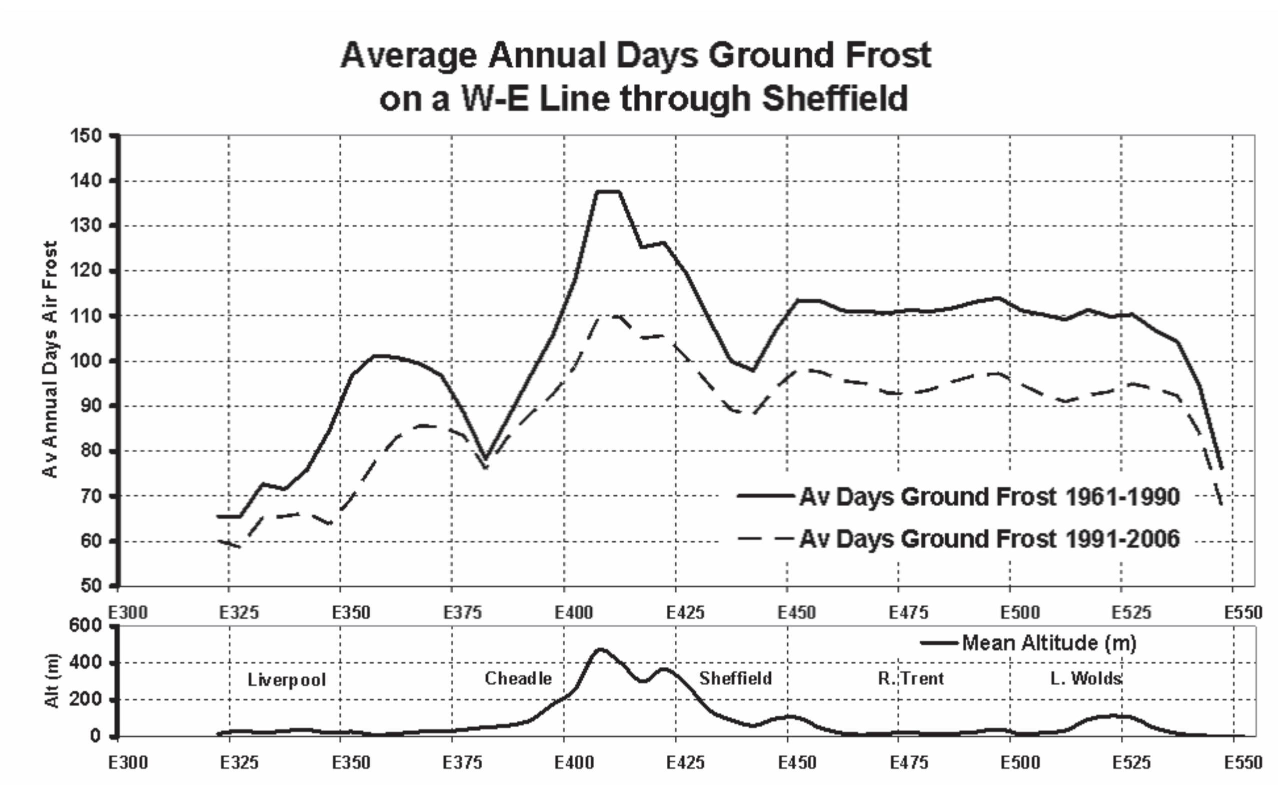

Figure 12 Annual Days of Ground Frost on a West-East Line through Sheffield

The W-E profile for ground frost follows the same pattern as for air frost, and shows the higher values discussed above. Lower values are seen in urban areas and near the coast. The low values and low difference between the periods at eastings 380 (SJ88NW) relate to an urban area north of Manchester Airport.

RAINFALL

The various measures of rainfall included in the available gridded data all show the same basic pattern across the Sorby area reflecting the topography of the area. Total rainfall and ‘rain days >=1mm’ are discussed in detail here, with brief summaries of some of the other measures.

The maps in Figure 13 show the average of the annual total rainfall for each period. Across the Sorby area, the annual rainfall varies by a factor of x3 between the highest values in the Dark Peak (SK19NW (Bleaklow) 1607mm for 1961-90, 1623mm for 1991-2006) and the lowest in the low lying areas in the north east (SK69NE (Finningley) 569mm 1961-90, SE60NE (Hatfield) 555mm 1991-2006). All of the upland areas in the west have relatively high values (>1000mm).

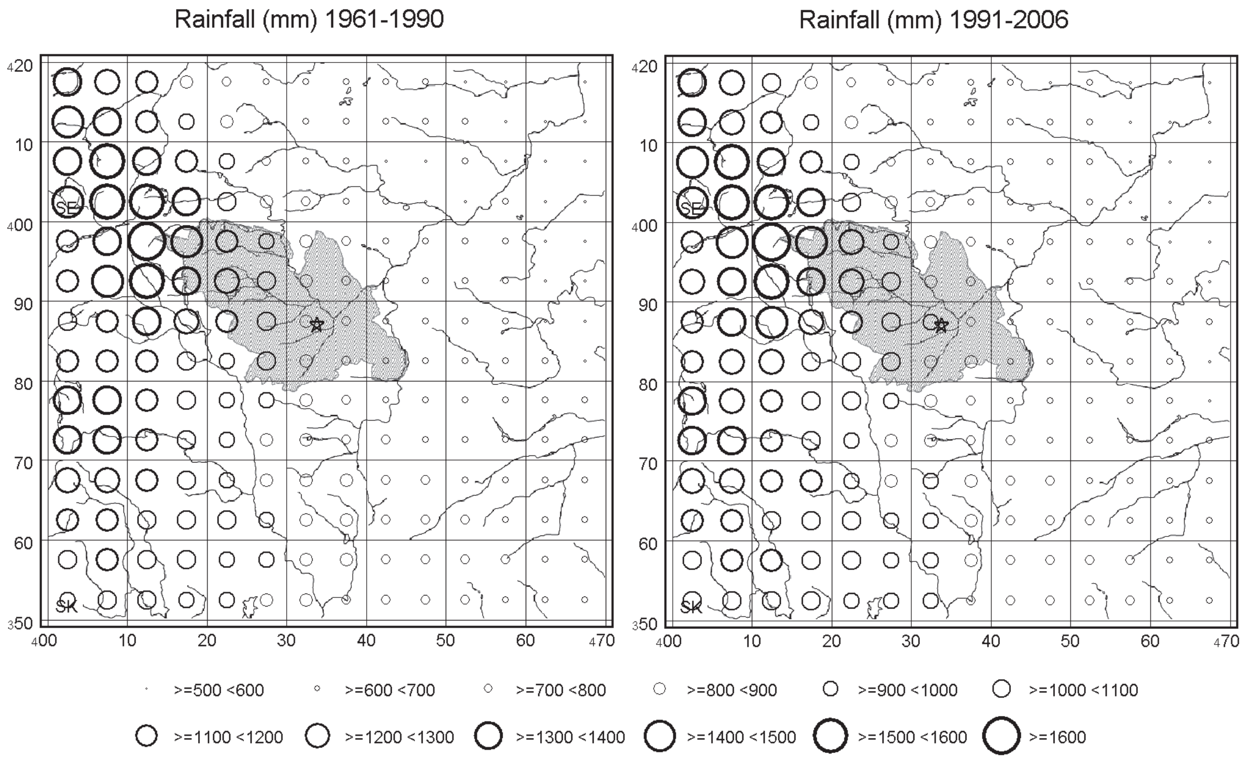

Figure 13 Annual Rainfall - Averaged for 1961-90 and 1991-2006

The differences between 1961-90 and 1991-2006 (shown in Figure 14) are generally small (+/-50mm, +/-4%) with a number of wide local variations, from +119mm (+10.1%) in SK08NE (Kinder Scout) to -92mm (-7.7%) in SE11SW (Honley). Even within adjacent grid squares, e.g. around SK09SE (Snake Pass), the variations can differ widely, probably relating to local topography.

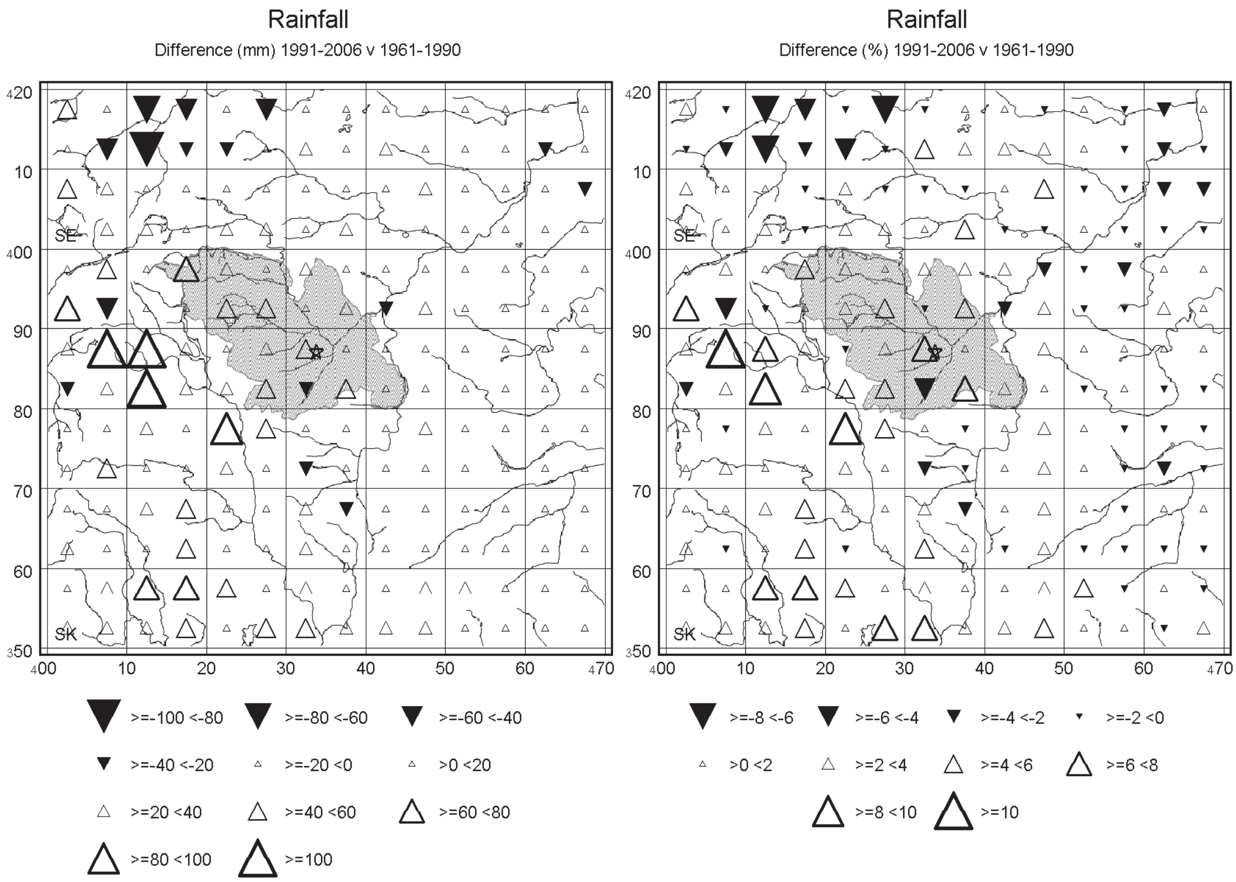

Figure 14 Annual Rainfall - Changes from 1961-90 to 1991-2006

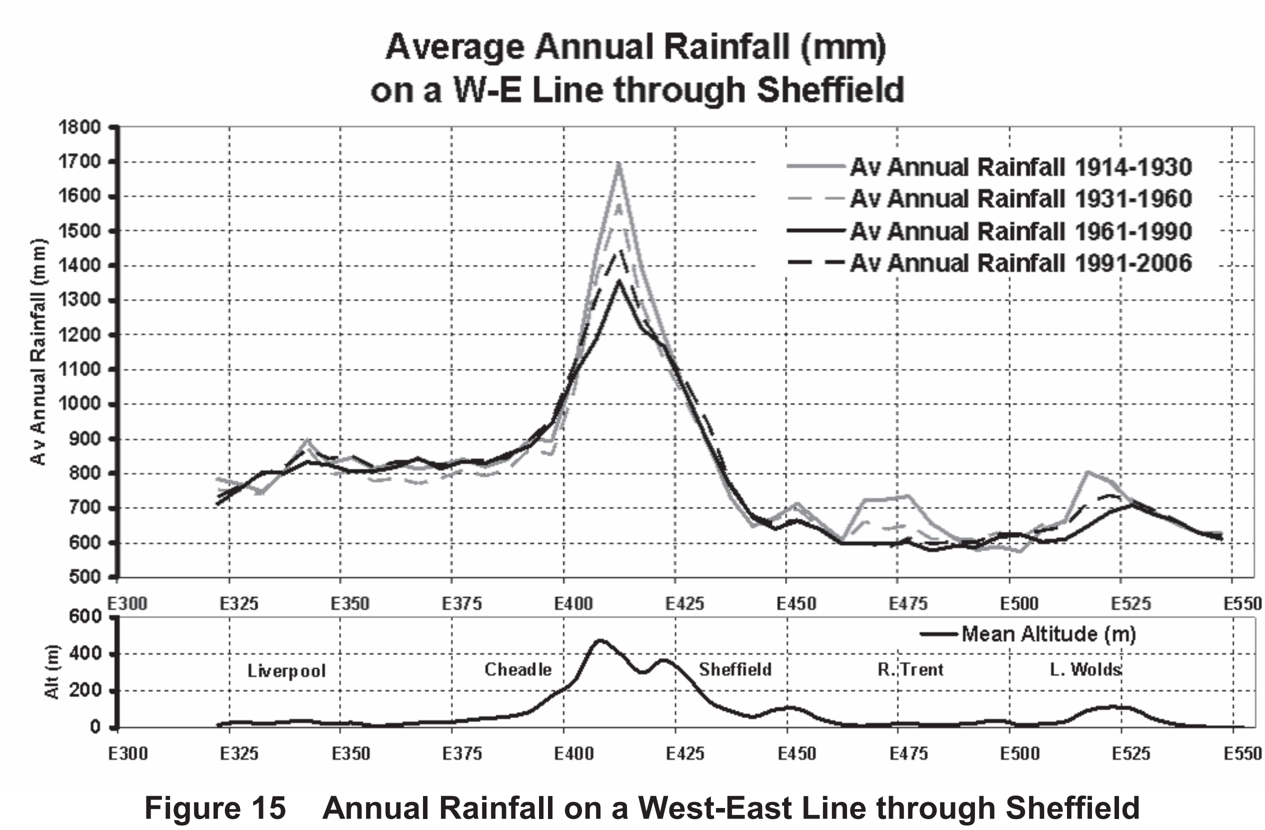

Figure 15 Annual Rainfall on a West-East Line through Sheffield

The generally small differences between 1961-90 and 1991-2006 seen in Figures 13 and 14 are again seen in the W-E profile in Figure 15, with markedly higher differences in the high ground of the Dark Peak. It is, however, interesting to note that the highest value (E410 SK18NW Edale Moor) shows an increase of 102mm between 1961-90 and the later period, which followed major decreases from the previous periods (e.g. a fall of 222mm from 1931-60 to 1961-90). These can be seen in Figure 16 which contrasts that square with the 'Weston Park' square.

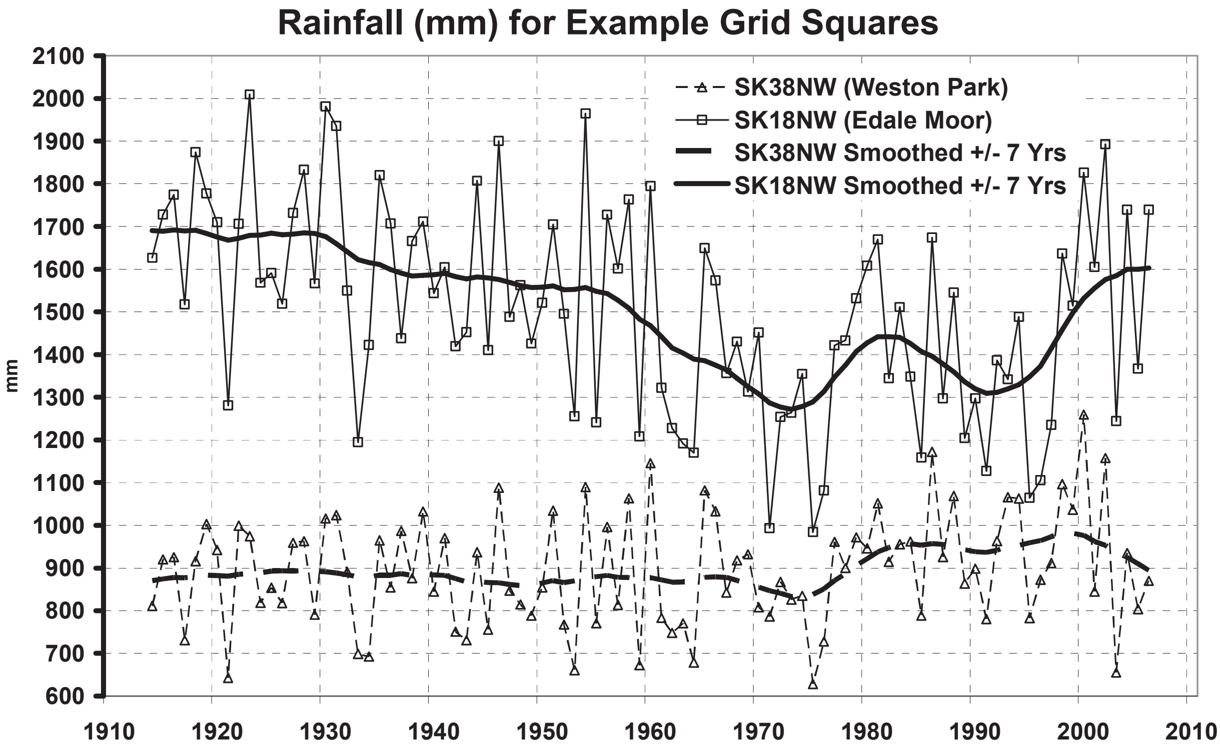

Figure 16 Rainfall comparison for Edale Moor and Weston Park

DAYS WITH RAINFALL>=1MM

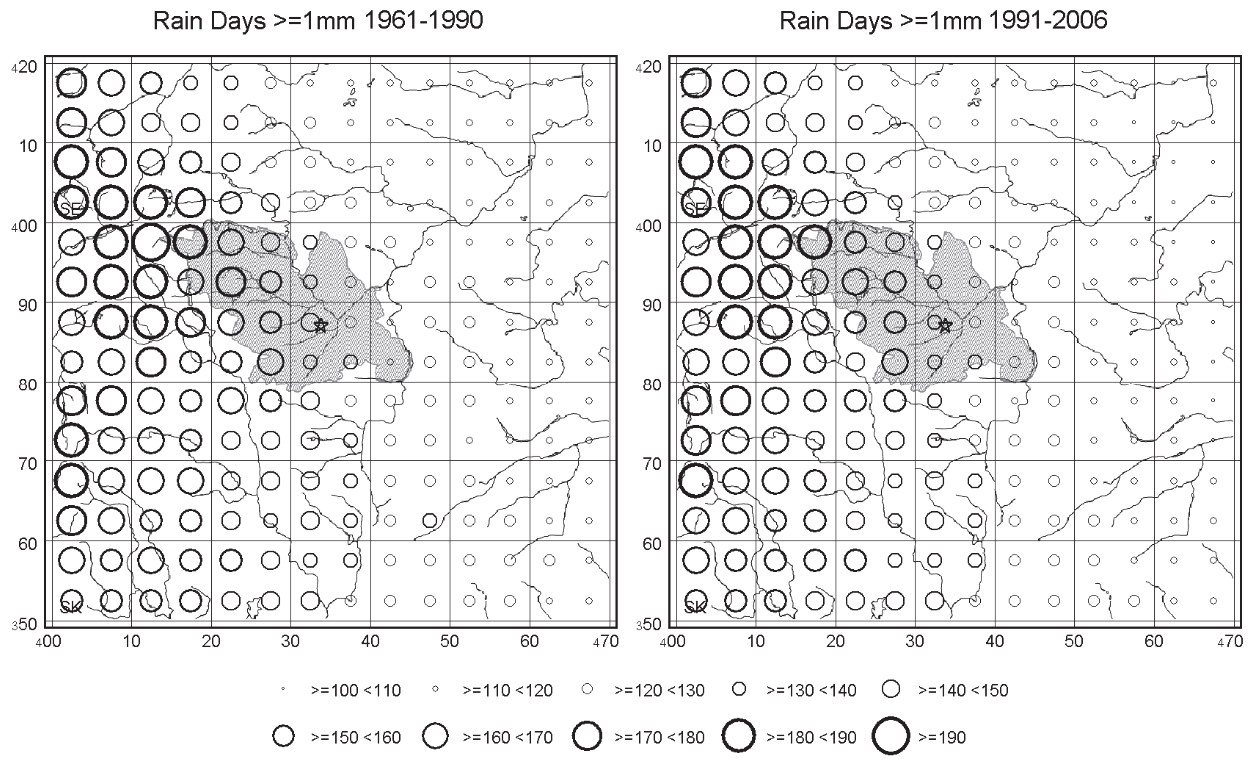

Figure 17 Annual Days with Rainfall>=1mm - Averaged for 1961-90 and 1991-2006

Figure 17 shows that the annual number of 'days with rainfall of 1mm or more' follows the same general pattern as rainfall amounts, with higher values (~190 days) on the high ground of the Dark Peak and low values (~107 days) in the low lying east. The highest values are 190.7days in SK19NW (Bleaklow) for 1961-90 and 189.2days in SK09NE (Crowden) for 1990-2006. The lowest values are 110.4days in SK69NE (Finningley) for 1961-90 and 107days in SK60NW (Kirk Sandall) for 1990-2006.

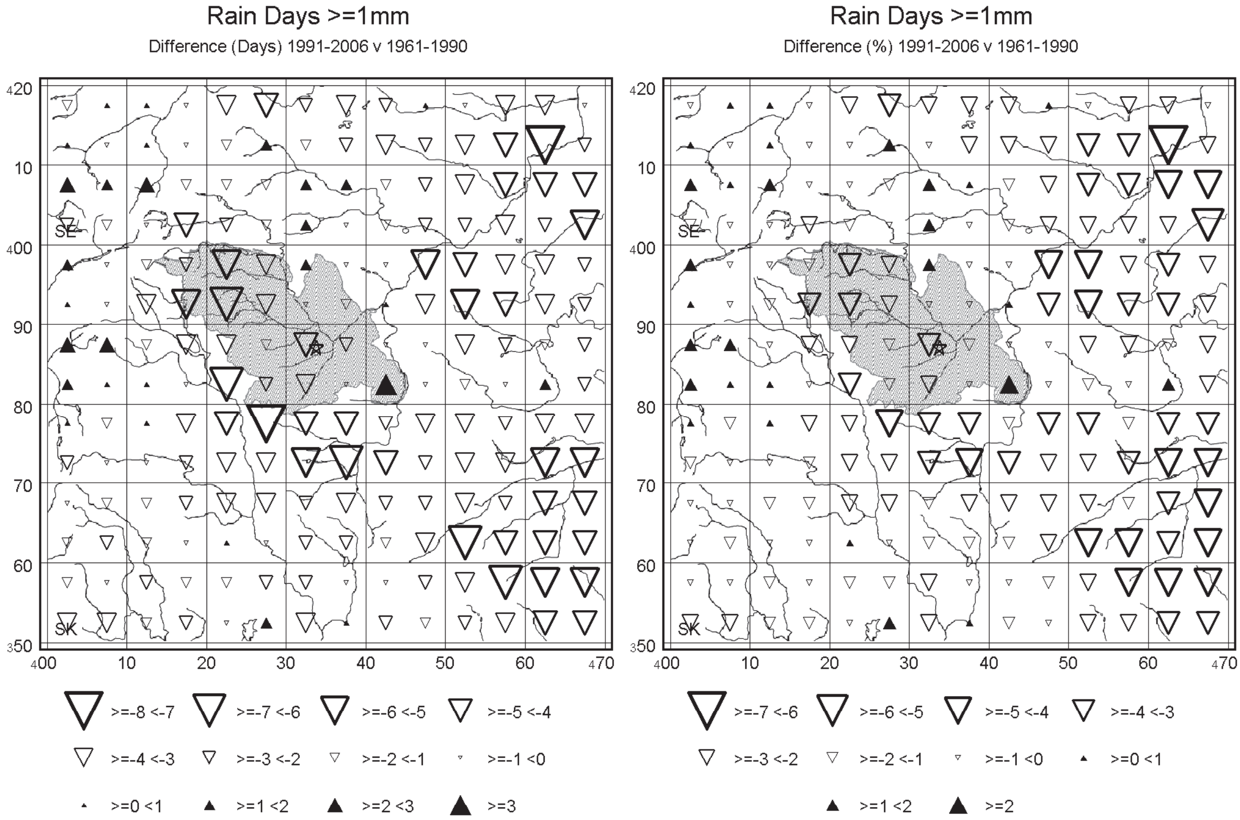

Figure 18 Annual Days with Rainfall>=1mm - Changes from 1961-90 to 1991-2006

The high values in the high ground in the west show relatively little (and probably not 'significant') change between the periods (Figure 18). Several areas south and west of Sheffield, in the north east around Doncaster and the south east around Mansfield show more significant decreases in the number of days of rain with the largest decrease of -7.6 days (-6.5%) in SE61SW (Stainforth). The largest increase is a localised, and possibly spurious, peak of +3.1days (+2.6%) in SK48SW (Mosborough).

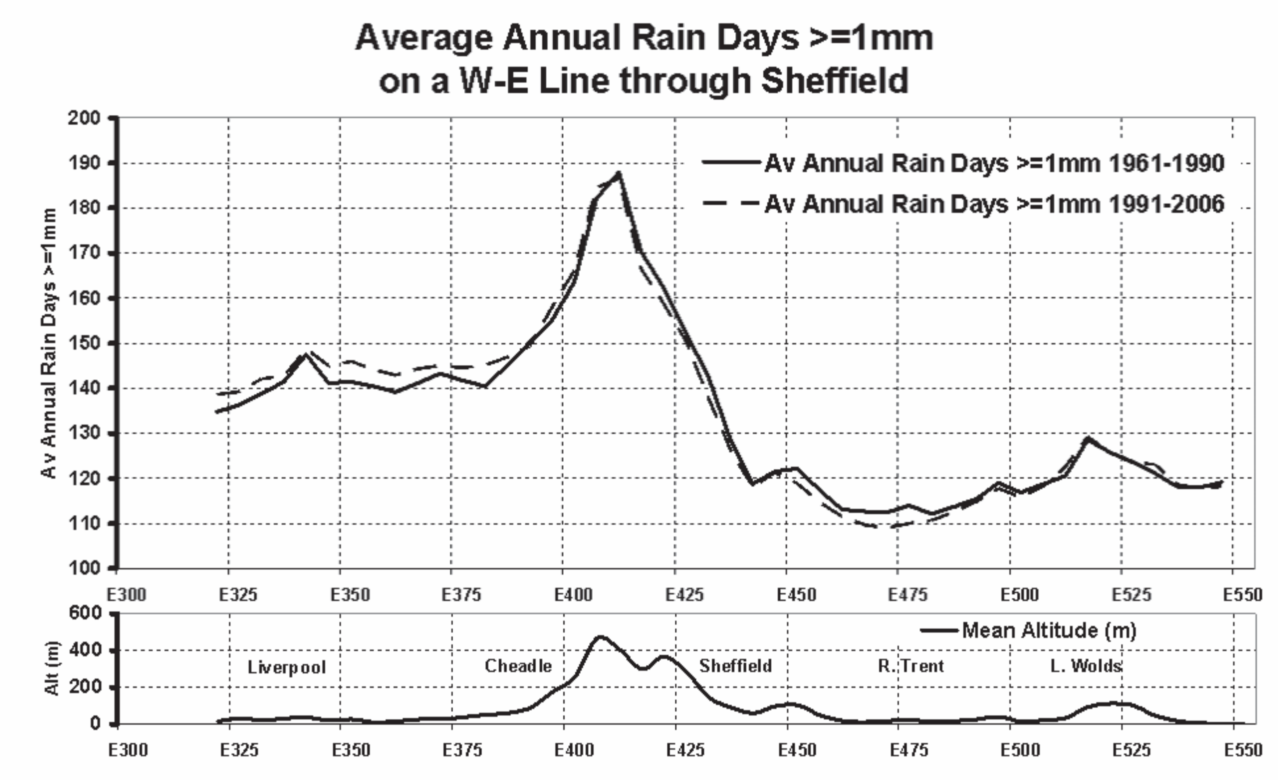

Figure 19 Annual Rain Days on a West-East Line through Sheffield

The W-E profile (Figure 19) shows more clearly that the number of rain days has not significantly changed between 1961-90 and 1991-2006. It does, however, miss the largest changes seen in the area maps. If any trend is present, it suggests a small increase to the west of the Pennines and a fall in the east.

DAYS WITH RAINFALL>=10MM

Annual 'days with rainfall of 10mm or more' closely reflect the patterns seen in the '>=1mm' maps, though obviously with lower numbers. Between the two periods, the range of values did not change (12.4 – 53.1 days for 1961-90, 12.3 – 53.0 days for 1991-2006).

The changes between the periods were not significant over most of the area (+/-2 days, +/-5%), with local clusters of decreasing values, and the occasional notable increase (e.g. +5.2 days, +21% seen in SK25SE (Brassington/Hognaston)).

MAXIMUM 5-DAY PRECIPITATION

As seen with rainfall amounts, the pattern of 'maximum 5-day precipitation' shows the highest values in the Dark Peak – SE10SW (above Dunford Bridge) 116.5mm for 1961-90 and 114.6mm for 1991-2004. Significantly lower values are seen in the White Peak (~80-90mm), but the lowest values are again seen in the east of the area (SE61NE (north of Thorne) 53.2mm for 1961-90 and 58mm for 1991-2004).

The majority of the area has seen an increase in the 'maximum 5-day precipitation', the largest increases being seen in the White Peak (14.5mm (19.9%) in SK16SW (Hartington)), and in the east of the area (10.7mm (19.6%) in SK68SE (Babworth)). A slight decrease is seen in the west of Sheffield (-2.8mm (-3.4%) in SK28NE (Rivelin Dams).

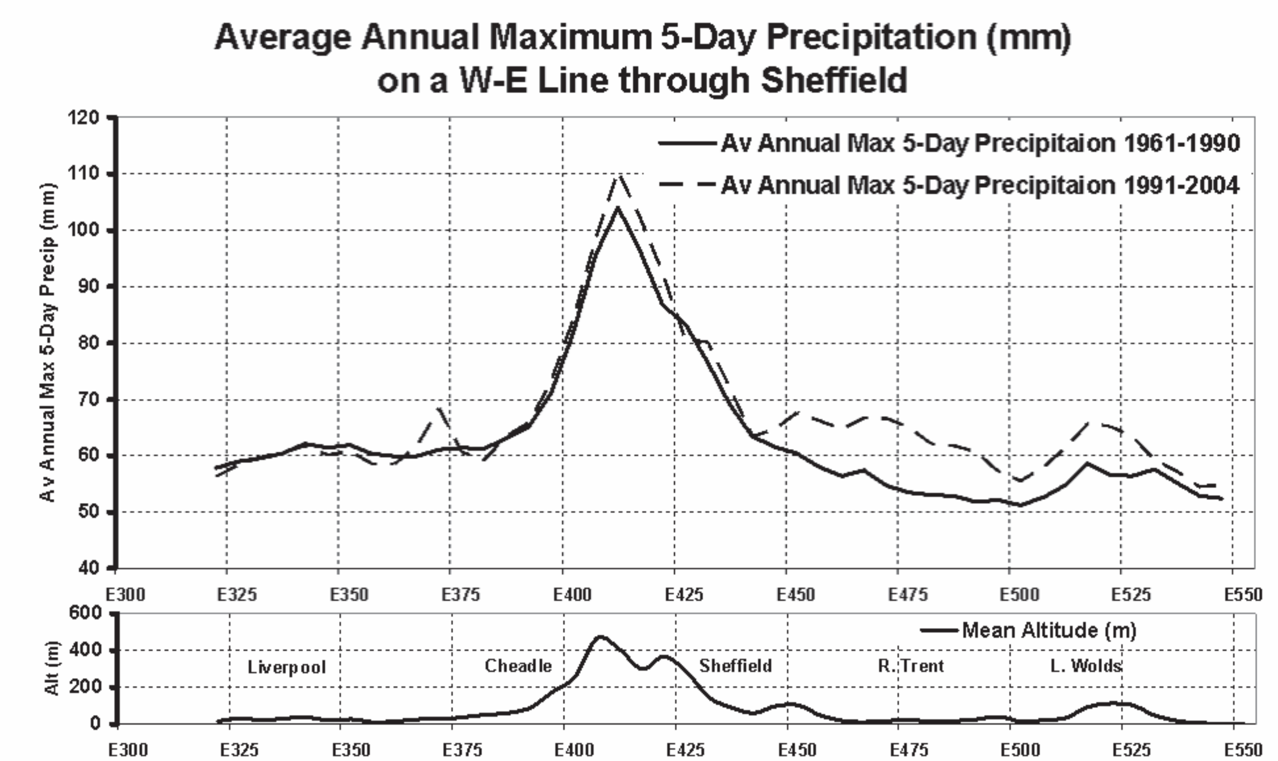

Figure 20 Annual Max 5-day Precipitation on a West-East Line through Sheffield

The W-E profile in Figure 20 shows the general, though small, increase in 'maximum 5-day precipitation' over most of the local area and the large increase to the east extending beyond the Sorby area. An increase in this value, combined with topography and other factors could indicate an increased risk of flooding.

MAXIMUM CONSECUTIVE DRY DAYS

The annual 'maximum number of consecutive dry days' (<=0.2mm rain in day) is an indicator of potential drought conditions. As would be expected from the general rainfall pattern, the highest values for this measure (see Figure 21) occur in the east of the area (17.9 days in SK65NE (Farnsfield) for 1961-90, 17.2 days in SK57SE (Cuckney) for 1991-2004).

Lower values are seen in the upland areas in the west. These are lowest in the Dark Peak for 1961-90 (12.7 days in SK19NW (Bleaklow)) and increasingly in the White Peak for 1991-2004 (e.g. 12.5 days in SK06NW (Flash)).

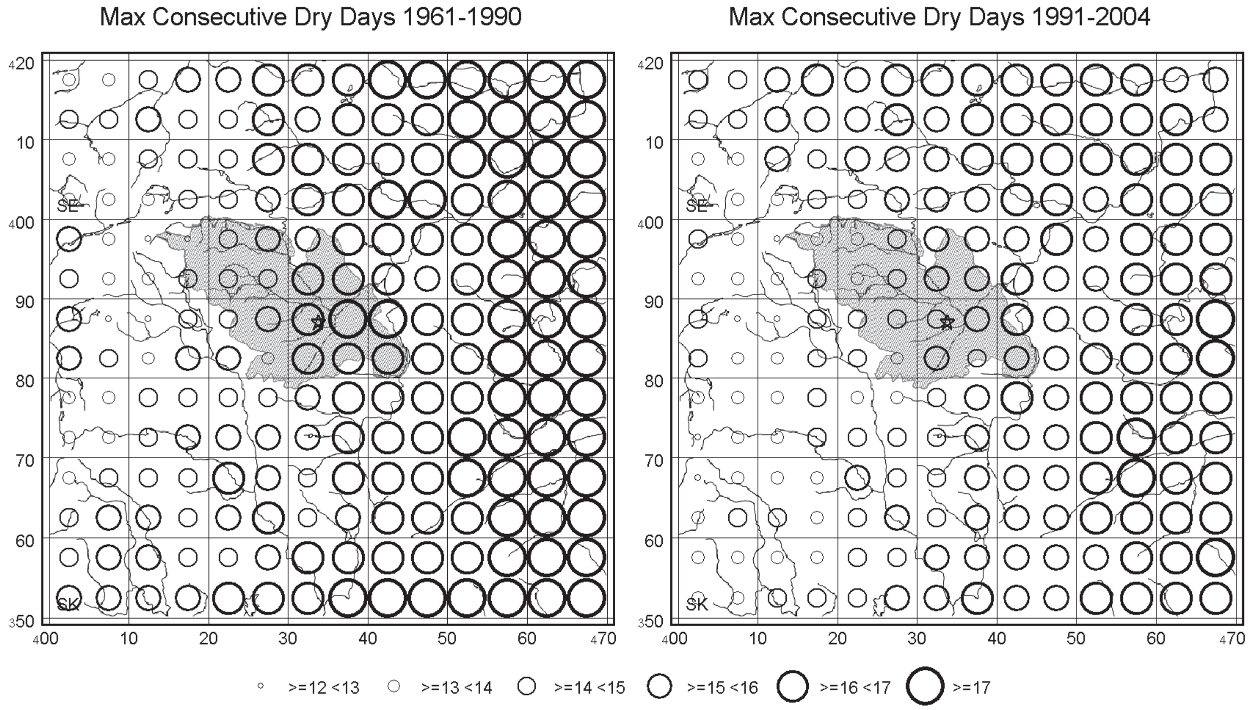

Figure 21 Annual Max Consecutive Dry Days - Averaged for 1961-90 and 1991-2004

The changes between the periods (Figure 22) show a general decrease in values except in the north-west (e.g. +0.7 days (+5.1%) in SE01NE (Slaithwaite)).

The decrease in values in the White Peak noted above is clearly seen, with the greatest decrease in SK05SW (Ipstones) (-2.1 days, -13.4%). Decreases are also seen in Sheffield (e.g. SK38NW -1.72 days, -10.5%) and in the north-east of the area (e.g. SE61SE (Thorne) -1.3 days, -7.6%).

The W-E profile (Figure 23) shows that the general decrease in 'maximum consecutive dry days' was greatest to the west of the Pennines (up to ~-2.5 days, ~-15%).

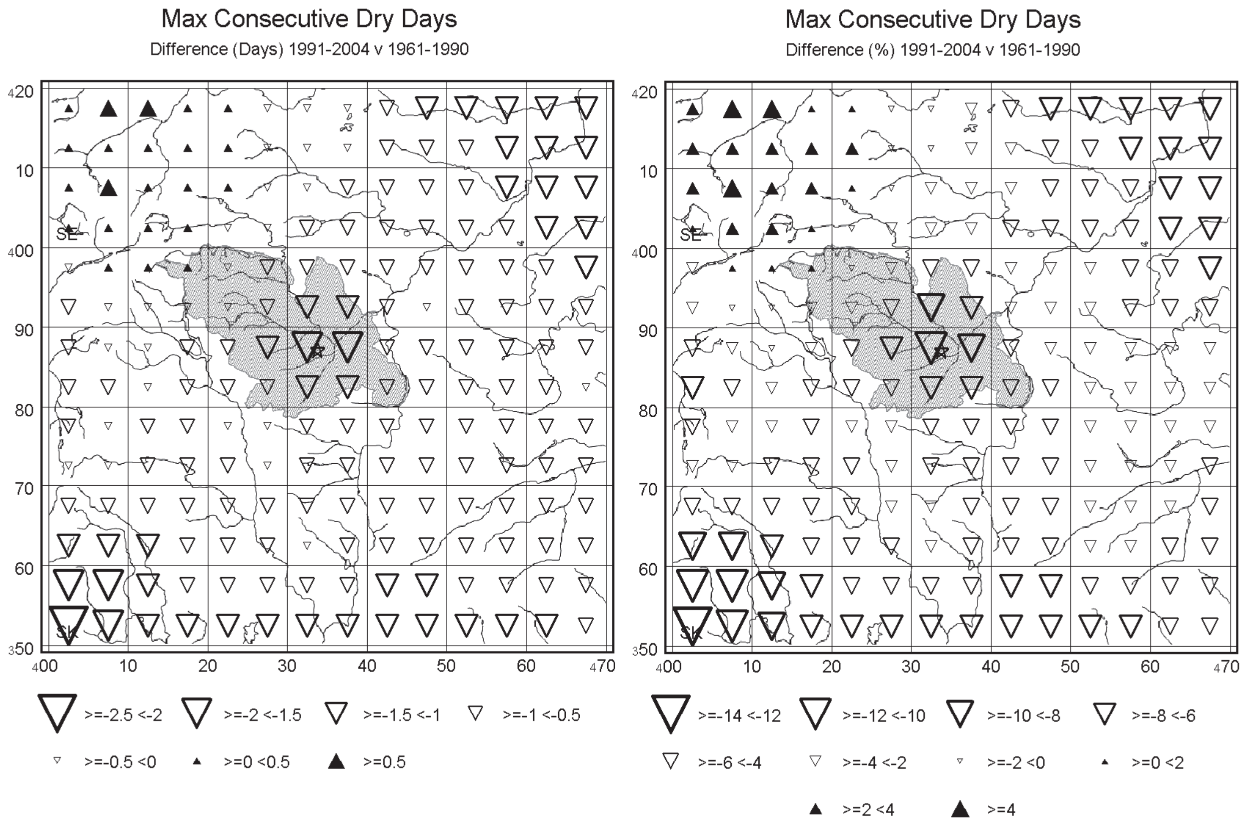

Figure 22 Annual Max Consecutive Dry Days - Changes from 1961-90 to 1991-2004

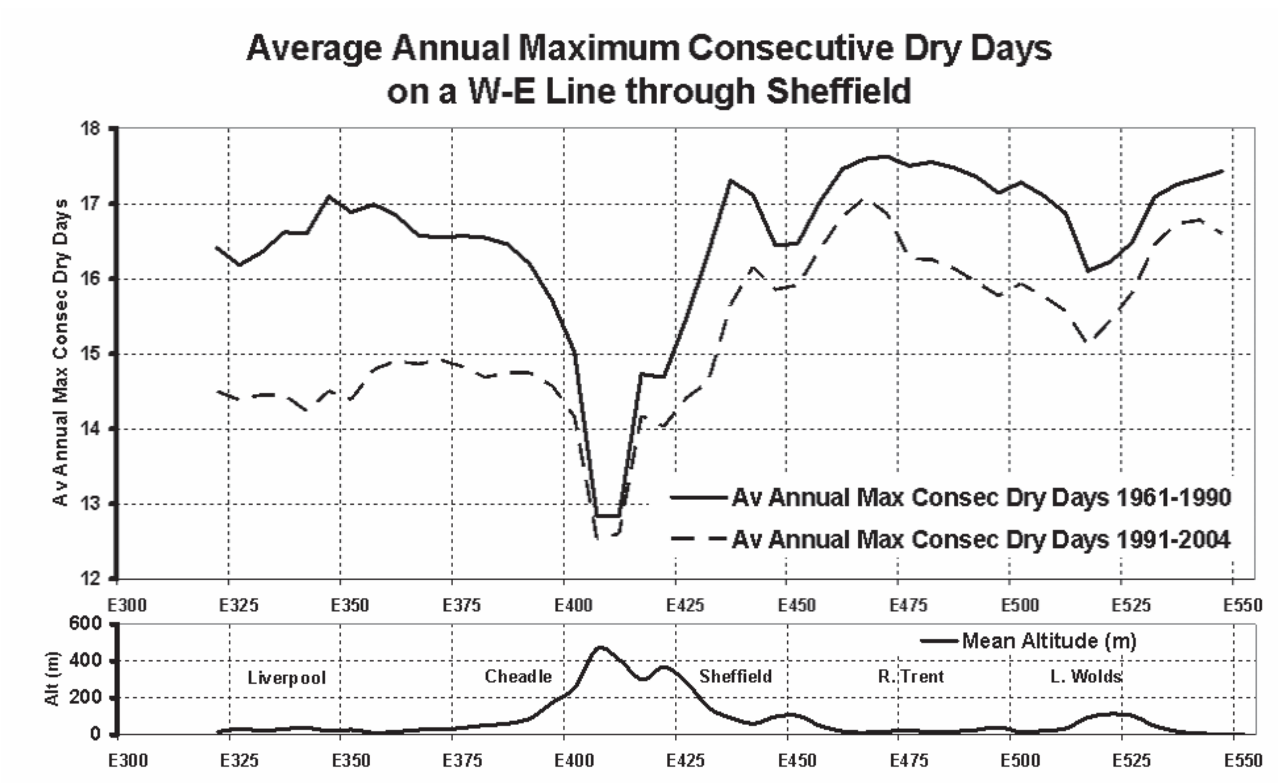

Figure 23 Annual Max Consecutive Dry Days on a West-East Line through Sheffield

DAYS WITH SNOW FALLING

Data for days with snow falling has only been provided by UKCP09 from 1971 to 2000, hence the Figure 24 shows the periods 1971-1990 and 1990-2000.

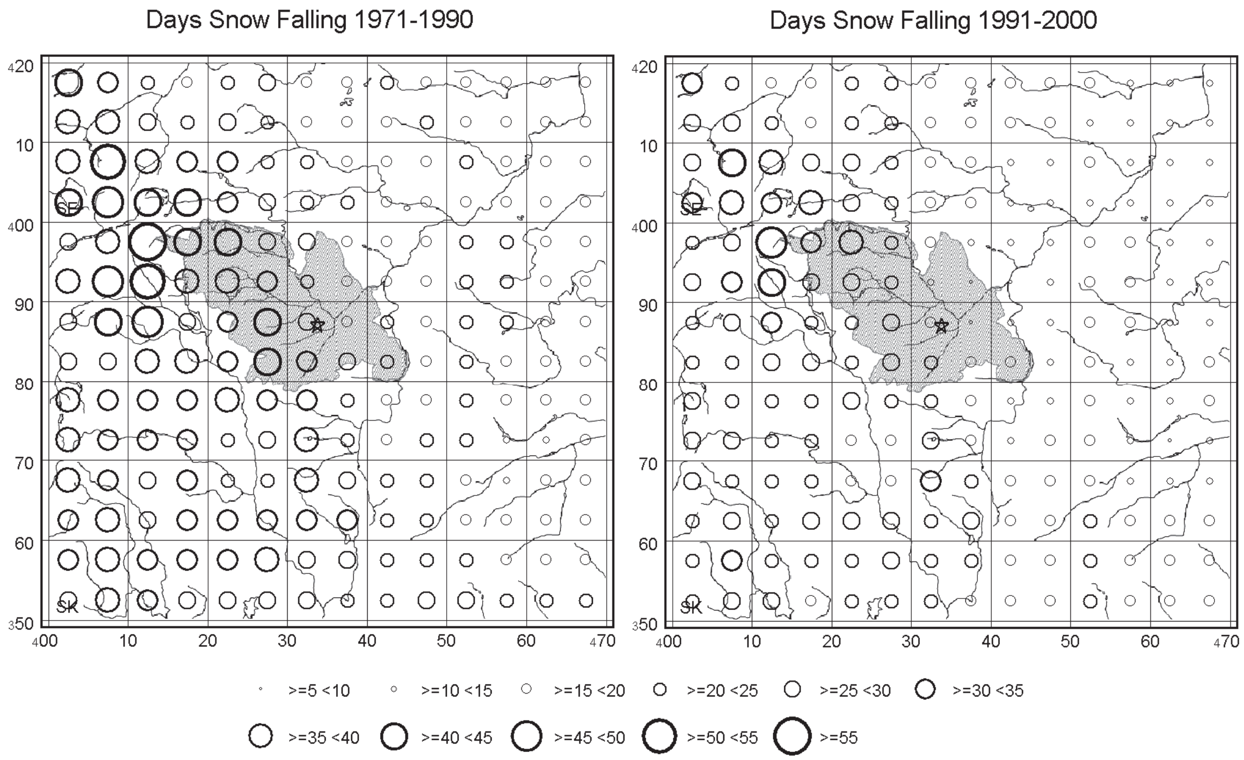

Figure 24 Annual Days with Snow Falling - Averaged for 1971-90 and 1991-2000

There is a wide variation in the number of days with snow falling across the area. Higher values are seen in the west of the area, with the highest being in Dark Peak, 57.8 days in SK19NW (Bleaklow) for 1971-90 and 47.2 days for 1990-2000 in the same square. High values were also seen in the 1971-90 period in the west of Sheffield – e.g. 41 days in SK28NE (Lodge Moor).

The lowest values are seen in the low ground to the east with a minimum of 13.5 days in SK67SW (Thoresby) for 1971-90. For 1990-2000 the lowest values are seen in the built-up area of Sheffield – 8.6 days in SK39SE (Shiregreen) and 9.7 days in SK38NE (Park Hill).

Most of the area has seen a decrease in the number of days with snow falling (Figure 25). The greatest decreases were in the area with high period values in the west. This includes the high ground within the Sheffield MDC where the greatest decrease was -15.3 days in SK28SE (Burbage Moor). In the south-east, some squares show an increase in the number of days with snow falling - + 4.2 days (+25.5%) in SK56SW (Mansfield).

In 'percentage' terms the pattern is different because some of the smaller decreases (~6 days) seen in the north-east of the area are in areas with low base values (~20 days). The area with relatively high percentage decreases extends in a band to the north-east of Sheffield, with the greatest percentage decrease in SK39SE (Shiregreen) (-47.4%).

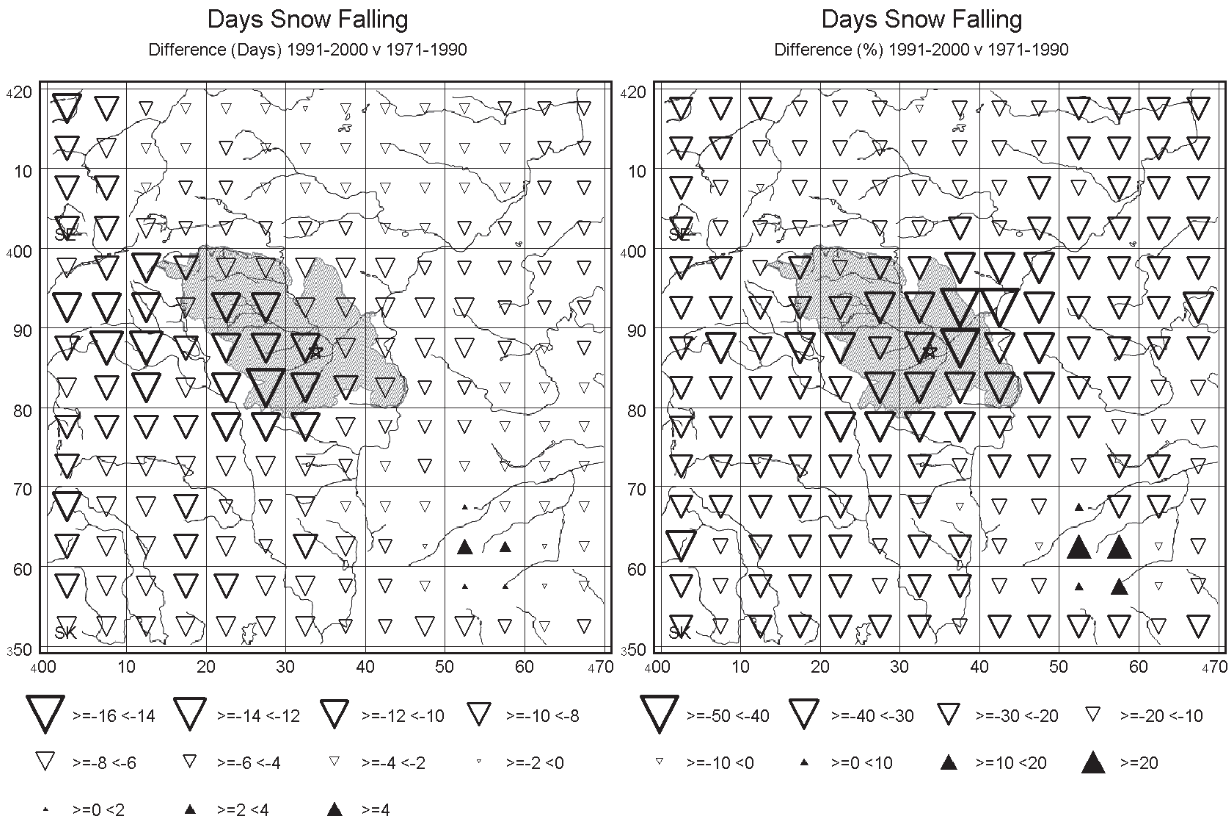

Figure 25 Annual Days with Snow Falling – Changes from 1971-90 to 1991-2000

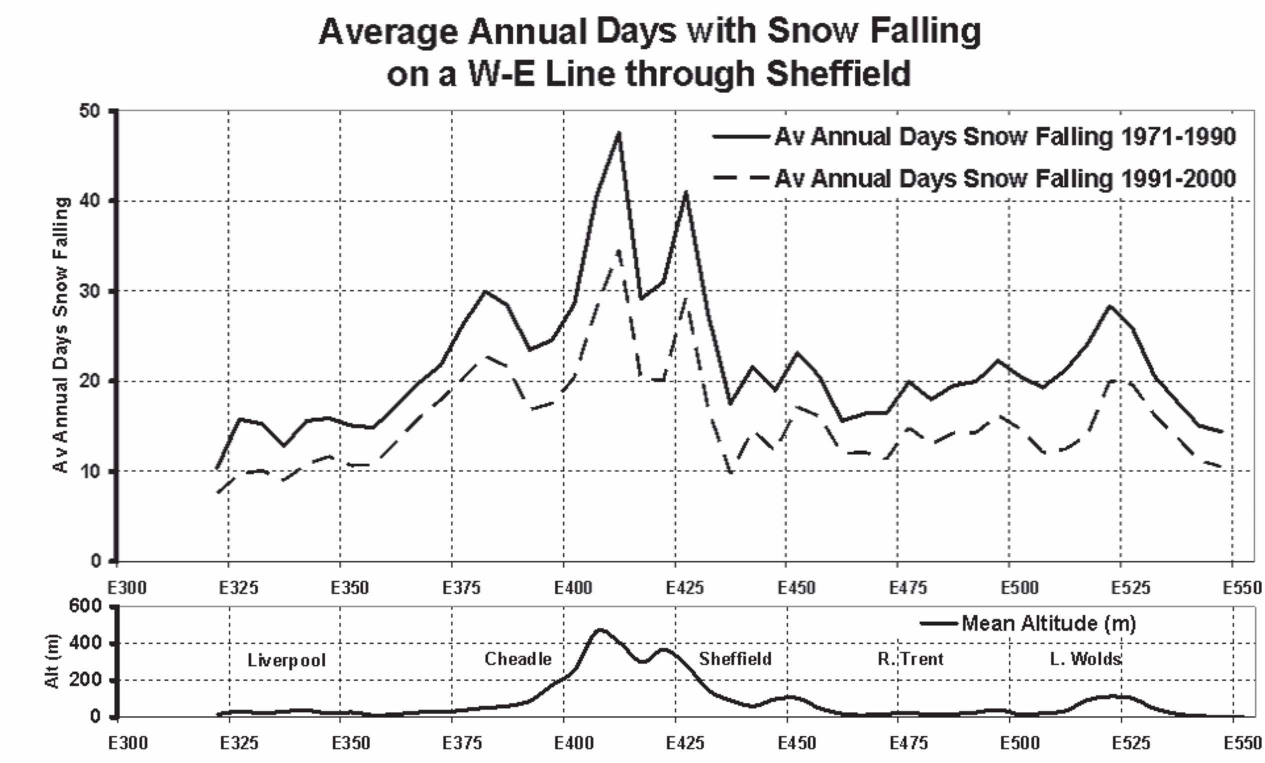

Figure 26 Annual Days with Snow Falling on a West-East Line through Sheffield

The W-E profile in Figure 26 shows the high values in SK18NW (eastings 410), Edale Moor, and SK28NE (eastings 425), Lodge Moor, which are seen in both periods. Away from the high ground, the patterns do not always reflect the altitude profile e.g. around

Manchester. The profiles are very similar across the entire country for both periods, showing a general decrease of about 5 days.

DAYS WITH SNOW LYING

Data for number of days with snow lying has only been provided from 1971 to 2006, hence Figure 27 shows the periods 1971-1990 and 1990-2006.

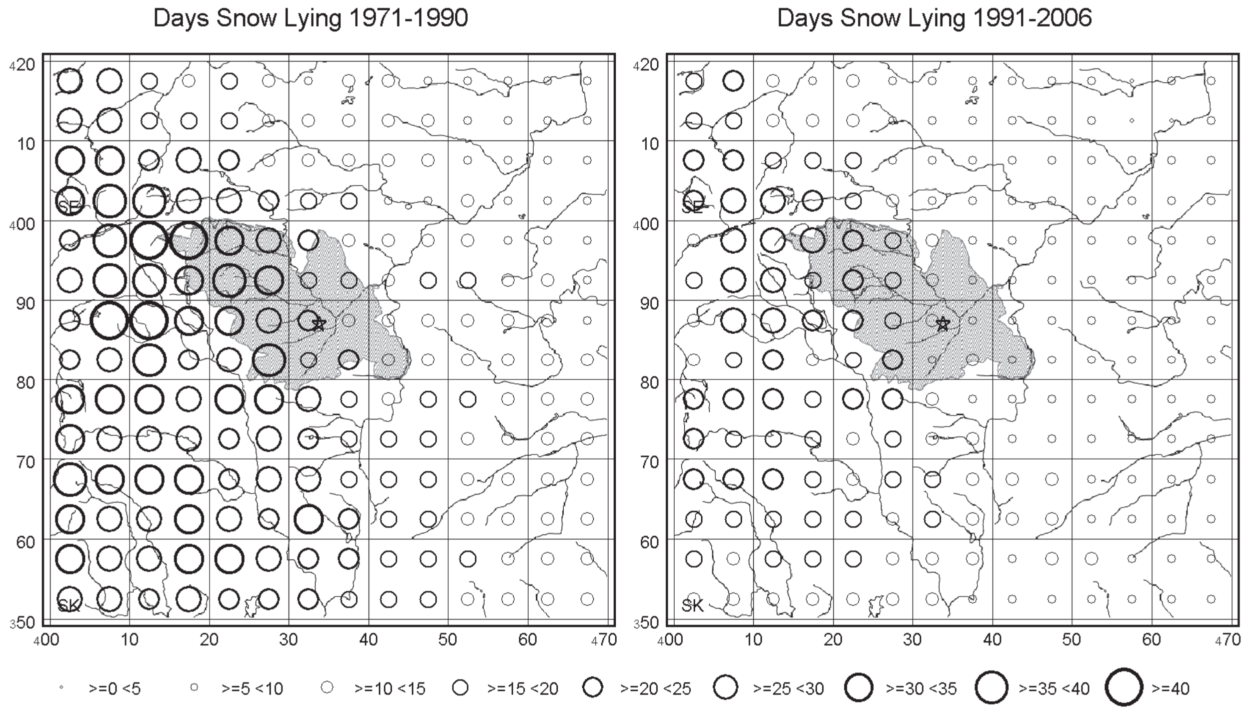

Figure 27 Annual Days with Snow Lying - Averaged for 1971-90 and 1991-2006

Once again there is a clear distinction between the high values seen in the western high ground (up to 43.2 days in SK18NW (Edale Moor) for 1971-90, and 29.9 days in SK19NW (Bleaklow) for 1991-2006) and the low values seen in the west. The lowest values occur in the lowest ground in the north-east, in SE61SW (Stainforth) (8.6 days) for 1971-90, and SE51NE&SE (Askern) (4.9 days) for 1991-2006.

The entire area has seen a decrease in the number of days with lying snow between the two periods. The largest decreases in 'days' (Figure 28) were seen in the south-west including both the White Peak and Dark Peak, to -15.5 days in SK05NW (Bradnop). The north-eastern area, with its low period values for 1971-90, also showed the lowest decrease in 'days' (-3.4 days in SE61SE (Thorne)), though these represent relatively large decreases as a 'percentage'.

Though the highest 'percentage' decrease is also seen in the far south-west (-55% in SK05SE (Grindon)), the overall pattern shows the same order of decreases around Sheffield (e.g. -53% in SK48NW (Aughton)) and towards Sherwood Forest.

The W-E profile (Figure 29) shows the lower number of days with lying snow to the west of the Pennines and the influence of altitude not always seen with number of days of falling snow. The values have decreased across the entire profile between the two periods.

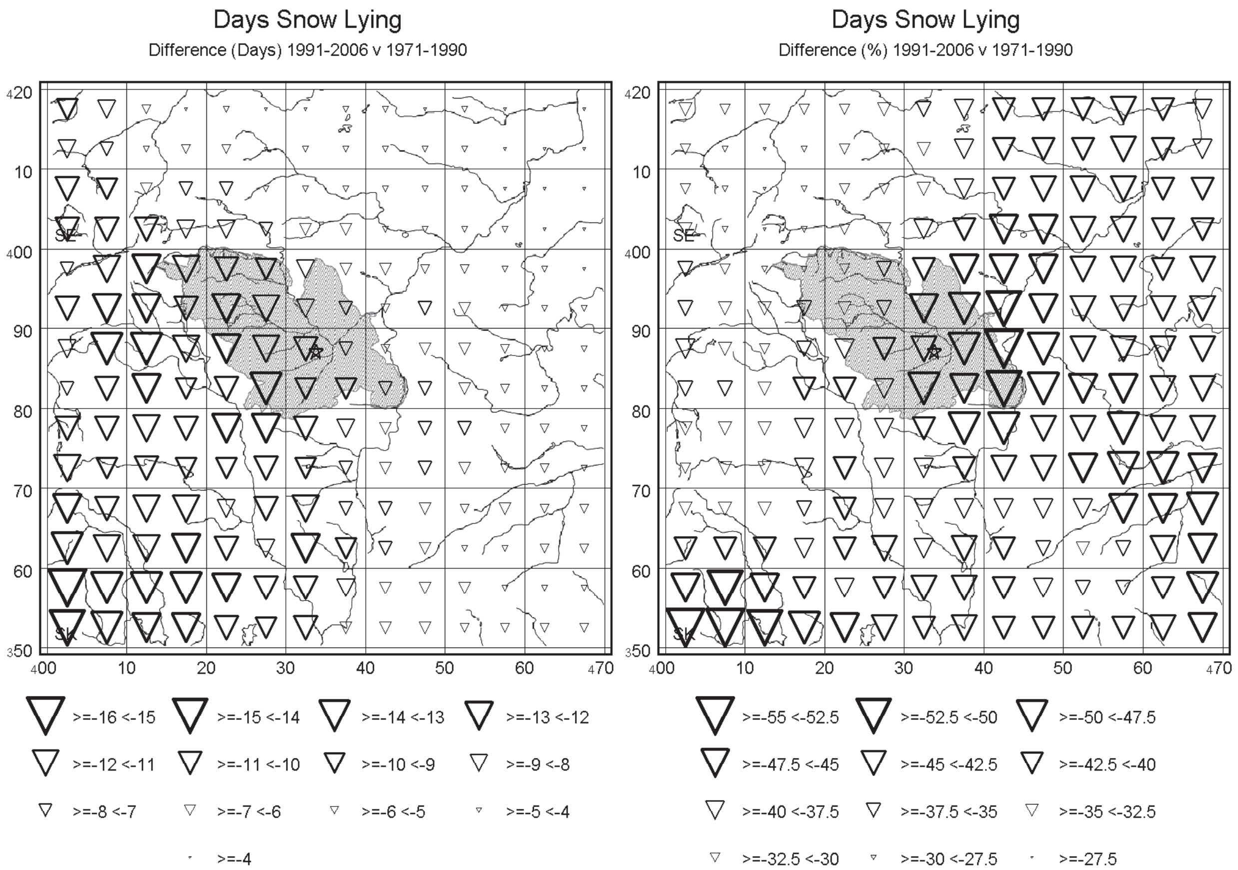

Figure 28 Annual Days with Snow Lying – Changes from 1971-90 to 1991-2006

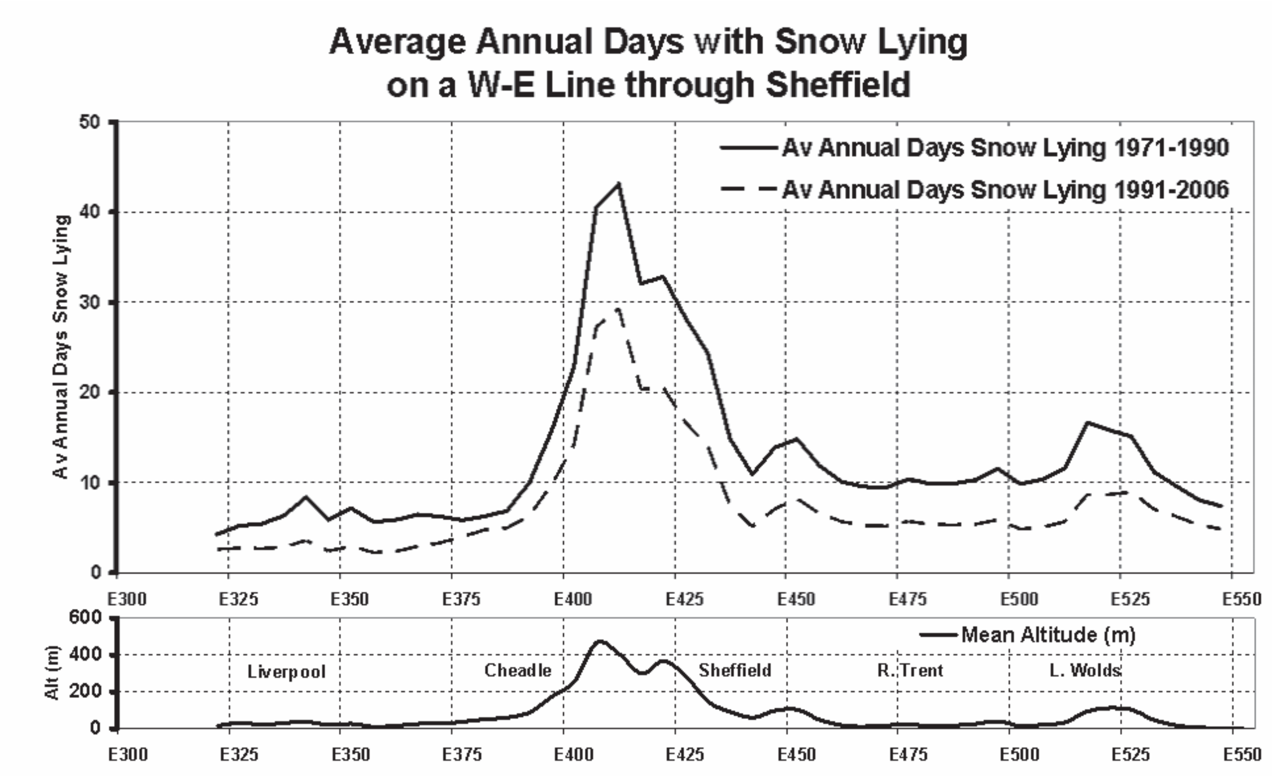

Figure 29 Annual Days with Snow Lying on a West-East Line through Sheffield

SUNSHINE HOURS

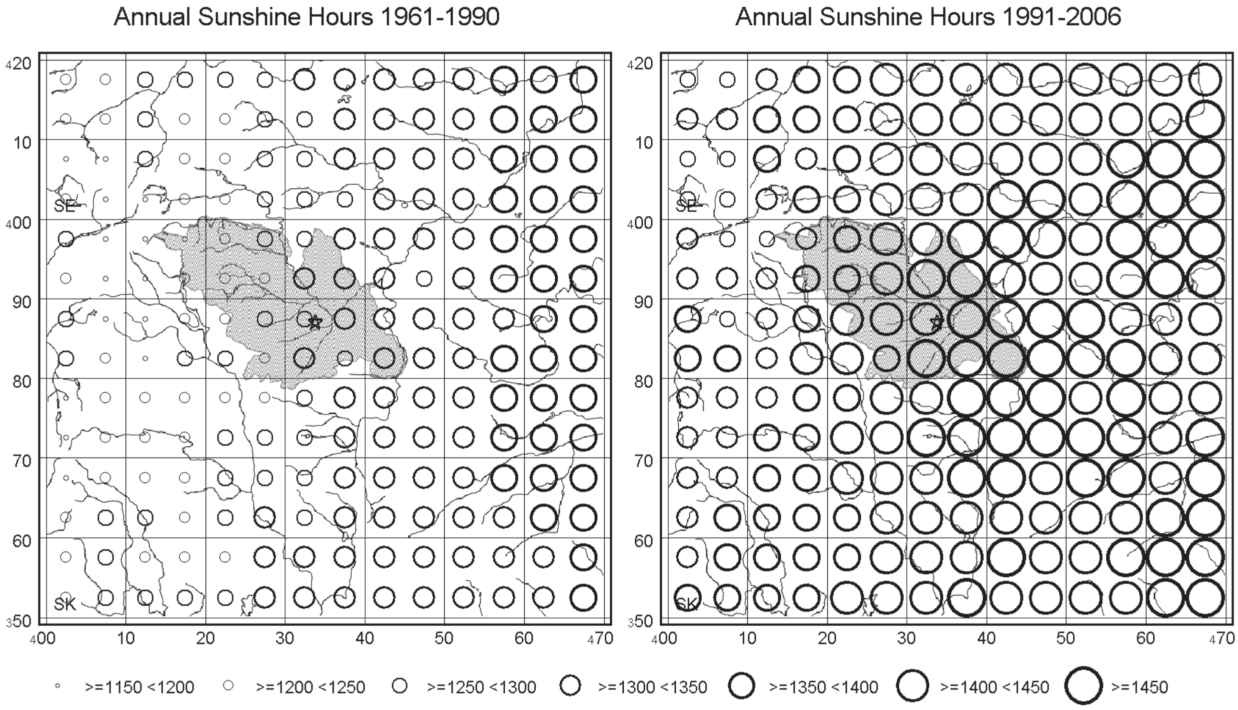

Figure 30 Annual Sunshine Hours - Averaged for 1961-90 and 1991-2006

The west-east pattern across the Sorby Area seen in Figure 30 reflects the topography (as also seen in the W-E profile (Figure 32) shown below). Highest values for annual hours of sunshine are found in the east (SK69NE (Finningley) 1398 hrs in 1961-90, SK65NE (near Southwell) 1492 hrs in 1991-2006). Lowest values are found in the Dark Peak (SK19NW (Bleaklow) 1160 hrs in 1961-90, SE00NW (Wessenden Moor) 1279 hrs in 1991-2006).

The area has seen a general increase in annual sunshine (Figure 31) with the greatest increases being around and to the west of the urban centres of Sheffield and Chesterfield (SK27NE (Barbrook) 185.3 hrs, and SK28SE (Burbage Moor) 15.3%). Low increases are seen in areas in the west such as Longdendale (SK09NW 64.2 hrs, 5.1%), but the lowest increases are in the low lying areas in the east (SK68NE (Ranskill, east of Blyth) 59.4 hrs, 4.3%).

Between 1931 and 1960 there were significant low values in the W-E Sun Hours profile (Figure 32) over and slightly to the east of the urban areas of Manchester and Sheffield and these areas showed notable increases into the period 1961-90. In contrast, no difference is seen between these periods on the west and east coasts. Looking at the later period 1991-2006, there has been an increase in annual sunshine across the country and this is most strongly seen around Sheffield.

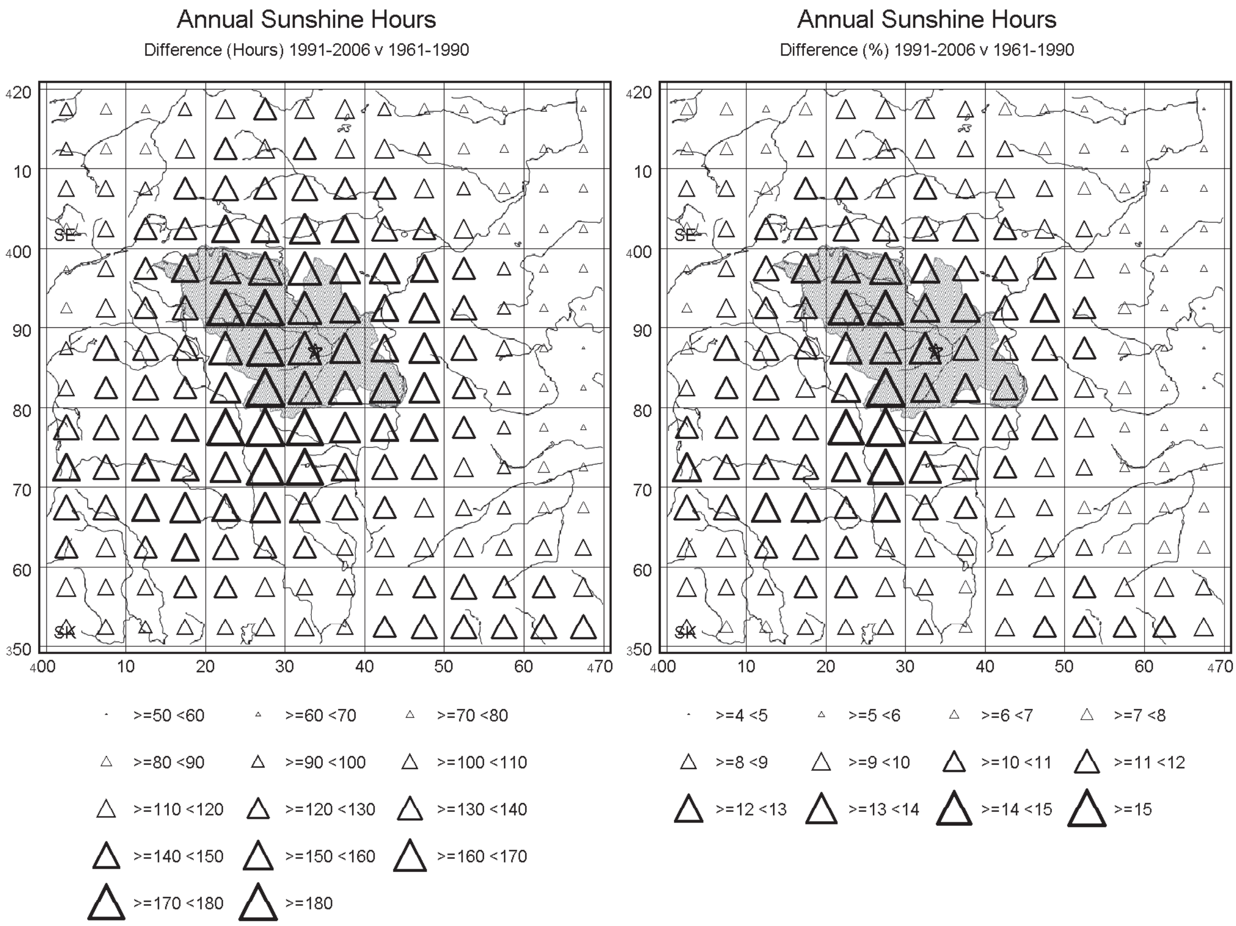

Figure 31 Annual Sunshine Hours – Changes from 1961-90 to 1991-2006

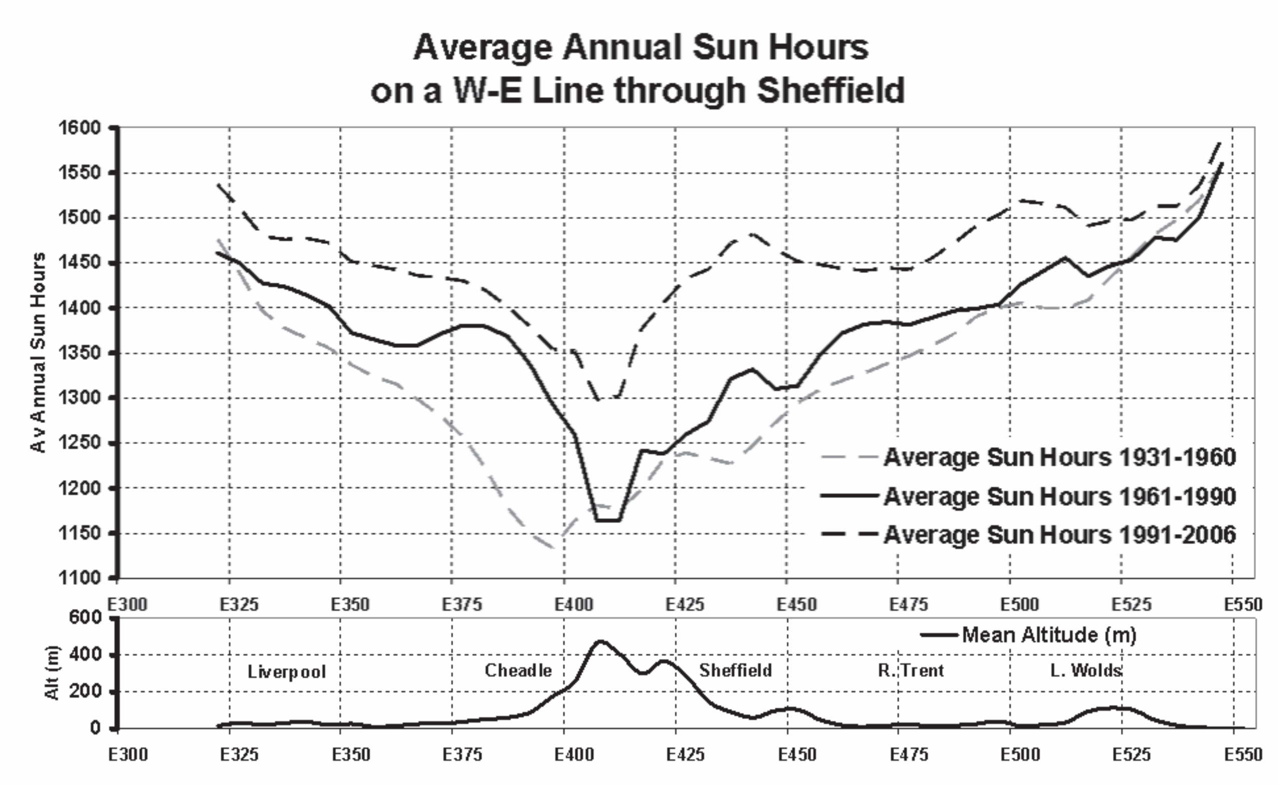

Figure 32 Annual Sunshine Hours on a West-East Line through Sheffield

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Perry, M and Hollis, D (2005). The generation of monthly gridded datasets for a range of climatic variables over the United Kingdom. **International Journal of Climatology, vol. 25** (2005), pages 1,041-1,054. Available as a PDF (590 kb) from *http://www.metoffice.gov.uk/climatechange/science/downloads/Monthly_gridded_datasets_UK.pdf*

Perry, M, Hollis, D and Elms, M (2009). **Met Office - National Climate Information Centre, Climate Memorandum No 24. The Generation of Daily Gridded Datasets of Temperature and Rainfall for the UK**. June 2009. Available as a PDF (2.27 mb) from *http://www.metoffice.gov.uk/climatechange/science/downloads/generation_of_daily_gridded_datasets.pdf*

Weather Events in and around Sheffield

INTRODUCTION

> "A few facts on this subject may serve for comparison in times hereafter, in the absence of more accurate meteorological observations. It is thought an unusually early harvest if the corn is brought home before the cutler's feast, which is held in the first week of September. About once in three years the river Don, above the town, is sufficiently frozen to admit for a day at least of the diversion of skaiting [sic], and sometimes for a longer period. Snow falls as late as the months of April and May, and even then in considerable quantities. It is not unusual to see it lying undissolved and universally diffused for the space of a fortnight or three weeks: and in remote parts of the parish, where they were sheltered from the beams of the sun, patches of the snow are sometimes to be found in the month of May, which had fallen in the November preceding." (Hunter (1819), p5)

Whatever we think of the weather, its extremes will always catch our attention. The following list of events shows how the weather has been the staple of diary entries and newspaper reports over several hundred years, as well as finding its way into historic records and even into parish registers. Though many are anecdotal, the events show how people in the past were more directly affected by the vagaries of the weather. Some quotes may be subject to poetic or journalistic licence and should by no means be taken as scientific observations.

Early references have been taken from a trawl of available literature aided by the facilities of Google Books (*books.google.com*) and the Internet Archive (*www.archive.org*) and a variety of other sources found through Google searches. These sources are listed in the References. Many of these events relate to the broader area loosely defined by the Sorby NHS recording area. In notes on early events, the original spelling and grammar have largely been left unchanged – amendments and notes have been shown in [ ].

More recent events are documented in the monthly and annual weather summaries produced by Museums Sheffield in connection with data collected at Weston Park Weather Station, or in local newspaper reports (primarily from The Star or Sheffield Telegraph). Other entries refer to the extremes extracted from the Weston Park data during the preparation of this paper (referenced as Weston Park in the text or as '(WP)') – all 'extremes' quoted are as they stood at the end of 2010 unless stated otherwise.

Part of the research took place during the refurbishment of Weston Park Museum and copies of many of the articles and associated photographs can be seen (at the time of writing) in the interactive display in the foyer of the museum. The research included access to the library at Sheffield Newspapers, which includes unpublished photographs as well as the library's cuttings files and bound copies of the papers themselves. Published material is also available on microfilm at the Sheffield Local Studies Library in Surrey Street.

Some weather related photographs are also available through 'Picture Sheffield' either at the Sheffield Local Studies Library or on the internet (*www.picturesheffield.com*). Where these are relevant to the listed events, the Picture Sheffield reference is given in the text.

Figure 1 Frozen fountain – Weston Park – 1911
(courtesy of Museums Sheffield)

WEATHER EVENTS

1536? **Flood**

"Harrison[1], who writes with the impression of the event fresh upon his memory, speaks of the sudden rising of the Don at the time of Aske's rebellion[2], which prevented the two armies from coming to an engagement, as if it were little less than something miraculous, as no rain had fallen in the neighbourhood of Doncaster. This flood evidently had its rise in this [the Sheaf] and the other tributary streams above Sheffield. The uncertain character of the Sheaf is even noticed in an instrument of as early date as the time of Edward I [1272-1307]. In the charter [?1280] by which Sir Ralph de Ecclesall gave his mill and other possessions to the monks of Beauchief, … it is stipulated on the part of the monks, that in case of high floods or snow they should be excused from sending a canon to Ecclesall, and allowed to celebrate the due masses in their own church at Beauchief." (Hunter (1819) p3)

1614-15[3] **The Great Snow, and a Dry Summer**

" This yeare, 1614-5, Jany 16, began ye greatest snow which ever fell upon the earth within man's memorye. It covered the earth fyve quarters deepe upon ye playne. And for heapes or driftes of snow, they were very deep; so that passyngers both horse and foot, passed over yates [?gates], hedges and walles. It fell at 10 severall tymes, and the last, to the greatest, to the greate admiration and feare of all the land; for it came from the fowre [four] parts of ye world, so that all countreyes were full, yea the South part as well as these mountaynes. It continued by daily encreasing untill the 12th day of March (without the sight of any earth, eyther uppon hilles or valleyes), uppon which daye (being ye Lorde's day), itt began to decreasse; and so by little and little consumed and wasted away, tyll ye 28th day of May, for then all the heapes or drifts of snow were consumed, except one uppon Kinder's Scowt, which laye till Witson-week or after.

…

1615. A dry Summer.

There was no rayne fell uppon the earth from the 25th day of March untill the 2nd day of May, and there then was but one shower; after which there fell none tyll the 18th day of June, and then there fell another; after that there fell none at all tyll the 4th day of August, after which tyme there was sufficient rayne uppon the earth; soe that the greattest part of this land, especially the South parts, was burn't upp, both corne and hay. An ordinary summer-load of hay was at 2li [£2] and little or none to be gott for money.

This part of ye Peake was very sore bnrn't upp, onely Lankishyre and Cheshyre had rayne ynough all Sumer; and both corne and hay sufficient. "

(Transcipt from Youlgreave Parish Register, Sleigh (1869))

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[1] Footnote in Hunter (1819) 'Vol. i. p. 166.' - possibly refers to Harrison (1577)

[2] The Pilgrimage of Grace in 1536 which ended with negotiations in Doncaster.

[3] Note that on the 'old' Julian Calendar used in the UK prior to 1752, the Civil or Legal new year started on March 25th. '1614-15' would therefore refer to the period between 1st January and the start of 1615.

1665 **Ice**

"Paid to labourers to wait [i.e. to watch] at the bridge [? Lady's Bridge or Sheaf Bridge] to break the ice. 3s 0d" (Sheffield Burgery Accounts, in Leader (1897), p183)

1666 **Flood**

"To John Hawksley for wood and workmanship about the bridge [? Lady's Bridge or Sheaf Bridge] broken by the flood. £1 2s 6d." (Sheffield Burgery Accounts, in Leader (1897), p185)

1683 **Flood**

"For cleanseing the Almeshouse after a great flood. 2s 6d" [Probably the almshouse shown next to Lady's Bridge in Gosling's 1736 map] (Sheffield Burgery Accounts, in Leader (1897), p223)

1684-85 **Ice**

"To [the] overseerers of the poore towards the relief of necessitous poore in the storms. £20" and "For hookes and breaking the ice above the bridge [? Lady's Bridge or Sheaf Bridge] att the break of the storm. 7s 6d" (Sheffield Burgery Accounts, in Leader (1897), p227)

This winter was mentioned in John Evelyn's diary (Evelyn (1665-1706) as one in which the Thames was frozen over.

1690-91 **Storm**

"For a powle [? pole] a hoope and pike for the Ladies bridg att the break of the storm. 1s 2d" (Sheffield Burgery Accounts, in Leader (1897), p251)

1703 **Storm**

"The church [the Parish Church, now the Cathedral] sustained some damage in the great storm of 1703" (Hunter (1819), p141) (Possible same event is mentioned in Thomas (1830/1857) (p33) but dated 1713.)

"In 1703, the chancel underwent complete and substantial repair, after injury sustained from a violent storm." (Gatty (1873) p 164)

The storm, on 26th November 1703, affected the whole country and was described by Daniel Defoe (Defoe (1704)). It is famous for wrecking Sir Cloudsley Shovel's ship on the Scilly Isles – an event which led to the development of marine chronometers to allow measurement of longitude.

1714-15, February 1st **High Winds**

[In diary entry for 1st February 1732-3] "A great wind, which continued most of the night. The same day, being Tuesday, 1714-15. was the great wind which did so much damage in the country; it blew down some yards of the stone-work of Wakefeild [sic] steeple, &c." (Hobson (1725-34))

1725-6, January 1st **Snow**

"The night before, and that day, there fell a great snow. The London post [coach] stop't two days; the Northern post one day; no passage over the moors to Woodhead. The minester, Mr Bayns, of Donfeild, lost in the snow nigh Grindle-firth bridge." – further entries show that the snow continued until 15th. (Hobson (1725-34)

– a footnote in the transcript adds that "Parson Baines was found dead on moors near Froggot Moss [sic]"

1726, December 13th **Frost, Snow, Wind**

"Tuesday, the 13th instant, was such an ill day for frost, snow, and wind, that severall people had like to have perished in coming over the moors from Woodhead, and some lost their lives in going from Sheffeild to Heithersedge." (Hobson (1725-34))

1729, June 10th **Thunderstorm, Flood**

"A violent thunderstorm occurred in June in Sheffield between 5-6a.m. and continued until 2p.m. Large trees were brought down and bridges broken away with flood waters. Water levels rose "four yards perpendicular in the space of six minutes". (Monthly Chronicle June 1729)[4]

"Much thunder and excessive rain. Part of the almshouses [? Talbot Hospital] taken down by the flood at Sheffield, and several poor people that lived in it drowned." (Hobson (1725-34))

1755, August 5th **Floods**

"The excessive rains raised the water to such a degree that three wooden bridges were forced down by the rapidity of the stream, and although it was market-day (Tuesday) few people could pass the river with safety.— Homfray's Jour." (Thomas (1830/1857) p46)

1762, June **Heat, Dryness and Moorland Fires**

"A moor at Solesberry [?Soulbury] in Buckinghamshire, another great one near Pately-bridge in Yorkshire, the high moors near Sheffield, and the moor or heath on Bloreme-hill [?Blorenge NGR SO260110] in Monmouthshire, are all on fire ; that on Bloreme-hill, near six feet deep, and those near Sheffield for thirty miles together in some places; owing, it is probable, considering in how many and distant places the fire broke out, not to malice or carelessness, but to the extraordinary disposition of the peat to kindle by inflammable exhalations, through the late excessive heat and dryness of the weather." (Burke (1787) p91)

1768, November 4th **Floods**

"Flood in the river Sheaf, which carried down the houses forming the North side of Talbot's hospital, and drowned five of the pensioners." (Thomas (1830/1857) p50).

1782, June 19th **Thunder**

"A very extraordinary thunder shower at Bakewell which did much damage" (Meeke (1996a))

1783, July **Thunder, Hot Summer**

"Remarkable loud thunder and strong flashes of sheet lightning, very hot summer and autumn, no frost till Christmas except some small ones." (Meeke (1996a))

1784 **Frost and Snow**

January-April – Frost and Snow
"April – Very cold weather for the season as any man can remember."

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[4] In Sheffield Local Studies Library 'Newspaper Cuttings Vol. 12'

Snow again in October.
“December – A great snow continued to the year end with an intense frost.” (Meeke (1996a))

“Very cold season, swallows coming into the house for warmth.” (Meeke (1996b))

1785, October 25th **Snow**
“A great snow in the evening.” (Meeke (1996a))

1789, July 17th **Thunderstorm**
“On the 17th about one o'clock, they had at Sheffield several tremendous claps of thunder, accompanied by vivid and repeated flashes of lightning, one of which had the awful and instantaneous effect of killing a man and horse on the moor near this town. The unfortunate man, whose name was Wadsworth, resided at Dronfield in the neighbourhood, and was come to Sheffield to purchase necessaries for the observance of the feast held there the following week.—The lightning entered his head, and proceeding downwards penetrated through the saddle, making a hole about the size of a bullet.” (Urban (1789) Vol 59, July edition, p665 – also mentioned in August edition, p754)

1791, June 12th **Snow**
“The beginning of the month the weather was very hot. 11th Very cold. 12th A heavy snow shower in the morning.” (Meeke (1996a))

1793, March 2nd **Storm**
“The last of these towers [at Sheffield Manor Lodge] fell in the great storm in the night of March the 2d [2nd] 1793.” (Hunter (1819), p191)

1793, April **Snow**
“First Bakewell Fair saw great snow, 15th another great snow, very severe frost.” (Meeke (1996b))

“York, April 8. On Monday last the neighbourhood of Sheffield experienced a more heavy fall of snow than was ever known in that country so late in the season. The roads were in Derbyshire impassable. The Manchester coach, containing seven passengers, was obliged to stop on the road all night, about five miles from Middleton. The coachman providentially returned back with his horses to Middleton, which, if he had not done, it is supposed he and the horses must inevitably have perished. A butcher driving cattle on the same road, and a person of Hallam, who were returning from Bakewell fair, we are informed, lost their lives the same night. Several cattle have suffered; and many other misfortunes, we fear, have been experienced in different parts of the country from so unexpected a storm.” (Anon (1793))

1797, August 17th **Floods**
“Violent storm, a.m. ‘The rivers Sheaf and Dun were swelled to an amazing height; the flood of the former was so sudden and impetuous, that of two men who were getting sand, one was instantaneously swept away, and the other was with difficulty saved.’—Sheffield Iris.” (Thomas (1830/1857) p85)

1798, May-June

"May and beginning of June remarkably dry and hot no rain for 6-7 weeks until June 19th when thunder showers". (Meeke (1996a))

1799, February 1st **Snow**

"A great snow greatest ever known and lasted to 20th" (Meeke (1996a))

1799, August 17th **Floods**

"Great storm over and about the town; 'The rivers Dun [sic] and Sheaf, as well as the brooks and streamlets, were swollen to an unusual height, overflowed their banks, inundated the houses adjoining, and did considerable damage to the hay and corn fields.' — Sheffield Iris" (Thomas (1830/1857) p89)

1800, August 25th-26th **Drought**

"Aug 25. Thermometer fell from 85[°F (29.4°C)] to 58[°F (14.4°C)].
Aug 26. The first rain fell after a drought of ten weeks." (Thomas (1830/1857) p92)

1801, September 4th /5th **Rain**

Extremely heavy rain so as to raise the rivers rapidly. The Don overflowed the banks below Rotherham and did considerable damage upon the levels. The fall of rain was not so heavy south of Sheffield. (Watson (1801))

1802, January 21st **Wind**

"On January 21st, 1802, the town was visited by a dreadful storm of wind, during which, the slates were torn from the roofs, and scattered through the streets with such violence that it was perilous to pass them. A stack of chimneys in St. James's street, fell through the roof of an adjoining house, and overwhelmed a bed from which four persons had just risen. A sheet of lead, about 2,000lbs. weight, was precipitated from the flat roof of the Tontine [Inn], into the yard, immediately after the Doncaster mail coach had set out, and upon the very spot where it had stood. Many chimney pipes were destroyed, casements blown out, signs carried off, and decayed buildings shaken to pieces. A child was crushed to death at Sheffield-moor, by a falling wall. Two trees by the river side, near the Nursery, were torn up by the roots, and laid across the road. In the Wicker, three high chimneys at Mr. Dixon's silver refinery were laid to the ground." (White (1837) pp54-55, probably quoting Thomas (1830/1857) p96)

1802, May 12th-14th **Hail/Snow**

"Storms of snow and hail during the last three days." (Thomas (1830/1857) p98)

1802, May 25th **Cold**

"The thermometer was at 29, three degrees below the freezing point [29°F -1.7°C]. 'The late colds must have done incredible harm to the fruit, since even the leaves of hardy trees are dropping off' — Iris." (Thomas (1830/1857) p98)

1802, May 28th **Hot**

"The thermometer (noon) was at 73[°F (22.8°C)]" (Thomas (1830/1857) p98) Compare to above entry for the 25th.

1803, July 20th **Thunder**

"After a fit of fine clear weather on the afternoon of the 19th, a deal of rain in Sheffield, and some thunder heard in Bakewell on the 20th." (Meeke (1996a))

1805, April 29th **Snow**

"This day fell one of the deepest snows of the past winter, and certainly the greatest that can be recollected, at this time of the year in this neighbourhood [sic]." (Thomas (1830/1857) p107)

1806, January **Floods**

"One of the highest floods probably ever remembered at the time, was that of the 16th of January, 1806; though that was more than equalled by the one of July, 1834. On both these occasions, the level space between the Bridgehouses and the Wicker, in the northern suburb of Sheffield, was completely laid under water; in the latter instance, the tops of the posts carrying the 'white rails' along the river side, being only just visible. In Rotherham, the lower parts of the town were, in like manner, flooded: and so unexpected and sudden was the inundation, that happening as it did during the night, many persons, who had retired to rest in small dwellings situate in low situations, were with difficulty aroused to a sense of their peril, and rescued from the water. Of course, a vast variety of matters came down with the torrent, including timber, hay, domestic animals, &c.: many of these were stranded in the low level fields, over which the waters lay like a sea, or were detained by various obstacles; while the salvage of others was effected under circumstances of "jetsom" and " flotsam," by individuals disposed to exert themselves in the labour." (Holland (1837) p18).

"18th – A great flood and another on the 20th." (Meeke (1996 a))

1807, April-May **Storms and Extreme change in Temperature**

"In the last week of April, 1807, occurred one of the greatest transitions from cold to heat that was ever recollected in England: within four and twenty hours the thermometer rose from the temperature of Christmas to that of Midsummer! During the first few days of the succeeding month, the oppressive heat of the weather was moderated by heavy storms of thunder and lightning … On Saturday evening, the 2nd of May, the day before having been characterized by thunder and lightning, accompanied by large bullets of icy hail, in various places—dark lowering clouds gathered over these hills with a most portentous aspect. At length, the rain, which at first fell heavily, descended in torrents such as had never been witnessed before, by any person living—a mass of clouds having, as it is termed, " burst," over the range of hills from Bradfield to Silkstone. The suddenly descending deluge tore up the ground on Green Moor, and the adjacent eminences, in a singular manner and to a great depth: the impetuosity of the torrent carrying the soil into the valleys in such quantities that it required a long time to cart it away. The rivers at Loxley, Rivelin, Midhope, and Penistone, pouring their accumulated waters into the Don, effected unprecedented desolation on its banks, not only carrying away great quantities of the arable soil, but trees, utensils of husbandry, cattle, &c. Unhappily, this was not the extent of the calamity ; in one house at Silkstone, a woman and her four children were seated together, when the flood came rushing in, and swelled to the height of the chamber so rapidly, that though the mother succeeded in getting three of her children up stairs, the fourth, a girl of seven years of age, perished. In an adjoining house, a woman and two of her grandchildren were also drowned: on some of the low grounds the water rose five yards in about five minutes! No wonder that a storm, the effects of which were so fatally terrible, and the traces of which are not yet obliterated on the hills, should be strongly remembered by many, who describe it emphatically as " the May flood." (Holland (1837) p80-83).

1808, July 13th **High Temperature**

"A very remarkable hot day; was supposed the hottest that had ever been here in England; many horses dead on the road, and many men were also killed by the excessive heat while working in the fields, and gooseberries were actually roasted on the trees." (Sparling (2005))

1809, September 8th **Floods**

"A cloud descended precipitately on Crookesmoor, from whence the water rolled down through the intervening fields and gardens, bearing away walls, and ploughing up the soil, until it reached Young-street, on Sheffield-moor, where, after inundating the ground floors and cellars of the houses, the flood spent itself over the road and adjoining land.—Sheffield Mercury" (Thomas (1830/1857) p122)

1809, September 19th **Hurricane**

"Early in the morning, the town and neighbourhood visited by a most tremendous hurricane, exceeding in violence any storm experienced at such a season. In its impetuous course, it tore trees from the roots, destroyed fruits and gardens, walls, windows, &c. — Sheffield Mercury." (Thomas (1830/1857) p122)

1810, 1811 **Frosts**

"The Peach and Nectarine blossoms upon the open walls, in other gardens in Mr. Wortley's [James Stuart Wortley, Esq. of Wortley Hall] neighbourhood, were almost entirely destroyed by the frosts last year and the year before [1811 and 1810]; but in both years Mr. Wortley was equally fortunate in the preservation of his produce." (Noehden (1812))

1810, July-September **Thunderstorms**

"Thunder storms appear to have prevailed extensively. That of the first of the seventh month did considerable damage at Sheffield." (Howard (1833) Vol 2, p111)

"August 31st 1810 there fell at Stone [near Maltby] an extraordinary shower of hail (or rather ice) and rain; accompanied by the most tremendious [sic] thunder and the most vivid flashes of lightening imaginable; the hailstones measured two and one half inches diameter. … This was followed by a very large flood, the largest that could be remembered." (Sparling (2005))

1811, May 12th **Waterspout**

"Waterspout on Oakover [?Okeover] side and moved across Darley Dale, did an amazing deal of damage." (Meeke (1996a))

1811, May 19th **Thunder, Hail**

"… a remarkable hailstorm in Denbighshire, April 23; at Melton, April 29; at Sheffield. May 19; at Birmingham, June 8; at Bury St. Edmund's, June 8." (Johnson and Shaw (1866) p57).

"May 19 - At Sheffield, there was a dreadful storm of thunder and lightning, accompanied with hail. The stones, which measured from one to five inches in circumference, were pieces of ice encrusted with frozen snow. The damage is beyond precedent. At Beauchief, a whirlwind tore up seven trees by the roots, broke several in the middle; many buildings were unroofed, and haystacks thrown down;

nearly all the water was carried out of Mr. Stead's mill-dam, and dispersed in the air." (Howard (1833) Vol 2, p137)

"In the afternoon, between five and six o'clock, this town and neighbourhood were visited by a tremendous storm of hail, accompanied with thunder and lightning - the streets were covered with hailstones three to five inches in circumference; fruit trees, hot-houses, &c., were destroyed; on the premises of 32 persons only, 10,710 panes of glass were destroyed. Sheffield Mercury " (From Sheffield Local Register (Thomas (1830/1857) p128) – quoted in Sheffield and Rotherham Independent, 8 July 1843, in discussion of 1843 Hailstorm.)

1812, March 21st **Snow**

"In consequence of the great inclemency of the weather, the mail due on the 21st March, from the north of Scotland, had not arrived at Edinburgh, nor the Glasgow at Carlisle. … Between Sheffield and Manchester, and Bradford and Halifax, the snow had drifted from two to three yards deep." (Howard (1833) Vol 2, p167)

1816 **Wet Summer**

"A very wet summer almost all the corn sprouted in the fields." (Sparling (2005))

1816 was known as 'the year with no summer'. Crops failed because of disruption to the weather caused by the ash cloud from the eruption of Tambora in Indonesia in 1815.

1820, January 1st **Frost**

"Anxious to behold the scenery of this romantic place [Matlock], when the trees and rocks, and every object in the dale, were covered with snow, I visited it on the first day of the year 1820. The frost, during the preceding night, had been uncommonly severe the thermometer, at nine o'clock in the morning [? in Sheffield], stood at 26 below freezing [6°F, -14°C]; a day of clearest sunshine, and a scene of beauty and splendour not often paralleled, succeeded. On my way to Matlock, I passed through Abbey Dale and Chatsworth Park the trees and hedges were covered with brilliant incrustations, their verdant clothing had disappeared, and a white foliage, light and elegant as the down on the cygnet's breast, lay on every stem and branch; and, when the rays of the sun glanced through the trees, they seemed hung with leaves of transparent crystal, which, in beauty and splendour rivalled the skill of the lapidary." (Rhodes (1824), p260)

1820 **Dry, Drought**

"The spring and summer very dry. Harvest got well, continued dry weather, water very scarce until the middle of December." (Sparling (2005))

1821 **Dry, Cold Spring and Summer, December Flood**

"The spring and summer dry but very cold until harvest when showry weather commenced and spoiled much corn; springs much lower than ever where known water very scarce until October; November & December very wet; Christmas Day, Barometer 27½ in. continued below 28 in. several days; same day a great flood." (Sparling (2005))

1822 **Mild Spring**

"January uncommonly fine and warm; … February & March very dry & warm… April a few cold windy days occurred but upon the whole the weather was fine; spring very forward, turnips in full flower … May produced as much hot weather as the whole of last summer with dreadful thunderstorms in some parts of the country and occasional showers which increased the forwarding of the spring. On the 31st [May] even late ash trees were in full leaf; the winter has passed over without the ground being once compleatly [sic] covered with snow; or any ice being frozen thicker than a penny piece. June very hot and dry." (Sparling (2005))

1823, December **Flood**

"December very wet particularly the latter end when we had a greater flood than ever had been since 1810; … much damage was done by the river Dun in which was more water than had been known for many years." (Sparling (2005))

"4th. Violent storm of wind; 'the streets of this place were plentifully spread with slates, chimney pipes, &c. which had been displaced by the violent winds.' " (Thomas (1830/1857) p174)

1824, October **Flood**

"October. The first end wet; a great quantity of rain fell from the 7th to the 12th. Much damage done on the Dun the water rose higher at Doncaster than had been known for 25 years before." (Sparling (2005))

1825, December 14th **Thunderstorm**

"A very severe thunder storm which did very material damage to Tickhill church, breaking the chimes and windows shaking the tower and other damage; the lightening was very white so as to dazzle peoples eyes and blind them for a short time; many sheep were lost by being frightened into the water ditches." (Sparling (2005))

1826, June **Cold nights, Hot days**

"Cold nights and scorching hot days … the middle of the month extremely hot the pastures all burnt up." (Sparling (2005))

1826,. July 1st **Hailstorm**

"A very heavy storm of hail at Mexboro' …hailstones measured 4 inches round." (Sparling (2005))

1826, July-August **Hot, Dry Summer. Thunderstorms. Moorland Fires**

"On the evening of Monday week last [?29 July 1826], … the atmosphere presented a most extraordinary appearance. As the sun was setting in the west, immense clouds burdened with electric fluid, arose in the east, and supernatural darkness appeared to anticipate the declining day. The peat and vegetable soil of which the Moors are composed having been prepared for ignition during the dry weather, by the most inconsiderable natural or artificial cause took fire, from the lightning at this time. The heath on the west side of the plantations belonging to James Rimington, Esq. first suffered from the destructive element; and on the following day it was discovered that the part of the Moor called Hobson Moss, [SK215944] had taken fire in different places, and was burning to the extreme depth of the soil. …. — Sheffield Independent. " (Taylor (1826))

"Burning Moors.—On Saturday afternoon [29 July 1826] it was discovered that the extensive moors in the vicinity of Sheffield had by some means taken fire. Such was the progress made by the fire in a few hours, that it was supposed upwards of six acres of the moors were burning on that evening. … on Monday night [31 July 1826] there must have been one thousand five hundred acres of land burnt and burning! That evening the scene was awfully grand—even terrific in its appearance. The thunder was heard in loud and continued peals, the lightning was seen in vivid and repeated flashes, darting across the firmament; the rain descended in torrents, and the ground for miles was in flame! …. The inhabitants of the houses in the neighbourhood are in great alarm for the result of this singular phenomenon, and are using every means likely to check its ravages.—Leeds Intelligencer. P. L. Aug. 2." (Howard (1833) Vol 3, pp227-228)

1827, October 10th **Flood**

"During the night of Wednesday, [10th,] an immense quantity of rain fell in this neighbourhood; the rivers Don and Sheaf were swollen almost beyond precedent. Considerable damage must have been occasioned along the banks of these rivers by such an unexpected flood.—Sheffield Independent, Oct. 16." (Howard (1833) Vol 3 , p261)

1828, July **Hot Weather, Rain and Thunderstorms, Floods**

"Sheffield.— 'In our last publication we alluded to the long continuance of hot weather which had been experienced in this neighbourhood. On Tuesday [15 July 1828], however, a change took place, and on Wednesday [16 July] the rain fell more heavily and incessantly than it is remembered to have done at the same season for several summers past. Indeed, not only were our two rivers remarkably high, but the springs of many wells, which had failed at the usual time, experienced a temporary refluviation.' — Sheffield Iris, July 17." (Howard (1833) Vol 3, p290)

"Doncaster, July 19. I have within a few days been over a considerable tract of land in this and the adjoining county, for the purpose of ascertaining the effects of the late floods on the crops. A great portion of the country through which the Derwent runs, as well as the other rivers which empty themselves into the Humber, has been overflowed to a very considerable depth, and the consequence has been, the complete destruction of the greater part of the grass, which was cut, and those crops which were not cut, will not be worth the trouble. … Manchester Mercury.—P. L. July 20.

Although within the last few days several thunder storms have fallen in this immediate neighbourhood, we have not heard of any serious injury to life or property. On Wednesday week [9th?] at Great Houghton, during a thunder storm, the lightning descended through the sky-light, which it destroyed, in the roof of Mr. Brook's house, and through the ceiling, into an upper apartment, and shook down the tester of the bed on which Mrs. Brook was reposing, without however inflicting any injury, further than the alarm into which she would naturally be thrown. Its course was then along a passage, in which there was a cupboard, whose contents of glass and earthenware were partly demolished, and the door of the cupboard dashed along the passage, at the extremity of which was a young female, who happily escaped unhurt. —Doncaster Gazette. P. L. July 21.

Newark, July 21.—You cannot possibly have an idea of the effects of the late stormy weather, and the consequent inundation of the large tract of country, unless you were to see it. All the country from this place, situated on the banks of the Trent, down to the Humber, has been completely overflown, and has borne the appearance of one expansive sea."

(Howard (1833) Vol 3, p290-1)

"The first week [of July] hot and dry high land both of grass and corn suffered severly [sic] from drought but the second week was very rainy; on the 9th we had a fresh [increased flow, e.g. of a spring] and on the 13th and 15th two very great floods by which much injury was done on the low lands much hay injured and swam away." (Sparling (2005))

1829, October **Early Snow**

"The weather since Tuesday night has been exceedingly cold. Yesterday there was snow on the ground in some parts of this neighbourhood, and ice was observed of a thickness which indicated, during the previous night, a degree of cold unusual for this period of the year.—Sheffield Courant." (Howard (1833) Vol3 p336)

1830, January 22nd/23rd & February 15th **Thaw after frost**

"Jan 22. Commencement of a thaw, after five weeks hard frost.
Jan 23. Return of the 'storm' and frost.
Feb 15. Breaking up of the frost, after a storm of upwards of two months duration. " (Thomas (1830/1857) p214)

1830, April 3rd **Change of Temperature**

"The most extraordinary changes in the weather, as experienced in this town, have lately taken place; the first two days of the present week were positively sultry, the glass standing at 80[°F (26.7°C)]; on Tuesday night a slight frost was observed, and at the present time the fields again present the white garb of winter."— Sheffield Independent. (Quoted in Thomas (1830/1857) p217)

1830, May 6th **Lightning**

"Storm over the town, (5 o'clock p.m.) with loud bursts of thunder; a house in Allen-lane, another in Church-street, and several others, struck by the lightning." (Thomas (1830/1857) p219)

1834, June-July **Floods**

"June 26th an extraordinary great flood in the Don; much damage by hails at Glossop on the 30th and at Wath on the same day, hardly a window was unbroken; an early harvest followed for after the rain at the latter end of July the corn ripened so rapidly that it was with difficulty cut fast enough - even beans were ripe on the middle of August - dry weather continued to the middle of November - water was very scarce." (Sparling (2005))

"… near the latter end of July, 1834, when he happened to walk up here [near Dunford Bridge], a heavy fall of rain had so swelled the river that its channel became too contracted for the quantity of water sent down from the moors : the consequence was such an overflowing of the banks hereabouts, as well as lower down, that many score roods of stone walling were destroyed; while from several fields on the line of the torrent, the crops and soil were washed away together." (Holland (1837) p53 – also mentioned on p18, see notes on 1806).

"In this valley [the Upper Don], mischiefs from freshes in the river are quite as sudden and considerable as in the vale beyond: a striking instance of this kind occurred in 1834. It was a fine autumnal afternoon — there had been no rain or, at all events, none of consequence, when the passengers by the Manchester coach to Sheffield, dismounted a few minutes at the well-known inn, at Woodhead, on the western side of the 'Appenines' after a few moments the bonny landlady ran in exclaiming, that such a flood as she never saw was coming down : and sure enough it was coming, bearing down before it both crops and soil! On the coach gaining 'the heights', it was found that a cloud had burst, the distribution of its waters westward, being the torrent just mentioned, while the deluge eastward was rolling down the vales of Midhope and Penistone ; just above Oughtibridge the coach passed the leading swell of the flood, which resembled the elevated tide wave called Eagre [a tidal bore]; its height above the subjacent current of the Don appearing to be scarcely less than about four feet!" (Holland (1837) p91-92).

"July 19. The lower part of the town inundated, and much damage done, owing to the excessive rain." (Thomas (1830/1857) p269)

1835, June 11th **Lightning**

"During a dreadful thunder storm, on June 11th, the spire of the parish church was perforated by the electric fluid, and several other buildings were injured." (White (1837) p66 – quoting from Thomas (1830/1857) p276)

1835, December 7th **Fog**

"… the writer of this notice walked from Midhope to Penistone, on the morning of the seventh of December, 1835, which, it may be remembered, was remarkable for the densest fog which had occurred during the season." (Holland (1837) p63).

1836, November 29th **Wind**

"A hurricane of wind did immense injury south of Sheffield, but was not violent here." (Thomas (1830/1857) p288)

1836/1837, December 24th - Jan 4th **Snow Storm**

"1836 Dec 24. Commencement of a snow-storm. The snow was so heavy and drifted so much, that most of the roads were choked up, and the coaches for several days were unable to travel.
1837 Jan 4. The severest snow-storm known for many years, which commenced on the 24th December, began to break up." (Thomas ((1830/1857) pp288-9)

1838, January 15th - March 2nd **Frost**

"Jan 15. The thermometer 36 degrees below freezing point. [-4°F (-20°C)]
Jan 20. The thermometer 37 degrees below freezing point. [-5°F (-20.5°C)]
Mar 2. Breaking up of a storm that commenced the second week in January. This day, the opening of the canal by breaking the ice, was completed, having employed 20 men and 22 horses four days. The canal had been frozen up for seven weeks." (Thomas (1830/1857) pp305&307)

1838, July 4th **Thunderstorm, Rain, Hail**

"On the 4th of July, 1838, the glass on the stoves and greenhouses [at Stainborough], with the plants and fruits, was almost entirely destroyed by an awful thunderstorm, which spread the greatest devastation in this neighbourhood. The skylights in the Hall shared a similar fate, and the hail and rain came down in such quantities, that the interior was literally deluged ; the water which accumulated on the roof, rushed down the staircases with the noise and rapidity of a torrent, bearing even articles of furniture on its course. The amount of damage was considerable. A sacrifice of human life occurred on that eventful day at the Moor-End Colliery [5],

[5] Huskar Pit (Thomas (1830/1857) p311)

situated between Stainborough and Silkstone, by a sudden irruption of water into the workings of that colliery, twenty-six human beings, colliers, eleven of whom were young females, being suddenly launched into eternity." (Twigg (1853) pp49-50)

1838, August 28th **Thunderstorm**

"A terrific thunder storm, of very great duration, which extended over almost the whole of England, and did much damage. Cusworth Hall struck by lightning." (Thomas (1830/1857) p313)

1839, January 7th **Wind**

"The morning of the 7th of January was characterised by a violent storm of wind, which did immense damage in various parts of the kingdom. Among the mischiefs done in the neighbourhood of Sheffield, a portion of the spire of one of the churches, and the handsome cruciform termination of the 'Cholera Monument' … were blown down." (Holland & Everett (1856) Ch. 89, p350)

"During the dreadful hurricane … the mischief that was sustained in the town and neighbourhood was greater than on any former occasion. The Church of St. John, lately erected on Park-hill, was, on the morning alluded to, the only one which appeared above the surface of the fog. During the hurricane, about five yards of the spire fell upon the roof, which it broke through, and greatly damaged the interior of the church. The upper part of the elegant Cholera Monument, … though consisting of single stones of several tons weight—was, with the massive stone cross, blown off, greatly damaging the lower part." (Roberts (1839), pp367-8)

"Dreadful hurricane, commenced during Sunday night [6th], and continued during Monday. … At Sheffield, part of the Cholera Monument was blown down, and various buildings were damaged, but no lives lost " (Thomas (1830/1857))

1839, July 31st **Flood**

"Great flood, nearly equal to that of the 19th July, 1834. The wooden centres used in the erection of the North Midland Railway, over the Dun, carried down against the wooden bridge of the Sheffield and Rotherham Railway with great force, but the shock was received without injury." (Thomas (1830/1857) p326)

1843, July 5th **Hailstorm**

"On Wednesday evening [5th July 1843], a thunder storm, attended by a hurricane of wind and a terrific shower of hail, passed over the town, doing almost incalculable damage. Tuesday and Wednesday had been oppressively hot, and during Wednesday afternoon thunder was heard at intervals, and dense clouds floated through the atmosphere. … The storm commenced with rain, which was quickly followed by a most impetuous wind, driving before it vollies of bullets, of hard clarified ice, the size of small marbles. …Happily the hail had passed over in little more than five minutes, but in that short period a deluge of water was pouring down our streets, and an immense destruction of glass was effected, probably greater than was ever known in Sheffield. … The Botanical Gardens … number [of panes of glass broken] is computed to be 5700, and the damage is estimated at £100 or more. We fear that the plants in the conservatories must have suffered as well as the glass." (Sheffield and Rotherham Independent, 8 July 1843)

"The Late Hail Storm … on the 5th July, the day was very sultry, and the wind veered much about. … Though the width of the rain might be from 10 to 15 miles, that of the great force of the hailstones seemed to have been confined to 200 or 300 yards, with occasional divergencies as though particular localities had been selected for attack. … the thermometer had ranged from 80 [°F] at noon to 64 [°F] in the evening. … Eckington and places further east suffered considerably. Rotherham escaped, but Darfield, Selby, and Ripon (missing Leeds) suffered much. The line of the storm seems to have been from the Severn across the island, leaving its last mark at Scarborough and Newcastle." (Sheffield and Rotherham Independent, 22 July 1843)

"July 5th. Great hail storm in Sheffield, much damage done to windows." (Battersby (2010))

1843, August 9th **Thunderstorm**

"On Wednesday [9th August] evening, about eight o'clock, a violent thunder storm from the south-west passed over the town. The rain fell in torrents, and the Chesterfield road was completely deluged with water, the drains not being sufficiently large to carry off the flood which accumulated from the neighbouring hills. … At Ecclesfield, the lightening [sic] descended the parlour chimney of the house occupied by Mr. Jackson, tailor. The plaster was knocked off the walls and some fustians on a shelf in the same room were considerably scorched. The electric fluid then appears to have ascended the staircase, and entered a bed-room, setting fire to a quantity of draperies in a corner of the room near the bed. The flames caught the latter, destroying part of the bedstead and most of the bed-clothing. …" (Sheffield and Rotherham Independent, 12th August 1843)

1843, October **Cold, Snow, Ice**

"The weather since this day week has been of the most extraordinary kind we remember to have witnessed so early in the season. The thermometer has been several degrees below the freezing point, for several successive nights; and during the night of Monday, and the following day, there was a considerable fall of snow and sleet. On the highest hills near the, town, the snow was two or three inches deep, and the storm was accompanied by a piercing cold wind from the north-east. The appearance of the trees was most singular. The heavy weight of snow on their leaves, in many places was more than the branches could support, and some of great strength and thickness were broken off, and others bent to the ground. Potatoes, and other tender-stalked vegetables, have been laid prostrate on the earth; turnip tops, also, have ceased to rear their heads, and we are apprehensive that a much longer continuance of the frost will do considerable damage to their roots. At Norton, on Thursday morning, the ice was more than an inch in thickness." (Sheffield and Rotherham Independent, 21st October 1843)

1844 **Dry**

"March rather wet until the middle of the month after that dry and cold.
April a very dry month not a shower sufficient to slack the dust fell during the whole of the month.
May came in very dry, pastures and spring corn suffering much from the want of rain, even wheat is suffering on dry lands, dry weather with very cold N. and N.E. winds continued to the end of the month …
The summer and autumn continued dry throughout … we have experienced a greater and a longer scarcity of water than for many years; a few days rain in the

beginning of Nov. set us at liberty for a week or so but it was afterwards scarcer than ever; and so continued to the end of the year." (Sparling (2005))

1845, July 4th **Thunderstorm**

"Dreadful Thunder storm in Sheffield much damage done to a small house in Colliers Row, Park. Much rain fell and the streets in the Park was completely flooded, one poor woman, who had some fowls in Duke street, the fowls got in the middle of the street when the rain fell so fast the water in the channels met in the middle of the street. The woman ran out to catch the fowls she fell down & was carried about one hundred yards to the bottom of the street. Had not assistance come quickly, would have been actually drowned. The electric flood also fell at Derby, but none were killed, some had their eyebrows scorched, others were struck nearly blind and a few lost the use of their limbs." (Battersby (2010))

1845, July 6th **Thunderstorm, Hail**

"Dreadful thunderstorm in Sheffield, Nottingham, Birmingham, Wolverhampton, Worcester and other intermediate places, which has ever occurred in the recollection of the oldest man living (nothing like it has happened since the memorable night preceding the death of George the 4th [25 June 1830]). At Frampton & Sydling St. Nicholas, in the county of Dorset, lumps of ice about an inch in diameter, many of a much large size, one was measured nearly 2 inches." (Battersby (2010))

1846, April 6th & 7th. **Floods**

"Great floods on the Rivers Don, Sheaf, Rother & Trent. Lands overflowed, the water was much higher than as remembered by the oldest person. 30 persons drowned near Gainsborough Bridge." (Battersby (2010))

1849, September 26th **Floods**

"(Sunday) Great floods in Sheffield, Rotherham &, Doncaster. Land overflowed with water to great extent, a footbridge at the bottom of Harmer lane, and a wooden cartbridge across the Don from the Wicker to Blonk Island for the erection of the next Station (MS&L) [Victoria Station] was taken down by the flood. Philadelphia works weir was partly destroyed. Blonk bridge was so gutted with water the arches was unseen and many thought it would not stand. Considerable damage was done to the Manchester water dams at Woodhead in their erection, it burst through the new weir and then burst the embankment so sudden a flush of water did considerable damage to the mills below. The damage to one firm was estimated at £1000 and to the water works at £500." (Battersby (2010))

1850, February 5th & 6th. **Wind**

"Dreadfull storm of wind, much damage done, a child named Bertha Spurr 2½ years old in Morpeth Street was killed by the falling of a chimney when in bed with its mother, who had a very narrow escape. A wall belonging to the Wicker tilt was blown down and did much damage. Nothing like it has occurred since the 6th of October[6] 1839, when part of the Cholera monument was blown down." (Battersby (2010))

"Wednesday Feb. 6th. An exceedingly high wind; much damage to chimney, roofs &c. the top of the spire of Donc[aster] new church blown off & fell through the roof;

[6] Other sources give this date as 6th January 1839.

the top of Balby wind-mill including the sails and axletree, break-wheel, fan-tail and roof of mill all blown off and fell on a house just by where several parties were in bed, but no one hurt; blew three large wheat stacks over at South Wongs [north of Oldcotes]; and a hovel or shed with stack at Capt. Duncombe's (late Mr. Fisher's farm) and killed three beasts." (Sparling (2005))

1852, February 5th Flood

"A tremendous flood on the river Holme caused by the bursting of the Bilberry reservoir [SE102070], situated 3 miles above Holmfirth, many cloth mills and many rows of cottage houses washed away, about 80 persons perished in the flood, much damage was done to Holmbridge Church the pews were floated, and in some places coffins washed up, Holmfirth Church was also flooded, the damage done is estimated in some newspapers to be about £600,000, it was one o'clock in the morning." (Battersby (2010))

"Very little rain except for a week or fortnight in the early part of February when a reservoir at Holmefirth burst and destroyed an immense amount of property and about 80 lives." (Sparling (2005))

1852, November-December Floods

"… dry weather for the most part continued until the latter end of October here when it set in rainy; a considerable quantity of snow fell in the beginning of Nov. and that month was very rainy throughout; great damage was done by the floods particularly in the Trent, in the Don and below Doncaster … Before this time there had not been a rainy season here for more than four years … in some places as much as 6 inches of rain fell in Dec." (Sparling (2005))

1852, December 27th Gales

"Dreadful gales of wind much damage done." (Battersby (2010))

1853, May Snow

"May 9th Monday. A Snow Storm of extraordinary intensity, it Snew [sic] incessantly from 6 o'clock in the morning till 9 at night with very little variation, the large flakes fell with a degree of intensity rarely surpassed, an average depth of about 2 feet of snow fell. Railway trains on the Manchester, Sheffield & Lincolnshire and the Huddersfield lines were stopped on their way.

May 13th. Hope Fair. Much snow remaining on the hills of the High Peak Derbyshire, many sheep lost, much damage done to the hedges and walls by the snowdrifts. " (Battersby (2010))

"Fall of snow for about 15 hours, unequalled since May, 1817. In July, the Bradfield Game Association resolved to defer the opening of the moors from 12th August till the 21st September, in consequence of many broods of young birds having been destroyed in the snow storm of 9th May." (Thomas (1830/1857) p512)

1854, January Snow, Rain, Floods

"First week frosty on the 3rd & 4th. Thermometer at 16º [°F (-8.9°C)] in the morning in some places much lower; on the 5th fell a great deal of snow; railways blocked up for 2 or 3 days; rain in considerable quantity fell on the 7th (at Donc[aster]) but a slight frost in the evening prevented a flood; however a subsequent fall of snow and rain caused a flood shortly afterwards; very high winds towards the end, much damage to the shipping on the east coast." (Sparling (2005))

"Jan 4. After intense cold, heavy fall of snow which blocked up the railways for some days, and greatly embarrassed the trade of the country. In the town, the omnibuses ceased to run and the cabs were worked with pairs of horses. Coals very scarce and dear. Many street lamps out in consequence of the frost.
Jan 18. Rapid melting of the snow and breaking up of ice—the valleys flooded—great flood at Rotherham—greatest flood known at Doncaster for 60 years." (Thomas (1830/1857) p521)

1855, January-February **Cold**

"The new year came in with a remarkably strong wind which blew Mr. Unwin's chimney down; mild weather with winds and showers occasionally continued till the 17th when a little snow had fallen in the night; fine season for late sown wheat; frost & snow continued until Feb 25th; during that time a great deal of snow fell at various times; in some part of the period the frost was very severe; the lowest point of the thermometer here was 12°[°F] but in some places it was down as low as 7°[°F] and even to zero. At Balby at -3°[°F (-19.4°C)]." (Sparling (2005))

"Feb 24. Breaking up of the frost, which had lasted 41 days,—the longest frost since that of 1814, which exceeded it by two days. The distress caused by its long duration produced bread riots in London, Liverpool, &c." (Thomas (1830/1857) p534)

1856, August **Floods**

"2nd. Nearly two inches of rain fell within a few hours, causing very extensive and disastrous floods. At Middlewood, the water was 18 or 20 inches higher than in the great flood of 1834.
7th. Thunderstorm of extraordinary violence and duration." (Thomas (1830/1857) p551)

"9th. Great Floods in Sheffield and Rotherham much damage done." (Battersby (2010))

1857 **A Very Mild Year**

A very mild year with a mean annual temperature of 10.5°C (50.9°F). Little frost or snow during the winter months. (Daniel Doncaster, Broomhall Park)

"[I]n the first week [of August] fell an enormous quantity of rain; the Trent overflowed its banks to a great extent; much corn land about Newark was covered several feet deep, some of it for several days; much damage was done about Retford too by the flood, … this was the case throughout a great breadth of country extending from south of Newark to a little North of Doncaster; the neighbourhood of Tickhill and Styrrup suffered much; the potatoes were afterwards found to be very much injured in some places they were nearly all rotten, even on the high land about Tickhill and Oldcoates fully two thirds were decayed." (Sparling (2005))

1858, June **Hailstorm**

"In the beginning of June there fell a severe hailstorm some of the hailstones measure ¾ inch in length flat in shape but the outline very rugged and uneven;

many windows broken at the Botanical Gardens but it did not extend even into the town where but a slight shower of rain fell." (Sparling (2005))

1860, Christmas **Frost**

"From this [table] it will be seen that the frost of [Christmas] 1860 was general throughout the country—-temperatures below zero being recorded at 78 stations, and even -10 [°F (-23°C]] being quite frequent, registered at 14 stations, and these in all parts of the country, except in the South and South-West." (The temperature shown for Sheffield was 4.0 °F (-15.5°C)) (Quoted in discussion of frosts in January 1867 when the temperature quoted for Sheffield was 15.5 °F (-9°C). (Symons (1867) Vol 1 Issue 12, January 1867, p105)

"Severe frost occurred on the night of 24th the Therm[ometer] down to 6°[°F (-14°C)] on the morning of Christmas Day skating on the dams. Decr. 25. Thermometer at 8º below zero [-8°F (-22°C)] at Balby; at 4° below [-4°F (-20°C)] at Tickhill." (Sparling (2005)) Note that these entries could refer to below freezing rather than below zero, therefore the Celsius conversions are speculative!

1864, March 11th & 12th **The Great Sheffield Flood**

"The Great Flood caused by the bursting of the Dale Dyke Reservoir of the Water Co. at Bradfield, the embankment gave way at 25 minutes to 12 midnight of the 11th. 240 persons were drowned, very great destruction of Cattle and property of every description." (Battersby (2010))

The 11th had been particularly stormy, rain had filled the new reservoir and there were strong winds, but the main cause of the flood was weakness in the wall of the dam.

1864, August 29th **Drought**

"Water supplied to the town on alternate days, on account of the drought - very dry summer - the price of milk raised." (Battersby (2010))

1867, January 12th **Frosts**

In a discussion of frosts in January 1867 the temperature quoted for Sheffield was 15.5 °F (-9°C). (Symons (1867) Vol 1 Issue 12, January 1867, p105)

1869, April **Thunderstorm**

"Sheffield.—A very sharp thunderstorm hovered over this town on Wednesday, 14th inst., between 6 and 8 p.m. ; the lightning was mostly forked, and of a pale pink colour ; the rain was not so heavy here as in South-West Lancashire." (Symons (1869) Vol 4 Issue 39, April 1869, p48)

"Sheffield.— [On the 14th April] lightning struck the spire of Stannington Church, partially knocked it down, and dislodged some large stones, which fell upon the roof and inflicted considerable damage. No one was hurt. —A couple of semi-detached houses, occupied by Mr. Ellison and Mr. Dearden, at Ranmoor, Yorkshire, were struck by lightning. The electric fluid seems to have passed down the bell-rope, which was either molten or snapped asunder. Mr. Ellison was standing close by the door watching the storm at the time, and near him was a metal fall pipe. Whether he touched it or not is not certain, but about the same time that the lightning passed down the bell rope, Mr. Ellison received a severe shock upon his arm nearest the pipe. Immediately afterwards he felt this arm beginning to swell rapidly, and prompt restorative measures had to be taken. He is still suffering from the injury. Mr. Dearden's servant man was still more severely hurt, and was for some time unconscious after the shock.

…

Holmfirth.—A cow, belonging to Isaac Sykes, farmer, was struck by a flash of lightning, and died almost instantaneously. A girl, who had been milking the cow, was also struck by the electric fluid. She was deprived of the power of speech, and still remains dumb." (Symons (1869) Vol 4 Issue 40, May 1869, pp49-52)

1868 **Drought**

"No rain – scarcely a shower – from the middle of May till August 11th… the pastures have been burnt up … the moors have been burning in many parts and the peat is still on fire in places ([August] 15th). … Old people are comparing this drought with that of 1826, when bread was used for Cawthorne Feast (the third Sunday in July) made from flour of that year's wheat." (Pratt (1882) pp167-8)

1870 **Drought**

"A very dry spring: a long drought about July." (Pratt (1882) p 168)

1872 **Thunderstorms**

"The summer [of 1872] was characterised by terrific thunderstorms: there was a waterspout over Silkstone." (Pratt (1882) p169)

1874 **Dry Summer, Severe Winter**

"Very little rain for several months after Easter. … The winter of 1874-5 was the severest known for many years." (Pratt (1882) p169)

1876-8 **Dull and Mild**

"The autumn and winter of last year [1876] and the spring of this have been remarkable for rain and the dullness of the weather. … The winter of 1877-8, after a wet season, was very mild – no skating – scarcely frost or snow." (Pratt (1882) p169)

1878-1879 **Severe Winters**

Two successive severe winters (1878-9 and 1889-90). In December and January of the first winter, temperatures fell below 0°C (32°F) on 54 occasions and there were 35 snow lying days.[7]

"Winter very severe: from November 9 [1878], when the first great snow-storm came, to nearly the end of February [1879], scarcely anything but snow and frost: skating for months together on the Park 'Cascades' [at Cannon Hall]. … Skating towards the end of November [1879] and beginning of December, again just before Christmas. Terrific gales, in one of which the Tay Bridge was destroyed … December 28th." (Pratt (1882) p170)

Buxton recorded a temperature of -18.3°C (-1°F) on the 6th December 1879, and Hodsock Priory recorded -21°C (-5.8°F) on the 7th. (Webb and Meaden (2000))

[7] See notes relating to W.F.Cooper in 'Sheffield's past weather observers'

1886, May **Floods**

Rainfall at Weston Park on the 12th and 13th May totalled 105.9mm (4.2"). The Don, Rother and Dearne valleys were all flooded.

1887 **Driest Year**

1887 shows the lowest annual rainfall in the Weston Park record (488.5 mm), far lower than in any subsequent year (1975 in next lowest at 559.3 mm).

"The weather of 1887 differed considerably from the normal, being on the whole dry, with a greater range of temperature than normal … there was rain on 153 days and the total rainfall for the year was 19.254 inches, this being 10.177 inches less than the average for the previous 5 years. the driest month was June with February and July also v dry (less than an inch in each)." (Howarth (1890)

1889, June-July **Drought**

Drought 10th June-8th July. No rain for 29 days. (WP)

1890-91, Winter (December-February) **Cold**

In 1929, 1890-91 was noted as the coldest winter to date at Greenwich Observatory where the mean winter temperature was 34.1°F (1.2°C) (The Observer, 3 March 1929). In the Weston Park records this would only be 'beaten' in 1962-3 (0.2°C, 32.4°F).

1893, Christmas Day **Thunderstorm**

A thunderstorm occurred on Christmas Day, being the only time this has been recorded in South Yorkshire. (WP)

1895 **Severe Winter**

A very severe winter at the start of the year (Figure 2). In February the mean temperature was -1.6°C (29.6°F). On 8 consecutive days the temperature remained below freezing. February 8th was the coldest night on record at –14.6°C (5.8°F). There were a total of 16 weeks of frost (WP).

Grenoside quarrymen made large snow houses near the quarries, where dances were held and refreshments served, the proceeds being distributed among the starving quarrymen and their families (Figure 3).

1905, March **Rain**

"Copious Rainfall and more Sunshine" (Headline, Sheffield Daily Telegraph) This followed a shortage of rain through the winter months.

Figure 2 Water carts in the streets of Sheffield 10th February, 1895 (courtesy of Sheffield Newspapers)

Figure 3 Snow houses at Skew Hill, Grenoside, 1895 (© Mrs M. Russell)

1906, August-September **Heatwave**

3 consecutive days 31st August to 2nd September with temperatures over 30°C at Weston Park, reaching 32.9°C (91.2°F) on the 2nd – its highest September temperature.

Bawtry (Hesley Hall)[8] recorded the highest September temperature (35.6°C, 96°F on the 2nd)) at any station reporting to the Met Office (up to 2000). (Webb and Meaden (2000)).

1908, April 22nd **Snow**

Snow fell in Sheffield and across most of the country.

1910, January 27th **Frost**

The grass minimum temperature was measured on the 27th at 4.7°F (-15.1°C) (see 1962 for extreme). The winter of 1909-10 had the highest number of days of ground frost (167 days with grass min <0°C) in the Weston Park records. June 1910 was the only month of that year in which there was no ground frost.

Figure 4 Drought at Redmires, September 1911 (courtesy of Sheffield Newspapers)

1911, July-September **Extremely Hot Summer**

From July to September there were 20 days with temperatures over 80°F (26.7°C). August 9th was the 2nd hottest day on record at 33.5°C (92.3°F). July was the 2nd sunniest month on record with 286 hours of bright sunshine (topped by 291hrs in 2006). (WP)

[8] The Bawtry weather station closed in 1983.

The low water level at Redmires exposed the ruins of an old blacksmith's shop and the old Mile Stone - the photograph taken in September 1911 includes the comment "not seen so low for 36 years" (Figure 4).

1912, July **Rain**

At the time, 1912 had the wettest July at Weston Park since records began (131.6mm, 5.18 inches). Other records show 6.25 inches (158.7mm) at Redmires and 6.96 inches (176.8mm) at Fulwood, while High Hazels recorded only 4.7 inches (119.4mm). (WP)

1918 **Bad Winter, Snow, Wet**

A bad winter with 18 inches (46cm) lying snow on February 4th. Also a very long wet period of 34 days from 7th September-10th October with rain every day. (WP)

1922, August **Floods**

The Bank Holiday weekend was "washed out" by a torrential downpour (starting on Friday 4th and continuing on the 6th, 7th and 8th). Walls were washed down, cellars flooded, and streets rendered impassable. Tram lines at Upwell Street, under the new bridge, were covered with water two to three feet deep. (The Star, Monday Evening, August 7th, 1922)

A 'Picture Sheffield' photograph (S10961) shows flooding at the Weedon Street / Meadowhall Road junction by Jessops Works.

Weston Park recorded 133mm (>5") over these 5 days, and 197.7mm (7.86")) in the month. A marginal note records that about 1" (25mm) fell in period on 30 minutes on the 4th, 6th and 7th, and that 8.5" (216mm) fell in the month at Stumperlow Hall[9].

Figure 5 Lightning captured in July 1923 (unknown date) (courtesy of Museums Sheffield)

1923, July 12th **Heat and Humidity**

Terrible heat and humidity on the 12th July with many people collapsing, followed by a very heavy downpour and a violent thunderstorm that passed to the east of

[9] These records would be those kept by James Dixon (1851-1947) F.R. Met.S., of Stumperlowe, Fulwood, who kept records of rainfall and temperatures, and made accompanying notes about the weather over 67 years between 1869 and 1936 (see 'Sheffield's Past Weather Observers')

Sheffield on the night of 12th/13th July (Figure 5). 64.8mm (2.55inches) of rain fell at High Hazels Park and lorries were brought in to remove the deep mud that had been washed onto roads. Several houses were struck by lightning. (WP)

1924-5 **Lack of Frost**

There was no air frost (Min Temp <0°C) between April 15th 1924 and 22nd January 1925. (WP & Noted in Sheffield Daily Telegraph, February 2nd, 1925)

1927, November **Record Temperature**

The highest November temperature recorded at Weston Park at 18.9°C.

1928, March 11th **Snow**

Heavy snow in centre of Sheffield ('Picture Sheffield' photo of Town Hall Square – S19965).

" 'This week-end's snow storm was one of the worst for many years' said Mr. E. Howarth, Sheffield's Weather expert, in an interview with the Star today. 'Certainly we have not had three like it during the past fifty years.' … At Weston Park there was 10 inches of snow while at Fulwood the depth was about 12 inches." (Telegraph and Star, March 12th, 1928) This followed blizzards in Derbyshire at Christmas when there was less snow, but gales caused drifting which blocked many roads.

1929, September **Drought**

Redmires Reservoir was again empty revealing the mile post seen in 1911.

In a letter to the Times (April 25th, 1929) a comparison was made between the recent cold winter and those for 1683-4 and 1684-5 (q.v.). These winters were severe and were followed by extensive droughts. There was low rainfall for five consecutive months through the winter of 1928-9 followed by drought in the summer months.

The Star on 17th September ran a story highlighting the situation of Bradwell where reservoirs were empty but they were using water from the local wells and mines. It includes a quote from a villager – "No, mister, we ain't short of water, thanks to the springs and pump, and the only trouble we have to contend with is the grumbling of the women, who are having to take more than their usual exercise!"

1932, May **Floods**

A Picture Sheffield photograph (S10963) shows "Woodfall Lane, Low Bradfield, flooding caused by storms in 1932." In May 1932 Weston Park recorded 59.4mm (2.3") of rain on the 21st, and a total of 170.7mm (6.7") in the month, the 3rd highest May total. The Toll Bar area of Doncaster and other parts of the Don and Dearne valleys were also flooded.

1933, February **Snow**

Blizzards affected most of the country and in Sheffield there were drifts up to eight feet deep in the suburbs. (Yorkshire Telegraph and Star, February 24th & 25th, 1933) The Daily Mail described it as "Britain's Worst Storm for 30 Years".

The Daily Express (February 27th) highlighted the problems of flooding caused by the thaw and mentioned the previous years floods at Bentley, near Doncaster where 1,500 people were homeless when the Don broke its banks. It also mentioned the rescue of a trapped women near the Flouch Inn; seventy stranded motorists given food at the Plough Inn on the Sheffield-Manchester Road; the collapse of the roof at 'Barnsley Stadium' under the weight of snow; and villages such as Grindleford in Derbyshire which were cut off from the outside world – "In the village of Stoney Middleton there is not a candle to be purchased."

1933, Summer **Drought**

In October, the Observer described the 'end of a wonderful summer' while the Sheffield Daily Telegraph (21st) highlighted 'the effects of the drought' showing that the Howden and Derwent Dams were below a third of the level of the previous year.

1934, December **Warm December**

December was relatively warm (average 7.7°C (46°F)) with only 2 days with a ground frost. (WP)

1937, September 17th **Heavy Rain**

1" of rain fell in one hour (3-4pm). (Noted in WP observation ledger)

1940, January **Snow**

Heavy snow in Sheffield – 59mm of lying snow noted at Weston Park on 29th – Photo (Picture Sheffield – S22383) shows city centre snow at Leader House in Surrey Street on the 28th. The severe weather was widespread and railway lines were blocked, including the Sheffield-Manchester line at Edale. (The Star, January 29th)

1940, November 28th **'Thunder' or not**

Thunder was recorded in the Weston Park observations ledger, but was later amended to 'Gunfire!'.

1940, December 6th **High Winds**

Wind often reached Gale Force for most of the day, with some gusts at 70mph (Marginal note in Weston Park Observations Ledger).

1941, June 22nd **Record Temperature**

The highest June temperature recorded at Weston Park at 31.4°C

1942, February **Frost**

The grass minimum temperature at Weston Park was below 0°C (i.e. a ground frost) for the entire month.

1942 **Floods, and Low Rainfall**

Floods in Beighton. Workers had to be taken to the colliery in boats.

Weston Park recorded only 0.08" (2mm) of rain between April 10th and May 9th.

1943, July 31st **Record Temperature**

The highest July temperature recorded at Weston Park at 31.8°C.

1944, May 29th **Hail**

"During thunderstorms on the 29th, rain at Weston Park, but in some districts – Fulwood, Dore, Meersbrook, Hillsborough – it was accompanied by hailstones of exceptional size (1/2” – 1”) and quantity.” (Marginal note in Weston Park observation ledger)

1946, November **Rain, Floods**

Barnsley Canal broke its banks at Burton Grange, flooding parts of Lundwood – The Star Nov 22nd, 1946.

Following heavy rains, Sheffield’s reservoirs were filled to capacity, including the new Ladybower Reservoir ‘opened’ in September 1945. (Star, November 22nd, 1946)

1946-1947 **Severe Winter, Flooding**

One of the most severe winters last century. Snow lying for 62 days. In January there were power cuts and many roads were blocked. In February the mean temperature was –2.1°C (28.3°F). On 24th, the Cowburn railway tunnel between Edale and Chinley was blocked by 20’ long icicles each weighing up to half a ton. A body was found in the snow at High Bradfield. Temperatures fell to –9.2°C (15.3°F) on 4th March. (Sheffield City Museum (1984))

There was a ground frost at Weston Park on every day from January 19th to March 16th.

The thaw later in March caused extensive flooding in areas such as Catcliffe and Beighton – once again miners had to use boats to get to work, and trains passing through Beighton station had to plough through the flood water.

1947 **Hot Summer, Drought, Record Temperatures**

By contrast, the summer of 1947 was hot with 14 days above 26.7°C (80°F) and with 33 days of drought between 5th August and 6th September. (WP)

The highest May temperatures on record at Weston Park of 29.0°C on the 29th.

1948, January 12th **Floods**

Heavy rain and melting snow led to floods in many parts of the country, including locally the Calder valley near Wakefield, the Dearne valley between Wombell and Darfield, the Don at Ickles and between Mexborough and Old Denaby, and the Rother at Catcliffe and Swallownest. At Castleton, the Peak Cavern was completely blocked and cottages below the cave were flooded. Floods were also reported at several places along the Derwent valley from Bamford through to Rowsley. (Sheffield Telegraph, January 12th and 14th, 1948)

1949, August 22nd **Storm, Lightning, Flooding**

“In centre of city, Intake, Darnall and Wincobank, storm was severe. Some damage by lightning, and flooding occurred in places”. (Marginal note in Weston Park Observations Ledger)

1950, February 3rd **Floods**

Yet again Beighton station was flooded and trains had to plough through the flood water after overnight rain (The Star) (Figure 6).

Figure 6 Floods at Beighton Station 3rd February 1950
(courtesy of Sheffield Newspapers)

Figure 7 Floods at Surbiton Street, nr. Broughton Lane 20th August 1954
(courtesy of Sheffield Newspapers)

1954, August **Floods**

Photos (Sheffield Newspapers) show floods on the 20th and 21st around Surbiton Street, Attercliffe (Figure 7); at Steel, Peach and Tozer's works at Ickles; and on the Sheffield-Rotherham Road.

Weston Park showed high rainfall on these days (~44mm per day) – 1954's August rainfall (166mm) was the third highest in the Weston Park records after 1922 (197mm) and 2004 (181mm).

1954-1957 **Snow, White Christmas**

3 cold, snowy winters and a white Christmas in 1956. Prolonged blizzard conditions in March 1955 led to thousands of tons of snow and ice accumulating on hillsides on the Snake Pass between Sheffield and Manchester. This was deemed to be such a serious threat to traffic that Derbyshire Council took the unusual measure of deploying around 200 pounds of explosives to shift it. About one third of the snow was dealt with in this way with little falling directly on the roads. (Sheffield City Museum (1984))

Troway, near Coal Aston, was cut off by 12 foot deep snow drifts. (The Star, January 17th, 1955)

The Weston Park records show 10" (25cm) of lying snow on Feb 24th-25th 1955.

Derbyshire was one of the areas worst hit by snow in January 1956, and Sheffield deployed its biggest fleet of snowploughs to-date (38 of them). The thaw brought flooding to Catcliffe and Mexborough, and in Catcliffe the flood water was frozen over. The freeze continued into February. (The Star, January – February, 1956)

1956, March 2nd **Gales**

Gales caused damage across Sheffield. Gusts were estimated at 60mph. Prefabs were destroyed at Sky Edge, roofs collapsed in Heeley and houses were damaged in Dronfield and other areas across the region. (The Star, March 2nd, 1956) (Photos (Sheffield Newspapers) also show damage in Ecclesall Road (Figure 8) and in Shoreham Street)

1958, July 1st **Floods**

Hundreds of people had to be moved from their homes when floods struck Sheffield in the early hours of July 1st 1958. The River Sheaf burst its banks at Totley Brook, Broadfield and Heeley. Houses in Suffolk Road were surrounded by water ten feet deep. Catcliffe, Treeton and Woodhouse Mill were also flooded, as was the George Hotel at Hathersage where a large wave of water smashed through the ground floor rooms. (The Star, June 30th, 1998)

1959, August-September **Drought**

A warm summer and 35 days of drought between 14th August to 17th September. Driest September on record with only 0.6mm.

Redmires and Ladybower Reservoirs were both very low, and into October the ruins of Derwent Hall were exposed (Figure 9).

Figure 8 Gale damage Ecclesall Road 2nd March 1956 (courtesy of Sheffield Newspapers)

Figure 9 Ruins of Derwent Hall exposed in the drought of 1959, 5th October 1959 (courtesy of Sheffield Newspapers)

1962, February 16th **Gales**

The Sheffield “Hurricane”. A gale affecting the whole of the eastern Pennines was at its worst in Sheffield and caused widespread damage to many parts of the city. Though local topography did not cause the gale it was undoubtedly a contributory factor in this area. Wind speeds at Weston Park reached 84knots/96mph at 6a.m. There were 36 gusts of more than 70 knots/80.5mph with most of the serious damage occurring between 5-7.30a.m. Trees were uprooted, blocking many roads, 4 people were killed and 6000 people left homeless. Some 98 buildings were damaged beyond repair, including 69 prefabs. There were 248 severely damaged buildings requiring major repair, 34,200 buildings were moderately damaged and 66,954 with minor damage. (see figures (anemograph chart and damage to buildings) and other details in section ‘Sheffield’s Weather’)

There were also gale force winds on the 12th February – maximum gust of 69 knots/79.4mph at 0210 GMT, and again on 15th December of the same year (gusts to 65 knots/75mph).

1962-1963 **Cold Winter**

A very cold winter with sub zero temperatures affecting most of Europe. The cold spell commenced in December 1962, lasting to 5th March; 73 days in total. Around 34” of snow fell and lay for 71 days. The first snow fell on December 14th. January and February were bitterly cold with snow and easterly winds on 54 days. A low temperature of -12°C was recorded in Rotherham on the 22nd, with ground temperatures to -16°C. At Weston Park, the grass minimum temperature fell to 2°F (-16.6°C) on the night of the 24th-25th December (an extreme for the station), and never rose above 0°C in February 1963.

Pennine routes were blocked by snow and ice. The Snake Pass was closed for three weeks and reopened on February 13th after overhanging snow was blasted using gelignite. In Derbyshire the costs for snow clearing reached £250,000, then a record for a single spell of bad weather (Sheffield Star).

Skaters were photographed (Sheffield Newspapers) on the pond at Longshaw (Figre 10) and on Wire Mill Dam.

1965, March 29th **Record Temperature**

The highest March temperature on record at Weston Park 23.5°C.

1965, December **Floods**

The centre of Matlock was flooded on the 1st by the River Derwent; Brightside and Woodhouse Mill were also flooded on the 9th and 10th (Figure 11).

December 1965 shows the highest December rainfall in the Weston Park records (210mm).

1967, August 11th **Floods**

One of the many occasions when Chesterfield Road was flooded under the Heeley railway bridge.

Figure 10 Skaters 27th December 1962 (courtesy of Sheffield Newspapers)

Figure 11 Sheep trapped in floods, Woodhouse 10th December 1965 (courtesy of Sheffield Newspapers)

1968, November 25th - December 1st **Dullest**

One of the dullest periods recorded at Weston Park with 21 consecutive days without bright sunshine.

1969, March 19th **Ice, Wind**

Emley Moor TV mast collapsed due to the combination of strong winds and the weight of ice that had formed around the top of the mast and on the guy wires. (Sheffield City Museum (1984))

Lying snow was recorded at Weston Park through most of February and March.

1970, April 13th **Floods**

Floods again hit the Brightside Lane area. On the previous day 49mm of rain had been recorded at Weston Park.

1970, May 23rd - June 24th **Drought**

A period of 31 days without rain recorded at Weston Park.

1971, September 26th **Tornado**

At approximately 4 p.m. a tornado struck the north east of Sheffield and also Rotherham, its path was about 60 metres wide and according to an eye witness, passed within 100metres of Tinsley viaduct. An Alsatian dog and its kennel were thrown clear of a fence and garden railings ripped from the ground. A 90 ton machine was moved 50metres along a railway track and an empty 40 gallon drum was lifted 1metre above the ground. Torrential rain and hail occurred for a short time and thunder was heard in Sheffield. (Wright (1973))

1973, July 15th **High Rainfall, Floods**

The wettest day on record in Sheffield with 119.2mm (4.69 inches) of rain in 24 hours (WP). Widespread flooding as the River Sheaf burst its banks and overflowed onto roads.
(see figure in section 'Sheffield's Weather' (Flooding at Nether Green))

1975, July 14th **Hailstorm**

"Severe thunderstorms affected the north Midlands during Monday 14 July 1975 … A damaging hailstorm … developed to the south-west of Crich … at about 05:00 GMT and moved north-eastwards towards Carburton … leaving a 31km trail of destruction … more than 5km wide. … At Meden Square, Pleasley one of the piles of ice remained 75 hours after the storm … Windows were shattered … market garden greenhouses were dashed to pieces." (Fellowes (1976))

1976, January 2nd-3rd **Gales**

Seven people were injured in Sheffield and many buildings damaged by high winds. Gusts of 72mph were measured at Weston Park. Further high winds occurred later in month.

1975 & 1976 **Hot Summers**

Two fine hot summers with extended dry periods and each with at least 21 days when temperatures were above 80°F (26.7°C). The ruins of Derwent and Ashopton villages were exposed at Ladybower Reservoir in both years (Photos (Sheffield Newspapers), Figure 12) and everywhere the ground was parched. September and October 1976 were extremely wet and refilled the reservoirs.

In 1975, rainfall was not especially low through the hot summer, but was quite low through the autumn months, reservoir levels were at their lowest in November and December. In 1976, summer rainfall was low but autumn rainfall was well above average. In September, there were moorland fires above Ringinglow.

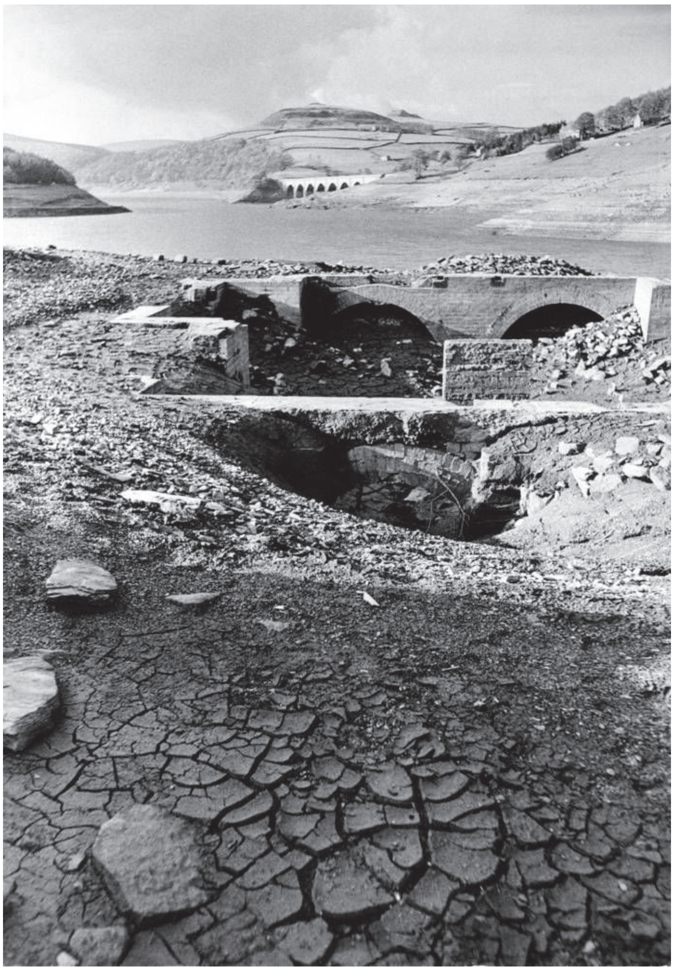

Figure 12 Drought at Ladybower Reservoir, 3rd November 1975 (courtesy of Sheffield Newspapers)

1976, December 1st **Black Ice**

Many people were injured by falling on black ice when overnight rain fell on frozen surfaces. Car pile-ups also caused traffic problems.

1977, February 25th **Floods**

Several major road closures due to blizzards and severe flooding. River Don burst its banks at Rotherham rising 1ft over official danger level. Blackburn Brook burst its banks flooding the area around Fife Street, Wincobank.

Weston Park recorded its highest February rainfall (201mm falling on 24 days), with 44mm of rain on the 22nd and 23rd and 38mm on the 25th.

1977, June 13th **Thunderstorm, Local Flooding**

Linley Lane at Birley was blocked by debris when a severe thunderstorm hit the areas of Frecheville, Birley, Hackenthorpe and Gleadless.

1977, November 17th **Mock Suns**

"People in Sheffield who saw more than one sun in the sky were not hallucinating, but experiencing a meteorological phenomenon. What they saw were mock suns caused by the sun's rays bent by ice crystals in the air yesterday. A spokesman for Bawtry Met.Office said mock sun's did not happen very often and there were usually two." (The Star, Sheffield, Fri 18 Nov. 1977)

1978, January 2nd **Floods**

Brightside Lane alongside River Don Works was flooded (Photo (Sheffield Newspapers), Figure 13). Weston Park recorded 20mm of rain.

Figure 13 Floods alongside River Don Works 2nd January 1978 (courtesy of Sheffield Newspapers)

1978, January 19th **Snow**

One of the worst snowstorms of the century in the south-west of England also affected Sheffield when snow caused a series of accidents across the city. Road conditions were described by the AA as diabolical. Freezing conditions continued into February.

1978-1979 **Severe Winter**

A severe winter with 71 days of snow over the winter period and Sheffield isolated for days as gritters went on strike (22nd January, 1979). Dronfield Railway Station was re-opened temporarily due to travel problems. Schools closed because heating oil could not be delivered. The grass minimum temperature only rose above 0°C on one day in January and one day in February '79. (Sheffield City Musuem (1984))

At the same time the Antarctic was experiencing a heatwave!

1979, May-December **Warm and Dry, then Warm and Rain**

Temperatures soared briefly to reach 25.8°C on May 14th. The summer was relatively dry, July only had 13mm of rainfall. October 9th had one of the highest October night-time temperatures (14.9°C) since 1888 (it was narrowly beaten by October 10th, 1954 at 15.1°C, and has been beaten on several occasions since 1979).

In December, temperatures were again unusually high as warm winds were diverted northwards by Mediterranean anticyclones. The month also saw thunderstorms and heavy falls of rain. (WP)

1980, January 21st **Snow**

South Yorkshire Police grounded all their vehicles as snow brought chaos to the region.

1980, May **Moorland Fires**

Low rainfall in April and high temperatures in May led to moorland fires above Redmires and the Rivelin Valley.

1980, June **Thunderstorms**

After a hot first week, rain fell on most days of the month. There were thunderstorms on five days accompanied by torrential rain and hail. Homes were damaged and fires were started by lightning across the area.

1980, November 18th **Gales**

Tinsley viaduct was closed and a gable wall collapsed on Sharrowvale Road as gale force winds topped 50mph.

1980, December 23rd **Heatwave**

High sea temperatures in the Atlantic raised temperatures across the area, reaching a maximum of 11.1°C (52°F) at Weston Park on the 23rd. The warm weather returned at the end of January due to an anti-cyclone over the Bay of Biscay and high pressure in the south of England brought gentle south-west winds.

1981, February-April **Snow, Rain, Blizzards**

Snow at the end of February was heaviest around Penistone, roads were described as ice-rinks and speed restrictions were placed on the Motorways.

This was followed by the wettest March on record (with 150mm rainfall), and by blizzards in April which left 4" (10cm) of lying snow across the region on the 24th. The problems continued for several days as power lines were brought down, and drivers were stranded in deep drifts. The Peak District suffered livestock losses in the blizzards, and North Derbyshire was cut off by deep snow. (Sheffield City Museum (1984))

1981, May-June **Floods**

The A57 at Woodhouse Mill was closed when flood waters broke through the road surface. Crops were damaged across the area and landslides cause delays to rail travel. Sheffield Market was under 8" of water after storms on June 5th and 6th.

1981, August **Heatwave and Rain**

Sheffield 'basked in a heatwave' when temperatures at Weston Park reached 26.1°C (79°F) on the 5th and 27.1°C (80.8°F) on the 27th. The month also had memorable downpours, with flooding in parts of the country on the 6th when lightning struck a house in High Green, and 47.5mm of rain fell in 48 hours at Weston Park.

1981, September 21st **Gales and Floods**

60mph winds swept the region. Chimney pots and tiles were brought down in Highfield. Power lines were down in Nottinghamshire and Derbyshire. Winds at Weston Park were strong on the 20th and 25th, with gusts of 60mph in the early hours of the 20th.

1981, December **Cold and Snow**

With an average of 5.7°C, 1981 had the coldest December since 1890 (which still holds the record (-0.5°C) for Weston Park) (Note that the very cold winters of 1947 and 1963 were at their coldest in February). Temperatures fell to -9.1°C on the 18th, the coldest December night since 1908.

The depth of lying snow on the 20th (34cm) remains the deepest December snow in the Weston Park record, and 1981 saw the first White Christmas since 1970.

1982, January **Cold**

A very cold month with air temperatures falling to -9.2°C on the 10th. (WP)

1982, January 31st **Dry Weather, Grass Fires**

Following low rainfall through most of the month, warm weather and drying winds caused by high pressure over northern France led to grass fires across the region. A Fire Service spokesman said he had never before heard of grass fires in January. (The Star)

1982, June **Hot Weather, Fire Risk, then Floods**

Hot weather led to warnings of potential fire risks on the high moors, and fire crews were called to grass fires on Hatfield Moors and Thorne Waste in June. The air conditioning failed at the Royal Hallamshire Hospital at the beginning of the month as temperatures at Weston Park topped 25°C (77°F), reaching 28.9°C (84°F) on the 5th.

Through the month, heavy rain flooded many areas, including Upwell Street, Ickles, Hyde Park and Rawmarsh on the 2nd and Queens Road, Heeley Bottom (Figure 14), and many other areas on the 23rd.

115mm of rain were recorded at Weston Park on the 20th, 21st and 22nd of June. It was the wettest month of the 20th century at Weston Park (225mm), though this was beaten in June 2007 with 285.6mm.

Figure 14 June 1982 floods at Heeley (courtesy of Sheffield Newspapers)

1983, April-May **Floods and Snow**

28.4mm of rain fell on April 10th causing flooding and delaying commuters. On the Trans-Pennine routes it fell as snow.

On the 19th, more snow closed Woodhead, and on the 27th floods affected High Green and Chapeltown. May continued wet, the waterlogged ground affecting dairy farmers, ploughing and crop planting.

1983, July **Hot**

A hot summer followed a wet spring. The mean July temperature at Weston Park was 19.4°C, the highest monthly mean of the 20th century (beaten in July 2006 at 20.1°C).

1984 **Hot, Dry Summer**

Hot, dry weather led to a water shortage with a hosepipe ban in much of South Yorkshire and the closure of areas of the Peak Park to avoid moorland fires.

1985, October 1st **Record Temperature**

The highest October temperature recorded at Weston Park at 26.3°C

1986, February **Dry, Cold**

February was unusually dry and very cold. Though little snow or rain fell, there was lying snow on most days of the month. Temperatures fell to -8.3°C on the 11th and 25 nights of air frost were reported. The mean monthly temperature at Weston Park was –1°C.

In March, the Snake Pass was closed first due to snow, and then due to the danger of avalanches as the snow thawed leaving overhangs of snow and ice.

1987, January 12th **Record Temperature**

A very cold month with temperatures at Weston Park falling to -9.1°C on the 12th. Bus services came to a standstill, trains were delayed and East Midlands Airport was closed. There were 13 consecutive days of frost at Weston Park.

1987, August 17th **Dust**

There were several reports of fine white/grey dust over the city. Originating from the Sahara, the dust was carried north on upper air currents. The same thing happened on October 28th, 1987, and May 7th, 1988. (Note in Weston Park records)

1989 **Sunshine Record**

The sunniest year on record (1724.9hrs) at Weston Park since sunshine records began in 1898, with a new sunshine record for May also (283.8hrs). August also set a new sunshine record with 240.5hrs, which has only been beaten in 1997 with 255.8hrs.

Together with May 30th 1997, July 3rd was the sunniest day on record with 16.1 hours of bright sunshine. (WP)

In July, 76 square miles of access land in the Peak Park were closed to avoid peat fires.

Each day from the 19th to the 25th July, temperatures exceeding 27°C (80.6°F) were recorded (WP). Road surfaces melted and well-dressings were ruined.

1990, January-February **Gales**

In January (25th) gales caused damage in Bradway and Ecclesall and overturned a bus in Dore. Winds topped 76mph in South Yorkshire, and the Tinsley Viaduct was closed. 45 people were killed across the country.

More high winds in February (26th) caused damage in Manor and Savile Street (Figure 15).

1990, August **High Temperature**

Temperatures soared to 34.3°C on 3rd August, the highest on record at Weston Park

After very little rain through July, a hosepipe ban was in force through early-August. 100 square miles of the Peak Park were closed

1990 **Record Temperature**

Together with 2006, 1990 was the warmest year on record at Weston Park with an average of 10.8°C (51.4°F).

1991, January **Gales and Snow**

Gale force winds on the week-end of the 6th affected much of the country, and though Sheffield was relatively unaffected, there was some damage and trees were brought down around the area. The gales were followed by snow on the 7th which drifted in the still high winds and disrupted traffic for several days.

Figure 15 Gale damage Savile Street East 26th February 1990 (courtesy Sheffield Newspapers)

1991, February **Snow**

"British Rail blames the wrong type of snow." (London Evening Standard). British Rail was caught out by a forecast cold snap that brought snow too soft and powdery for their snowploughs to be effective. The snow was fine enough to be drawn into engines, electrical equipment and points, thus disabling many trains.

On the 9th, almost a foot (30cm) of lying snow was measured at Weston Park – by no means the snowiest parts of the city – and temperatures fell to below -6°C.

1991, December **Floods**

The River Sheaf broke its banks near the city centre as debris in the swollen river blocked the flow. Sheffield station and Granville square were under three feet of water and the new Ponds Forge swimming pool was closed by flood water.

1993, June 9th **Heatwave, Thunderstorm, Flood**

Sheffield was in the middle of a heatwave when properties in the south of Sheffield were damaged by a heavy thunderstorm, a house in Dronfield was hit by lightning, and Chesterfield Road was (once again) flooded at Heeley Bridge.

1993, December 9th **Gales**

High winds and heavy rain hit transport as lorries were blown over on roads across the region. Finningley recorded winds of 73mph, a record for the station.

1994, March 15th **Gales**

Gales tore away cladding from a warehouse in Infirmary Road, and damaged other buildings in the area.

1994, December 11th **High Winter Temperature**

Weston Park recorded one of the highest December temperatures (17.6°C) in the country and the highest on record at Weston Park. This almost reached the 'highest' at any Met Office station (to 2000) of 17.8°C at Aber (Gwynedd) (Webb and Meaden (2000)).

1995, July **Moorland Fires**

Moors were closed in an attempt to contain grass and peat fires after four months of dry weather. Hosepipe bans were brought in for some parts of South Yorkshire.

Summer rainfall (June-August) for Weston Park was the lowest in the record (45.9mm, marginally less than 1976 (50.8mm)).

1996, January 27th **Snow**

Heavy snow closed many shops in Sheffield city centre (Figure 16) and Meadowhall as staff were unable to travel in to work. The Snake and Woodhead passes were closed and motorways were reduced to one lane.

January 1996 still holds the monthly record for the lowest hours of bright sunshine at Weston Park (5.8hrs).

Figure 16 Supertram in the snow, 27th January 1996 (courtesy of Sheffield Newspapers)

1996, February 16th **Nacreous Cloud**

Rare occurrence of nacreous (mother-of-pearl) clouds in the region. Formed at heights of up to 30km, these unusual clouds display strong iridescence. They occurred with strong north-westerly winds in an outflow of arctic air just before sunset. The colour was exceptionally brilliant against a darkening sky. (see section 'Sheffield's Weather')

1996, July 8th and August 7th **Lightning**

Lightning and hail storms occurred in both July and August. In July, car windscreens were broken, and on August 7th the roofs of houses in Crosspool were damaged. During the August storm, snow fell at Stannington after a day with temperatures above 80°F.

1997, May **Wet and Cold, and then the Sunniest Day**

May Day Bank Holiday (5th) saw continuous rain (25mm in day at Weston Park), and on the 7th, temperatures fell below freezing in South Yorkshire (0.8°C at Weston Park).

Together with 3rd July 1989, May 30th was the sunniest day on record at Weston Park with 16.1 hours of bright sunshine.

1998, February **Warm**

February temperatures more typical of April/May Warmest Valentines day on record. (The Star 27th February, 1998)

1998 showed the highest February average (8.2°C), and the highest February temperature on record at Weston Park at 17.6°C (on Valentine's Day).

1998, June 1st-2nd **Heavy Rain**

Weston Park recorded 79.3mm of rain in two days, more than the total June rainfall in 80% of the years in the record (mean June rainfall = 50mm))

1999, February 5th **Gales**

Two lorries overturned on the M1 near Tinsley and the M18 was closed for a time due to high winds.

2000, June-July **Dull**

June and July both had less than average hours of sunshine, and July was the dullest and coldest for 20 years and the wettest for 7 years. Garden parties, fetes and carnivals were 'ruined'.

2000, July 28th **Thunderstorm, Hail**

"A violent storm passed over Aston at about 3pm on Friday 28th July. It started as a thunderstorm with torrential rain … the run-off from the rain was extreme (up to a foot deep in places) and then the hail started … visibility was down to about twenty feet … [the hailstones] increased in size to marble-sized. The ice swirled on top of the flood water … Foliage was stripped from gardens, flowers and leaves were shredded. The storm raged for half an hour solidly. … it seems to have cut a very restricted swathe through Aston and Aughton." (Croxton (2000)).

The storm affected much of the city, a house in Fulwood was struck by lightning, and The Peacock at Owler Bar was flooded.

2000, October 30 **Gales and Rain**

Windspeeds of 62mph were recorded at Weston Park, trees were blown down and cars blown over, rail services cancelled and many roads left impassable in the region due to flood water.

2000, November 6th **Floods**

Torrential rain flooded many roads in and around the city. The River Don burst its banks at Stocksbridge and Oughtibridge, at Norfolk Bridge near the centre of Sheffield, and in the centre of Rotherham. In Derbyshire, the lake at Hassop Hall overflowed and flooded the Hassop-Bakewell Road, and in Bakewell the Wye covered the riverside walk.

Across England and Wales there were 22 flood warnings on 13 rivers.

2001, February 28th **Snow**

A heavy and rapid fall of snow plunged the city into chaos. Snow ploughs could not get through, 21 schools were closed and bus services badly hit.

2001, December **Mild and Windy**

The month started warm (reaching 12.2°C (54°F) on the 5th) and ended windy, with gale force winds on the 28th which threatened to topple a 250ft crane in West Street. North westerly winds reached 51 knots (59 mph) at 0907 hours. After New Year, temperatures plunged to -6°C (21°F) on the 3rd.

2002, February-March **Gales**

Trees, chimney pots and aerials were blown down, and the High Street was cordoned off as winds gusted to over 40mph on the 22nd. Gusts reached 70mph on the 26th – buildings and roofs were damaged, children were sent home from schools and fallen trees blocked roads. More gales in March uprooted trees in Ranmoor, Dore, Grenoside and Loxley.

2002, July **Rain**

The wettest July for 29 years at Weston Park (133.8mm compared to 1973 which still holds the record at 200.6mm - 2009 came close with 126.3m).

2002, October **Gales**

South Yorkshire and North Derbyshire were hit by rain and gale force winds, trees were brought down and rail services were affected.

2002, November-December **Floods**

Torrential rain left roads across the city under 2ft of water on November 16th, and on December 30th more rain flooded Woodhouse Mill and caused flood alerts on the Dearne, Sheaf and Rother.

2003, January 26th **Record Temperature**

The highest January temperature on record at Weston Park at 16.7°C.

2003 April **Record Temperature**

The highest April temperature on record at Weston Park at 24.8°C on the 16th.

2003, August **Heatwave**

Temperatures rose to 31.4°F on the 9th at Weston Park and warm weather continued into September. August's average (17.9°C) was one of the highest in the record – it was higher three times in the 1990s, but not since.

2004, February 27th **Snow**

Many schools in the city were closed and transport was disrupted by snow. The Snake Pass was closed though other routes remained open.

2004, April and August **Floods**

Flooding affected the city in both months – including Blackburn Road on April 26th, and Heeley Bridge (Figure 17) and Little London Road on August 10th. In August, 77mm of rain fell at Weston Park on the 9th, and transport was affected both by road and rail – rail tracks were submerged at Dore and Bradway, and between Meadowhall and Barnsley.

August was the wettest for 82 years (181m), and the 2nd wettest on record. (WP)

Figure 17 Flooding Heeley Bridge, 10th August 2004
(courtesy of Sheffield Newspapers)

2004, December 24th **Gales**

Gales on the 23rd and 24th damaged buildings, threatened the Ferris Wheel in Fargate, and closed the M1 near Chesterfield.

2005, February **Snow**

The Snake Pass was closed on the 25th after several days of snow hit the area.

2005, June 19th **High Temperatures, Lightning**

High temperatures (e.g. 30.4°C at Weston Park) were brought to an end by a dramatic storm. Lightning destroyed the roof of a house at Chesterfield and of a block of flats in Chapeltown. The 13th floor of the Sheffield University Arts Tower was also hit by lightning.

2006, July **Record Temperature**

The hottest month and sunniest month on record at Weston Park with a mean monthly temperature of 20.1°C and a total of 291 hours of bright sunshine

2006 **Record Temperature**

Together with 1990, 2006 was the warmest year on record at Weston Park with an average temperature of 10.9°C.

2007, January **Gales, then Snow**

High winds affected Sheffield through the month. Part of a block of flats collapsed on the 3rd; 60mph winds overturned vehicles, closed roads and damaged buildings on the 12th; and brought torrential rain on the 19th, causing flooding on routes into the city.

Snow arrived on the 22nd, stranding motorists and cutting power lines in Derbyshire. Further heavy rain caused a dam to collapse above Stoney Middleton.

More snow hit South Yorkshire in February.

2007, June **Floods**

The wettest month recorded at Weston Park weather station since records began in 1882, with a total of 285mm, 60mm more than the previous wettest month (June 1982). Two periods of exceptionally heavy rainfall occurred on 13th-15th (135mm) and 24th/25th (87mm).

The banks of the River Don were breached in Sheffield, affecting the area from Hillsborough, downstream to Kelham Island and beyond to Blackburn Meadows. Two people lost their lives. An electricity sub-station in north Sheffield was flooded leaving 48000 homes without power. Ulley Dam was threatened with collapse, the M1 subsequently closed for 3 days and nearby communities evacuated as water was pumped from the reservoir to relieve pressure on the dam wall. 1275 domestic properties and 1000 businesses in Sheffield were flooded and numerous roads, retaining walls, bridges and street furniture also damaged. People were rescued from rooftops by RAF helicopters and more than 1400 displaced people were accommodated and fed. (Sheffield City Council (2008))

(see figures in section 'Sheffield's Weather' (rainfall graph and River Don flood at Meadowhall))

2007, June 26th **Tornado**

A tornado was reported at Treeton. (The Times)

2008, February **Sunniest**

February 2008 was the sunniest February on record at Weston Park with 121 hours of bright sunshine and more than twice the average sunshine for the month. There was also a wide temperature range for the month from a maximum of 15.6°C on the 12th to -6.7°C overnight minimum on 20th.

2008, February 2nd **Snow**

Heavy overnight snow closed the Woodhead Pass.

2009, January-February **Cold**

January and February were both cold and dry with the coldest January in 8 years and the coldest February in 3 years at Weston Park. There were 9 days of lying snow in February and 11 nights of air frost.

2009, March **Sunniest**

March was the sunniest in 15 years at Weston Park. It was also a relatively warm and dry month compared to average.

2009, June 10th **Rain**

Sheffield was the wettest place in the UK on 10th June 2009 (source: Weathernet) with 88.1 mm of rain falling on the 10th, almost matching that on the 14thJune 2007 (88.2mm) prior to the 2007 floods (both well below the record of 119mm in July 1973). The rainfall total for the month was three time higher than average with most rain falling on just 12 days (although still around 100mm less than for June 2007)

2009, August **High minimum temperatures**

Temperatures fell no lower than 10.5°C this month, the highest minimum for August at Weston Park since records began. Temperatures were above average throughout the autumn

2009 **High minimum temperatures**

Temperatures fell no lower than 7.8°C this month (22nd) at Weston Park. They have been lower than this in September every year from 1883-2008.

2009-2010, winter **Cold**

December 2009 was the coldest since 1996. There were 13 air frosts (the highest for December in 8 years) and consecutive nights of frost from 18th to 25th December at Weston Park. Snow fell intermittently from the 20th to the end of the year and lay for more days than in any other December since 1981, lying to a maximum depth of 10cm at Weston Park.

The cold conditions continued throughout January and February and gave mean temperatures at least 2.0°C lower than average, the lowest for January since 1987. Minimum temperatures were the lowest for January in 9 years (down to -4.5°C) and there were 20 ground frosts. Snow lay on the ground at Weston Park for 14 days, reaching a maximum depth of 16cm on the 6th (Figure 18). An unusual occurrence of freezing drizzle overnight on the 12th gave widespread black ice and very hazardous ground conditions. Although cold, January was around 50% drier and 30% sunnier than average.

Snow lay on the ground at Weston Park for 5 days in February, lying to a maximum depth of 10cm on 21st. There were 23 ground frosts and it was the coldest February in 16 years with minimum temperatures falling to -3.3°C. It was also the dullest February in 17 years at Weston Park.

The first fortnight of March was also notably cold with temperatures falling lower than they did in all the previous 3 winter months (-5.6°C on the 8th).

Figure 18 Weston Park Weather Station 8th January 2010 (© G. Boon)

Postscript-2010, November-December **Cold**

It had been decided that the cut-off date for collation of data for this publication would be winter 2009-10, this being the time at which preparation of the charted data began. Final amendments to the text, however, were still being made at the end of 2010, a period that was to be one of the most severe early winter periods on record. In the light of this fact, we decided to include an overview of the months November-December 2010 within this account, and to update the charts and 'extremes' shown in earlier sections.

The cold set in during the middle of November 2010 as winds changed from mild westerlies to cold north and north-easterlies as the block of high pressure over Greenland steadily intensified.

By the last week of November this not only gave night frosts but daytime temperatures also struggled to reach above freezing. On the 28th, temperatures failed to rise above -0.5°C all day. Overnight temperatures on 27th/28th dropped to -7.2°C, this being a new record for November. The lowest daily mean temperature on record at Weston Park for November occurred on the 28th (-3.8°C). Snow showers developing over the North Sea pushed steadily inland, reaching Sheffield on 25th. It was the snowiest November recorded at Weston Park in 15 years (Figure 19).

Also notable this month was the considerable contrast in temperature from the beginning to the end of the month, the highest November temperature in 5 years (17.3°C) occurring on the 4th.

Figure 19 Highland Cattle in the Shirebrook Valley, 30th November 2010 (© G. Boon)

There were further significant snowfalls in December, especially at the beginning of the month for Yorkshire and Lincolnshire. Snow lay to 38cm depth at Weston Park on the morning of the 1st (Figure 20) and persisted on the ground for around 10 days. It was the deepest snow recorded in December at Weston Park (since measurements of snow depth records began in the 1950s). The snow brought train and bus services to a standstill, and caused lorries to jack-knife whilst many car drivers abandoned their vehicles. Strong winds also created snow drifts. Around 60 lorry drivers were stranded on the A57 for two days due to the road being blocked by abandoned vehicles and deep snow. Temperatures during the first 2 days of the month did not reach above -0.6°C and there were consecutive night frosts from 25th November to 9th December inclusive.

A brief period of milder weather occurred from the 10th-16th December before snowfall and freezing temperatures returned on the run up to Christmas (from 17th onwards). A combination of snow-covered ground, clear nights and short day length gave the coldest temperatures recorded at Weston Park in 23 years. Temperatures reached no higher than -4.4°C on the 20th, with average temperatures that day of just -6.5°C (the lowest on record for December at Weston Park). The intense cold persisted throughout Christmas, eventually ameliorating on the 27th with the arrival of rain-bearing Atlantic fronts.

December is rarely the coldest month of the year, temperatures generally being lower after the winter solstice than before. In 2010, however, December temperatures fell to -8.7°C on the 20th at Weston Park, the lowest temperatures recorded there for any month since January 1987 and the lowest for December since 1981. In Scotland (Altnaharra, Sutherland) temperatures fell to record lows of -21°C and in Yorkshire they fell to -19°C at Topcliffe.

Figure 20 Snowfall at Crookes 1st December 2010 (© J.P. Richards)

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Sheffield's Weather by Gaynor Boon & Adrian Middleton

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Above: Snow on Fargate, 31st January 1983 (courtesy of Sheffield Newspapers)

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