1816 – the year without summer: the experience of Newcastle-upon-Tyne

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Introduction

This year marks the 200th anniversary of the much-discussed *year without a summer*, the general background to which requires little elaboration in this presentation beyond what follows; it is thoroughly reviewed in, for example, Klingaman and Klingaman (2014), Oppenheimer (2003) or Stothers (1984), whilst a good overview of volcanic influences on climate in general can be found in Robock (2000). The eruption of Tambora in April of 1815 – arguably the largest in recorded history (Lamb, 1970) – created a stratospheric dust veil of such opacity as to plunge the planet, or at least a good deal of it, into a wintery grip. Though temporary, this occurrence was of an intensity rarely matched in recent times; however, it is important to remember that it was by no means unprecedented in terms of conditions in preceding years. Gordon Manley's Central England Temperature series (Manley, 1974) gives 1816 an annual mean of 7.8°C. This figure is equalled by that of 1784 – the year of the Lakagígar eruption in Iceland (Demarée and Ogilvie, 2001) – with several years in the 1690s being yet lower (1695 at 7.2°C for example). The year 1814 was also cooler (7.7°C) and draws attention to the as yet unidentified but seemingly significant volcanic eruption of 1809 and, possibly, the more persistent influence exerted over the decade by the Dalton Minimum of solar activity (Wagner and Zorita, 2005). Other than 1816, only 1740 (6.8°C and the coldest in the series) and 1879 (7.4°C) have been cooler in the CET. Such statistical niceties notwithstanding, records of harvest failures abound, and the consequent social and economic dislocations were widespread and echoed around the parishes of England and well beyond. Whilst a quasi-global event, as far as relatively meagre evidence allows us to suggest, this paper focuses on just one location: Newcastle-upon-Tyne, where, by good fortune, a hitherto largely overlooked but detailed and reflective weather diary survives in words and statistics to bear witness to the climatic hiatus in this one location. What follows relates the diary's content, but in doing so tells us much of the dedication of observers and of their methods in a period of enlightenment but many years before the establishment of any form of organised networks of observers.

James Losh: political reformer and weather observer

The weather diaries that form the basis of this paper were kept by James Losh of Jesmond, Newcastle-upon-Tyne between 1802 and 1833 and are now in the care of the Newcastle Literary and Philosophical Society[1], the foundation of which was partly his responsibility (see http://www.litandphil.org.uk for more details). The diaries consist of thrice-daily observations of the wind and weather, usefully supplemented by temperature and air pressure readings. Of equal interest are Losh's lengthy written reflections on the weather of each month and of each year. These are inevitably concerned with the prevailing weather conditions, but in this still largely pre-industrial age Losh comments extensively on the agricultural and botanical consequences. As will be pointed out later, some debate surrounds who made the observations, but he was clearly the driving force, and his name, rightly, is attached to the series from this point.

James Losh was born in Woodside (near Carlisle) on 10 June 1763. He enjoyed an excellent education befitting the son of a country gentleman and entered Trinity College, Cambridge in 1782, emerging with his BA four years later. He was called to the Bar in 1789 and also considered ordination, but his Unitarian views prevented him from following that pathway. He was, however, intellectually and politically active through his life. He visited France not long after the Revolution, and his striking and elegant appearance lent him the look of an aristocrat: he was saved from the *sans-culottes* only by the good offices of Joachin Murat (later King of Naples!). Despite this unpleasant encounter, he translated publications on the Revolution from French into English. He suffered a breakdown in 1795 that left him vulnerable for the rest of his life. He recuperated in Bath where he met Humphrey Davy; he also counted Southey, Coleridge and Wordsworth amongst his acquaintances. In 1798 he married Cecilia Baldwin, moving to the Grove, in Jesmond on the then eastern limits of Newcastle-upon-Tyne, where he remained until his death in 1833. This move was not by accident, and Losh had worked as Recorder on the Northern Circuit and also enjoyed business interests in mining and chemicals in the area. He remained politically active, being instrumental in Grey's Reform Movement and doing much to promote schools and education in the Tyneside area. A rather grand, if imaginative, statue to him in full Roman garb stands proudly in the entrance to the Newcastle Literary and Philosophical Society's Library (Figure 1); rarely can a weather observer have been so immortalised.

As is evident from the weather diaries, he was methodical in his approach to life, and in 1807 wrote *The following is the arrangement which I now resolve to adhere to in future and I hope that I may not deviate far from it … to rise at 7 and to breakfast at 9, leave home at 10 and set out from my chambers at 4, dine at 5, drink tea at 7 and go to bed at 11…* Losh's personal diaries and correspondence have been published by the Surtees Society (Hughes, 1962) and, whilst suggesting a life-long interest in politics and education, are mute on the motives that prompted him to start his weather observations, an activity that persisted right up until the time of his death. There is, however, some doubt that he made all of the observations himself. His work as Northern Area Recorder took him, as is made clear from his diaries, away from Newcastle on his circuit duties, often for several days. It cannot be determined who made the observations during his frequent absences, but they were dutifully performed and written up in a clear and consistent hand that may well be that of James Losh, drawing perhaps on notes made at the time by others.

[1]The James Losh diary for 1816 is held under catalogue N551, accession number 1868

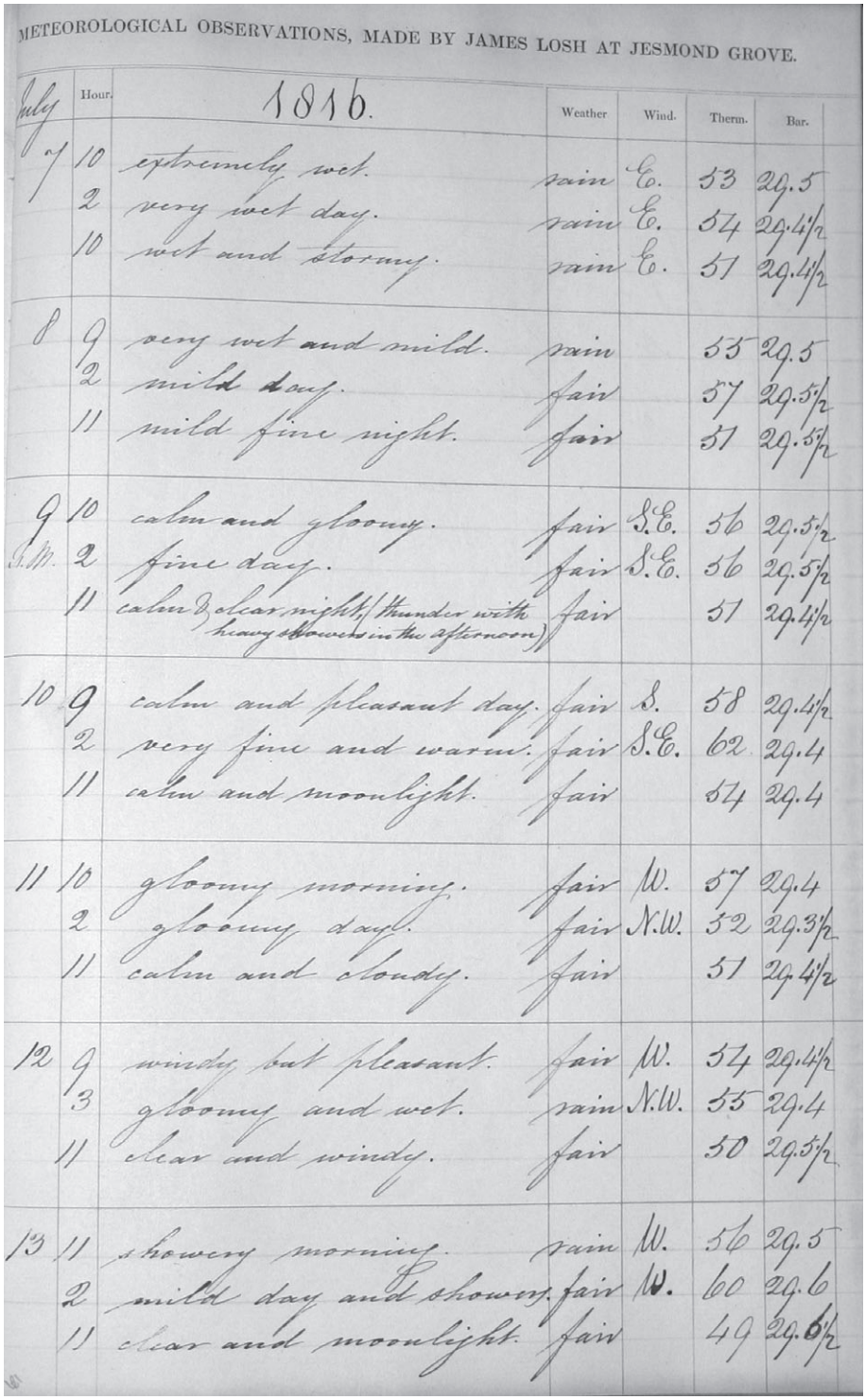
RMetS Royal Meteorological Society

Figure 1. The statue commemorating the contribution of James Losh to the city of Newcastle-upon-Tyne. (© Newcastle Literary and Philosophical Society.)

The diaries of James Losh

The weather diaries begin in 1802 and run through, without interruption, until 1833. Regrettably, no attempt has hitherto been made to abstract and digitise this fund of data, the layout and general form of which do not vary through that three-decade period. A typical page is shown in Figure 2 and consists of observations made three times a day; this is usually 0900, 1400 and 2300h (local time, as GMT had not then been established). There are occasional departures from this, but they are infrequent and minor, for example from 10 to 25 August and again between 1 and 12 November 1816 the evening observations were made at 2200h. At the conclusion of each month there is, on the page facing the observations, a written account of the month, and likewise at the end of every year. In the event of noteworthy happenings an account might appear attached to that day's observations (an example can be seen in Figure 3). In general, this is a remarkable, complete and valuable series of observations and accounts.

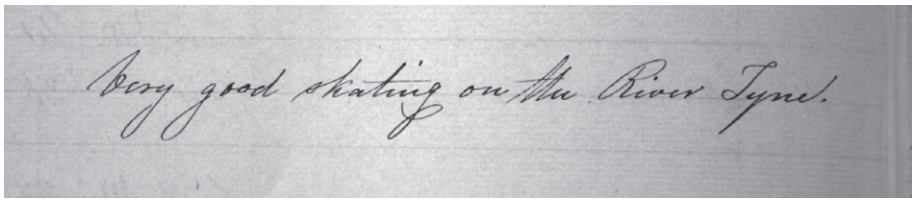
In more detail, the daily record consists of – working across the row of a typical page – the date and time, a general and brief description of the weather, then a single term description such as 'rain' or 'snow' or 'fair', followed by the wind direction (on an eight point compass), the air temperature and air pressure. Wind direction entries were rarely included for the 2300h reading



METEOROLOGICAL OBSERVATIONS, MADE BY JAMES LOSH AT JESMOND GROVE.

July	Hour.	1816.	Weather	Wind.	Therm.	Bar.
7	10	extremely wet.	rain	E.	53	29.5
	2	very wet day.	rain	E.	54	29.4½
	10	wet and stormy.	rain	E.	51	29.4½
8	9	very wet and mild.	rain		55	29.5
	2	mild day.	fair		57	29.5½
	11	mild fine night.	fair		51	29.5½
9	10	calm and gloomy.	fair	S.E.	56	29.5½
S.M.	2	fine day.	fair	S.E.	56	29.5½
	11	calm & clear night (thunder with heavy showers in the afternoon)	fair		51	29.4½
10	9	calm and pleasant day.	fair	S.	58	29.4½
	2	very fine and warm.	fair	S.E.	62	29.4
	11	calm and moonlight.	fair		54	29.4
11	10	gloomy morning.	fair	W.	57	29.4
	2	gloomy day.	fair	N.W.	52	29.3½
	11	calm and cloudy.	fair		51	29.4½
12	9	windy but pleasant.	fair	W.	54	29.4½
	3	gloomy and wet.	rain	N.W.	55	29.4
	11	clear and windy.	fair		50	29.5½
13	11	showery morning.	rain	W.	56	29.5
	2	mild day and showery.	fair	W.	60	29.6
	11	clear and moonlight.	fair		49	29.6½

Figure 2. A typical page from the James Losh weather diaries. (© Newcastle Literary and Philosophical Society.)



Very good skating on the River Tyne.

Figure 3. All but impossible today – one of Losh's additional notes, on the subject of skating on the Tyne (11th February). (© Newcastle Literary and Philosophical Society.)

suggesting that cloud movement (obscured at night for the most part) might have been used in its determination. Temperatures were recorded in degrees Fahrenheit and to the nearest whole degree (only once in 1816 was a fractional part included), and air pressure was recorded in inches and vulgar fractions. No evidence is forthcoming about the manufacture or exposure of the instruments. With regard to location, it is worth noting that in the early nineteenth century Jesmond lay on the limits of the city but surrounded by gardens, in what might be today described as an exposed rural setting.

The vocabulary used in the written accounts is of interest. It is limited in extent and falls under the two headings noted above of general description and specific, single-word accounts. The latter may be dealt with first, there being only four terms used: 'fair', 'snow', 'rain' or 'sleet'. Of these, 'fair' is by a notable margin the most commonly used. However, when set against the preceding lengthier descriptions for the same day, it is abundantly clear that 'fair' – to Losh's way of thinking at least – is associated with a huge variety of conditions, of which only a few can be exemplified here (Table 1). Of the general descriptions more needs to written as the vocabulary is more extensive and elaborate, lending a sense of greater accuracy and discrimination to the account. Table 2 lists all those terms used by Losh in 1816. They range widely and include items that might be employed today but others that might not, though not lacking force for all that, and 'disagreeable', to take a good example, enjoys a currency that most would identify with today. The terms were often used in combination and further qualified by additions such as 'very' or 'frequent' to give a depth of description lacking in the one-term accounts.

An issue arises, however, from this component of the diaries, and one that has bearing on the later analysis. Most importantly, it is not always the case that mention of precipitation is matched by the entry 'rain' or 'snow' in the following column. For example, on 26th December the entry 'very windy – showers' is followed by 'fair' in the next column. There are many other such inconsistencies and the manner of their treatment will be discussed later.

The weather of 1816 in Newcastle

One can hardly embark better on this enterprise than to quote Losh's review of the year: *the whole year of 1816 has been singularly unfavourable to the products of the earth rather however to the quality than to the quantity of them. Fruits of every kind, though in many places abundant, have never attained their full flower. Potatoes were both a scanty crop and of poor quality, and wheat in general ill-ripened and much spoiled also by the bad weather* during *the whole of the harvest. Barley was not better than the wheat, and oats, although they suffered the least, were much injured. Indeed when we consider that November was this year one of the principal harvest months it is rather to be wondered at that any corn was preserved than that as much was destroyed. The bad season added to the other difficulties of the Country, has produced considerable alarm and anxiety in the public mind. I am satisfied that the present evils are only temporary.*

These reflections are nicely elaborated and given substance by the daily observations. These are gathered here together in monthly form, the temperature and air pressure readings being converted to SI units. The mean monthly temperatures are presented in Table 3 and relate to the morning, afternoon and evening readings. No changes have been made using, for example, Glaisher corrections (1848) in order to estimate maxima and minima, neither have changes been made to take account of the occasional 1h time shift in observation times noted earlier. The results are as informative as they must have been alarming to those who endured them. The absolute maximum for the year struggled to rise above 20°C, whilst the minimum of −7.2°C, though not unmatched in recent times, occurred in a prolonged spell of inclement conditions when, between 0900h on 28th January and 0900h on 2nd February, there are no readings above zero, whilst between 2300h on 6th February and 0900h on 12th February only 2 of the 14 observations were above freezing (Figure 4). The absolute minimum of −7.2°C was recorded at 0900h on 9th February, and it can only be speculated that the preceding overnight minimum may have been yet lower. The winter's last air frost occurred on the night of 13th April, with the next winter's first frost on 7th November. Such figures notwithstanding, few records testify more adequately to the conditions than the additional note made on 11th February: *Very good skating on the Tyne* (Figure 3). It must, however, be emphasised that an air frost in the current context can only be interpreted on the basis of a fixed-hour (usually, but not always, at 0900h) reading of below zero; there may well have been nights of frost but with a recovery before the morning observation that leaves no record. Expressed otherwise, this frost day count must be regarded as conservative.

Not surprisingly, snowfall embraced a longer time span than that for frost. Figure 5 summarises the monthly counts of rain, snow, frost and ice days. Snow fell on 37 days in the year, with March being the

Table 1

Various daily and general descriptions all of which, despite their variety, were followed by the specific description 'fair' in the next column of the diary.

Date (all 1816)	*General description*
1st January	Delightful day
29th February	Gloomy and cold
18th March	Very windy – showers of rain and hail
30th April	Gloomy wet day
17th June	Fine sunny morning
12th July	Windy and pleasant
21st August	Clear morning – bright sun
22nd September	Gloomy and disagreeable day
26th October	Hoar frost – fine morning

Table 2

General vocabulary from James Losh's 1816 diary. Most of these terms were, at one stage or another, qualified with 'very', 'extremely' or 'frequent' and were often used in combination, e.g. 'calm and gloomy'.

Relating generally to:	*Terms used*
Wind	Calm, windy, stormy
Visibility	Clear, fine
Precipitation	Wet, damp, rain (and rainy), small rain, showers (and showery), hail, sleet, snow, dew, frost (hoar and hard)
State of sky	Cloudy, hazy, dark, starlight, moonlight, gloomy, sunny
Temperatures and events	Hot, cold, mild, thunder
General terms	Pleasant, delightful, disagreeable

Table 3

Mean monthly and extreme temperatures (°C) for 1816. The 'derived' mean is based on the mean of the 0900, 1400 and 2300h observations.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
0900h	1.5	1.7	2.5	4.8	9.2	12.4	13.6	13.3	12.1	9.6	4.0	2.4	7.3
1400h	2.8	4.2	4.9	6.9	11.3	14.5	15.3	15.8	14.2	10.9	4.5	3.6	9.1
2300h	1.6	1.3	2.2	3.6	7.4	10.0	11.5	12.0	10.4	9.0	3.7	2.4	6.3
Derived mean	2.0	2.4	3.2	5.1	9.3	12.3	13.5	13.7	12.2	9.9	4.0	2.8	7.5
Abs. max.	7.2	9.4	10.0	12.2	14.4	20.0	20.6	20.6	20.6	15.0	12.2	10.0	20.6
Abs. min.	−5.0	−7.2	−3.9	−1.1	1.7	2.2	9.4	8.3	5.0	3.9	−3.9	−2.2	−7.2

snowiest month. The last snow of the winter was on 11th May, notable as St. Pancras Day – one of the famous Ice Saints' feast days of May (Bowker, 2014). This must have been a remarkable fall as the additional note for the day reads: *We had today, for two hours, the heaviest fall of snow I ever recollect to have seen at any season*. That day began with hail on northwest winds but by 1400h the wind had shifted to the southeast and the snow had begun, although temperatures remained unexceptional at 5°C. Snow began early the following winter, with falls on the night of 8/9th November. Indeed, so poor had been the summer that Losh observed on 11th November: *Snow on the ground, much corn still uncut*.

Losh did not, it seems, possess a rain gauge, and we must rely on the record of rain-days to recapture the precipitation picture for the year. It was, however, necessary to rework some of the diary data in order to secure this count and, as observed above, there were occasions when rain was noted in the general account but did not appear in the single-term column where, for example, 'showers' could be followed by 'fair' (see Table 1). The counts in Figure 5 (for both snow and rain) are based on aggregating all days when rain (or snow) were noted, irrespective of where in the account that reference appeared. It must, however, be stressed that the number of rain-days is probably an underestimate, and the count should be more properly regarded as an index allowing one month to be set against another. July, with 20 'days', emerges thereby as clearly the wettest month, followed by August and October, with 14 'days' each. Losh's comments on August are worth here repeating: *The past month of August has been the most unfavourable to the country of any within my remembrance – the weather has been uniformly cold and very frequently wet – the corn, though the crops seem very heavy, is so very far from being ripe that there seems too much reason for fearing that much of it will not ripen at all this year. Potatoes look good but they too are remarkably backward, as is fruit of every kind. It appears to me that every thing is a month later than usual.* Moreover, Losh recognised that his

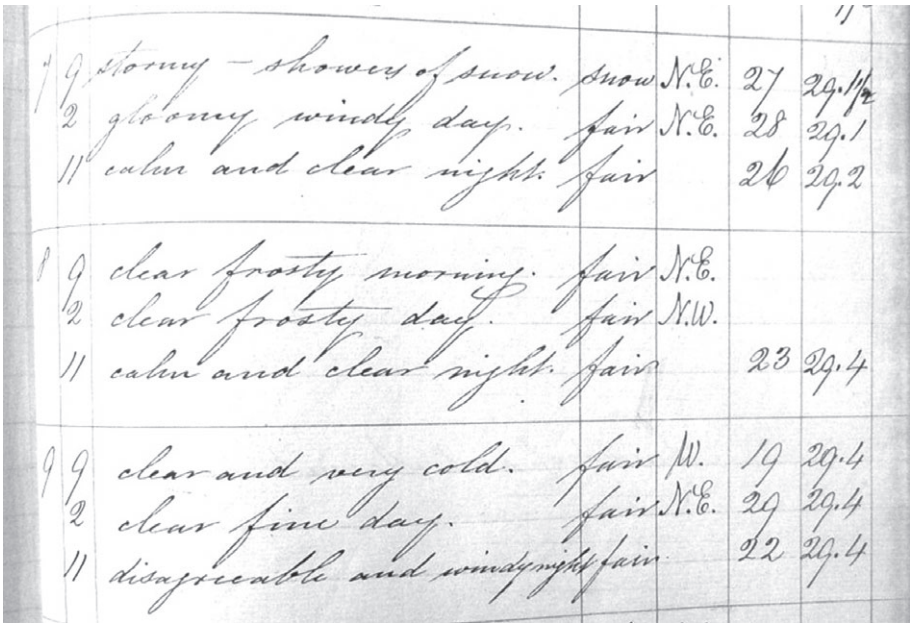


Figure 4. The year's coldest spell, that of early February, as recorded in the James Losh diaries. (© Newcastle Literary and Philosophical Society.)

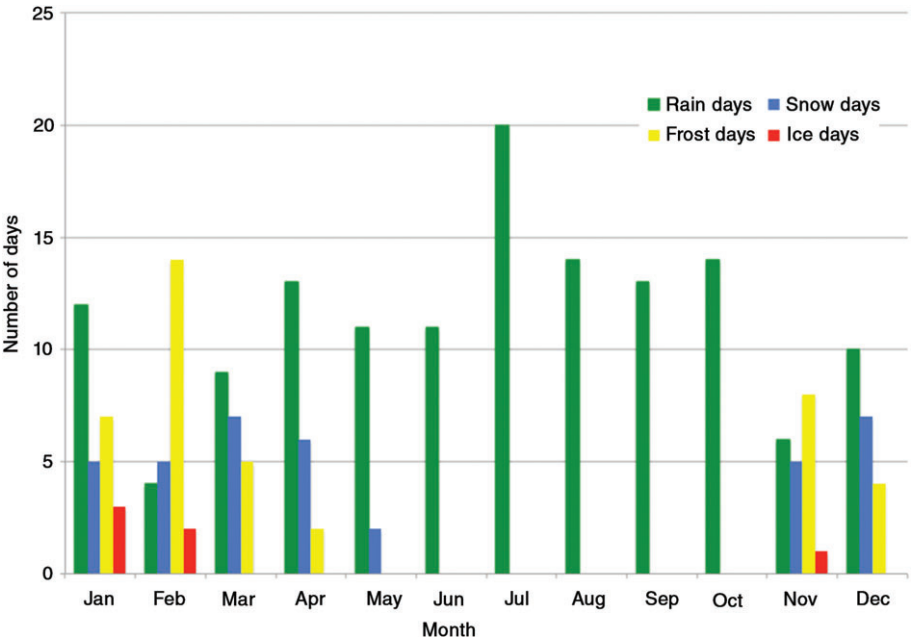


Figure 5. Monthly counts for 1816 of rain, frost, snow and ice days.

experiences were by no means local, and his September review states: *This month of September has been very unfavourable to the Country, and the present state of the crops is greatly alarming. There is very little corn cut in this neighbourhood and very much not*

*nearly ripe. What is still worse I fear the same bad season has extended not only to Great Britain**, but to the whole of Europe*** (the current author's emphasis).

Such broader aspects raise the question not only of temperatures but of the atmospheric circulation at the time. Fortunately the Losh diaries are an abundant source of data for wind direction, being recorded twice daily. Figure 6 is the wind rose for the year and is based on all sub-daily observations. The results are interesting as it might be thought that such cold conditions would be associated with abundant northerlies, especially in summer, and easterlies in winter, but such is not the case and it is the westerlies that dominate, with northerlies being the least frequent direction for the wind. The monthly figures are, however, more illuminating and are provided in Table 4. It is interesting to note the abundance of easterly and southeasterly winds during an evidently wet summer. This strongly suggests – but does not prove – a southerly displacement of the polar jet stream and the passage of depressions to the south of the region leaving it exposed to typically wet on-shore conditions of the sort recently experienced in the Morpeth floods of 2008 (Wheeler, 2013).

Again, as might be anticipated, the cold winter seems not to be associated with easterlies, as occurred, for example, in the intensely cold decades of the 1680s and 1690s (Wheeler *et al.*, 2010). This direction was only infrequently experienced, and westerlies dominated the season. Unusually, it would seem, the normally tempering westerlies of winter are here associated with cold conditions. Indeed, in the year's coldest spell, which came in late January and early February, the winds remained stubbornly and remarkably west to southwest. Much here of course depends on the provenance of airstreams that, whilst being westerly over the British Isles, may have come originally from more northerly latitudes. A possible analogue might be offered by January 1984, when northern England and Scotland experienced some very low temperatures despite the overwhelmingly westerly nature of the month; this curious combination was the result of a number of depression cold sectors drawing Arctic air from Greenland rather than from further south. Part of the text from the Climatological Observer's Link bulletin for the month is worth recalling: *The remarkable thing was that the cold air supply originated on the western side of Greenland where surface temperatures were around minus 30C*. The degree to which exceptionally low sea surface temperatures may have contributed to the abiding chill of the year is a matter upon which, in the absence of any evidence, even speculation should be avoided.

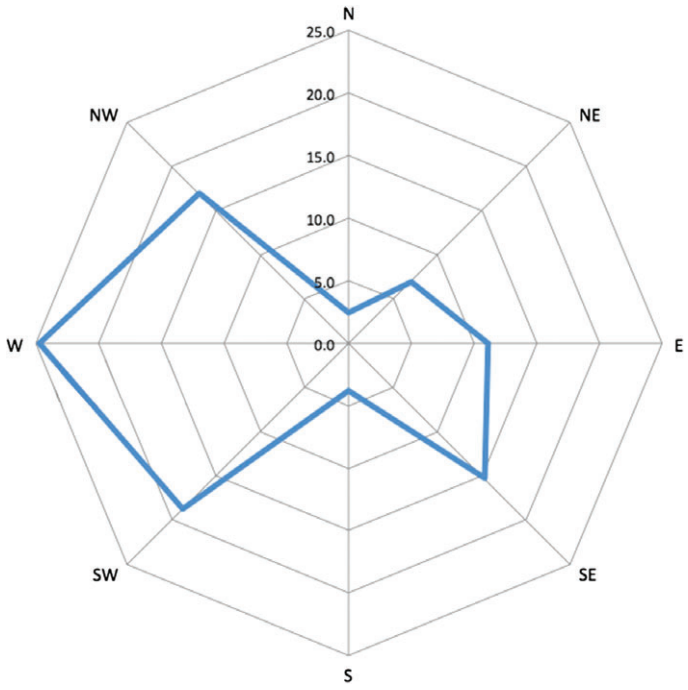


Figure 6. The wind rose for 1816 based on all observations during the year.

The air pressure record (here uncorrected for temperature or for altitude) casts further light on the year, and Figure 7 reveals the degree to which July, already identified as the wettest month of the year, emerges also as notably 'cyclonic', with the air pressure plunging that month to a degree matched only by the mid-winter months of December and January. Once again we may make recourse to Losh's monthly overview, and for July he writes: *In this July we have had more rain and cold weather than I remember in any former year at this season – still however the crops though certainly later than usual do not look very unpromising. The wheat is in flower and the oats just coming into ear – the hay harvest is becoming general, though very little is in yet is secured even in Pike* [sic].

There are no records of wind strength other than occasional written references in the daily accounts. The term 'windy' is used too often to denote anything other than relatively modest activity, but the term 'stormy' carries greater conviction. There were 14 such 'storm' days in the year, none during the wet months of May, June and July and only one in August. March, with four storms, was the most turbulent month, followed by April, with three, and

Table 4

Percentage of observations denoting winds on an eight-point compass for 1816. Bold text indicates the most frequently observed directions for each month.

	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
N	0.0	3.5	0.0	3.7	0.0	6.3	3.5	0.0	0.0	6.3	4.7	1.6
NE	6.1	10.5	6.9	20.4	6.2	6.3	7.0	6.2	6.3	3.1	4.7	0.0
E	6.1	0.0	10.3	9.3	**24.6**	17.5	**26.3**	9.2	15.9	14.1	0.0	0.0
SE	20.4	1.8	24.1	**25.9**	23.1	14.3	17.5	4.6	9.5	15.6	18.6	7.9
S	0.0	0.0	8.6	3.7	4.6	6.3	1.8	1.5	0.0	9.4	4.7	4.8
SW	**24.5**	**38.6**	19.0	18.5	7.7	12.7	8.8	6.2	30.2	6.3	**27.9**	25.4
W	16.3	10.5	**25.9**	11.1	**24.6**	17.5	17.5	**46.2**	**31.7**	**35.9**	20.9	**38.1**
NW	26.5	35.1	5.2	7.4	9.2	**19.0**	17.5	26.2	6.3	9.4	18.6	22.2

Figure 7. Monthly air pressure for 1816 at the three times of daily observation.

January, February and December, with two each. September and November registered only one storm each, and October none. Only once, however, does any form of storm activity attract Losh's attention sufficiently for it to be noted as a supplementary daily comment. This was on 10 September (a day noted otherwise as only being 'very windy') when the entry appears: *Violent storm and much injury done to trees etc. by the wind. The Vicar's Ash in Westgate Street*[2] *was blown down*.

How cold was 1816?

As noted above, 1816 was by no means the coldest year in the CET series, and its reliable place in the wider geographic – that is, regional or hemispherical – sense cannot be confidently determined for lack of suitable evidence. We can, however, attempt a more local assessment. Newcastle-upon-Tyne no longer supports a weather station, but fortunately the University did operate an observatory between 1941 and 1987, the data from which are usefully summarised in Sharp (1988). The observatory was situated not far from Losh's site but in a now thoroughly built-up part of the City, and the urban heat island effects must be acknowledged, even if they are not quantifiable. The period of record does, however, pre-date the warming of the last decades and avoids any blurring of the comparisons in that respect.

Such caveats notwithstanding, the cautious comparisons are illuminating. We have no maximum or minimum temperatures with which to estimate means as they are understood today, but we can, as a reasonable and qualified alternative, take the mean of the three daily observations (Table 3). To judge as best one can from Glaisher's 1848 table of corrections, this derived mean has a bias of +0.8 degC, that is, it is warmer than any mean based on the maximum and minimum readings. Even allowing for this, the 1816 derived annual mean of 7.5°C has no comparison in the more recent record, the coldest year of which was 1963 with 8.3°C. Sharp helpfully gives the standard deviation of his various means and the 1816 value has a *z*-score of −3.9: in simpler terms this renders 1816 a 1 in 1000 year event, although it must not be forgotten that that conclusion is based on a much more recent statistical distribution of annual figures and is offered as an illustration rather than a probabilistic statement. In contrast, the individual months reveal a more complex picture, and one that in many ways imparts, if perversely, the true character of the year. Although none of the 1816 months were colder than those that constitute the 1941–1987 Newcastle extreme set, all of them were, and this is without local precedent, below the recent respective monthly averages. It might be added, however, that only two were significantly cold in terms of *z*-scores, these being April ($z = -2.21$) and November ($z = -2.00$). Of the monthly absolute minima, only that for June of 1816 (at 2.2°C) would have set or equalled the record of 2.2°C set on 1 June 1962. On that latter occasion the preceding night (of 30th/31st May) experienced an air frost; given that the Losh reading was for 0900h, it is reasonable to suggest the same may have been true in 1816.

The annual frost and snow incidences are noteworthy rather than record-breaking. The last sub-zero thermometer reading of the 1815/1816 winter was on the night of 8th April, while the mean date for last air frost for the period 1952–1989 was 16th April. The first sub-zero reading of the 1816/1817 winter was on the night of 7/8th November, against the more recent mean first air frost date of 13th November. Snowfalls were no more impressive and the number of snow days in each winter month of 1816 was well short of the respective records, although they are all above their respective means.

[2]Westgate Street was in the city centre.

Conclusion

In conclusion, whilst 1816 was indeed a year without a summer it does not perhaps wholly match the almost mythical status with which it has been credited. Most certainly the year's mean was a reminder of its character, but no major records were broken for individual months, and it was the cumulative effect of every month being below average temperature that marks it out, and not merely as the year without a 'summer' but one in which all seasons were cold.

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Letters

Readers are encouraged to submit letters for possible publication. Letters can be submitted either electronically through the system used for articles, by email attachment to weather@wiley.com or by post, as shown on the Contents page. The Letters Editor reserves the right to edit any letter.

Today, 22 December 2015, I mowed my front lawn in Reading on the shortest day of the year, because: (a) it needed it, and (b) the weather allowed it.

Is this a record? It certainly is for me.

Michael Sewell
Reading, UK
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May I comment on paragraph seven of Anders Persson's letter in the December issue of *Weather* (Persson, 2015)?

The assertion is made that the 'British side' was unable to make a correct physical interpretation of the Rossby wave formula, and that as a consequence its progress in NWP was blighted. In my view the development of NWP in the Meteorological Office had nothing to do with this, but rather it had to do with how the practice of weather forecasting evolved in the period before computers became available and with the resources that were available during the 1950s and early 1960s.

In the 1940s the theory of baroclinic development was a hot topic, and in the Met Office considerable attention was given to the version of it due to Sutcliffe. In the early 1950s the daily forecast conferences at CFO Dunstable generally considered the implications for development that flowed from it, though the discussion could be wide-ranging and commonly the changes likely as a result of applying the Rossby wave formula (correctly interpreted!), quoted by Persson, were also enthusiastically presented. When it became possible to gain access to computers, it was an obvious logical step to put the development theory to a stiffer quantitative test, and this was achieved in the Sawyer–Bushby model, produced at a time when models of similar complexity were being tested in the USA. It was, I believe, fully recognised that the forecast at middle level produced by the S–B model was substantially barotropic; but it was considered a strength that the model also gave a forecast of surface pressure, which was and remains the most important level in practical forecasting.

At this time (1953–1956) part of the research I was carrying out involved spectrally analysing the 500mb flow to isolate the planetary long waves, and producing a barotropic forecast to determine if this gave useful indications for longer-range forecasting. This involved travelling with Bushby to work on the computer in Manchester. So, although I was never involved in the NWP project, I was at that time quite close to it. Scientifically, and at least for those closest to the 'coal face' it was undoubtedly a time of great optimism, with no sign of the frustration that Persson thinks marred progress. Tests showed, however, that the forecasts from the computer model were inferior to those of CFO (at a time when CKM Douglas was still having a substantial beneficial input, as I observed as a forecaster in CFO). But this was probably more a spur to further research initiatives than it was a dampener of the general mood.

An important factor influencing the progress of NWP was the availability of resources. The 1950s was a period of considerable flux in the Met Office, and this impacted on all the research programmes. Throughout, computing time was severely limited. But the availability of suitable staff was also a problem. In the early part of the decade the consequences of the post-war reconstruction, when many staff were shed, were still working their way through the system; the Brabazon committee report (1956) allowed for the recruitment of young researchers, though the results took some years to become apparent; and the move to the new HQ in Bracknell was a significant disturbance to the staff and their work. It was probably only after the move to Bracknell was completed that a more concerted approach to NWP became possible.

One may agree or disagree about the wisdom of the decisions taken in the Met Office concerning NWP, but they followed a coherent and deliberate course allowing for the resources available, and the notion that it would have been radically different if only those involved had been capable of interpreting the Rossby wave formula in some different way seems quite bizarre.

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