A weather diary from Donegal, Ireland, 1846–1875

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Introduction

Previous studies have presented weather diaries for Ireland dating back to the eighteenth century. These include the diary of Thomas Neve near Derry in Northern Ireland for the years 1711–1725 (Dixon, 1959), the diary of Isaac Butler from Dublin for the years 1716–1734 (Sanderson, 2018), the diary of Joshua Wight from Cork from June 1753 to September 1756 (Tyrrell, 1995), and the diary of Dr John Rutty for Dublin covering 1716–1765 (Rutty, 1770). Systematically recorded weather diaries rank among the most important sources for historical climatologists (Brázdil *et al*., 2005), and empirical data and qualitative descriptions from the above diaries, which collectively span more than 50 years, have been critical to developing estimates of eighteenth century precipitation for Ireland (Murphy *et al*., 2018).

Curiously, few diaries have been located or presented for the nineteenth century, one notable exception being the diary of Humphrey O'Sullivan, covering the years 1827–1835 (McGrath, 1936). While early instrumental observations commence at a handful of stations from the early 1800s (e.g. Dublin, Kilkenny, Derry, Belfast, Armagh, Cork and Sligo), it is not until after 1870 that observations become more widespread (Noone *et al*., 2016; Murphy *et al*., 2018). In this paper, we present a weather diary for Glendooen, Co. Donegal, most likely compiled by Rev. Henry Kingsmill for the years 1846–1875. The original manuscript record of the diary is held in the archives of Armagh Observatory (Butler and Hoskin, 1987). The diary is an important source of information on nineteenth century Irish weather as it was recorded in the northwest, a relatively poorly observed part of the island, and covers a critical period of Irish history – that of the Great Famine, 1845–1852.

Figure 1. Image of Glendooen Rectory, home of the Rev. Henry Kingsmill. (Photo taken by Dr John Butler, August 2002.)

The diarist and location

The diary represents the weather conditions experienced at Glendooen, situated in the townland of Doon Glebe, Co. Donegal in northwest Ireland. Glendooen is approximately 6km from Letterkenny, the county's largest and most populous town. The site itself is an old rectory, built in 1814 for Rev. Joseph Stopford, rector of the parish of Conwal, Co. Donegal. Glendooen continued as a rectory until 1919. The site consists of a main house and two adjacent outbuildings, surrounded by a walled garden. Now under private ownership, Figure 1 shows the site in 2002.

While the diary is unsigned, and its pages never definitively state the author's name, it is most likely that the observer was Rev. Henry Kingsmill. Kingsmill was born in 1803 in Kilkenny in southeast Ireland. Educated at Kilkenny College, he took up a fellowship at Trinity College Dublin in 1828, where he remained until appointed Rector of the parish of Conwal in Donegal in 1836. Kingsmill was resident at Glendooen during his time as rector of the parish. He held this position until 1876, when he moved to Dublin to retire (Butler *et al*., 1998). His death is recorded on 3 November 1888 at Rathmines in Dublin.

Figure 2. Example of monthly tabular type diary entries for the years 1851–1856 from the Glendooen Weather Diary. This form of entry is typical for the years 1846–1872.

The diary

The original Glendooen diary is held at Armagh Observatory (document M32 in the catalogue published in the *Journal for the History of Astronomy* by Butler and Hoskin (1987)). In order to transcribe and analyse the diary, 139 scanned pages were provided by Armagh Observatory as Portable Document Files (PDF), covering the period from 1846 to 1883. The contents of the diary represent conditions at Glendooen from commencement up to the end of 1875, after which time the observer moved to Dublin. While notes were continued after this move, we constrain our focus in this paper to the Glendooen years as entries become less detailed and more sporadic after this. Over the years, the format in which information is presented changes, but can be roughly organised into the categories described below.

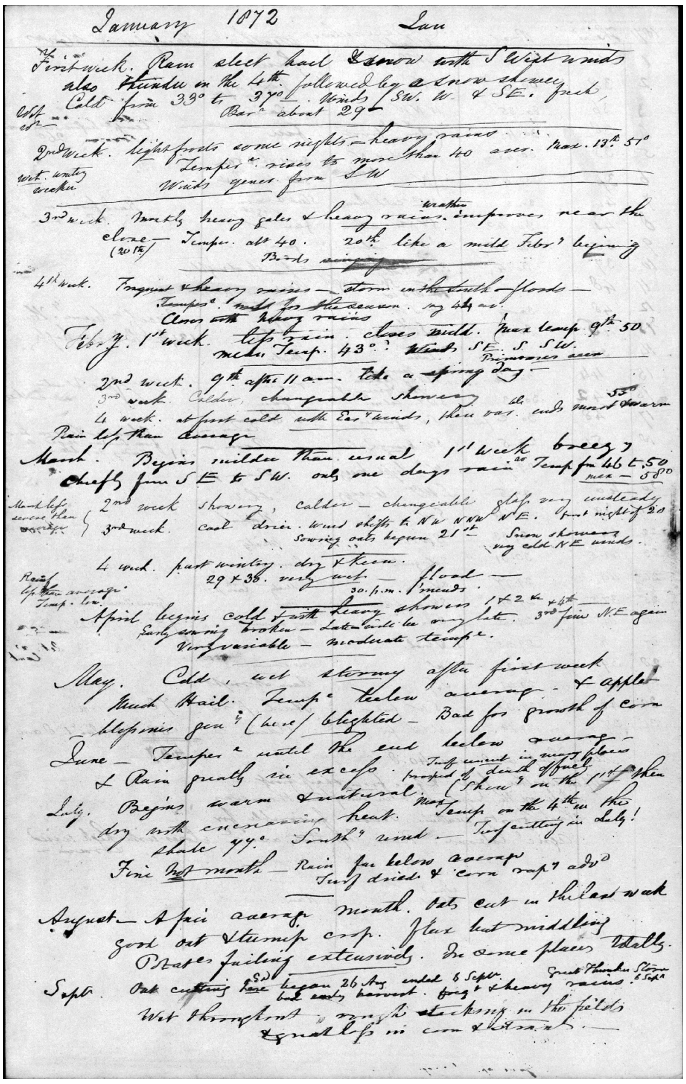
Summary descriptions

The diary provides descriptive summaries of monthly weather in both tabular and paragraph form. These entries often contain reflections not just on weather, but also on flora, fauna and notes on harvest reports. For the tabular form, seven pages are presented covering the years 1846–1872 (see Figure 2 for an example layout). There is some overlap with instrumental observations made at the same site for the years 1864–1871 (see below). From 1872, the observer changes format and describes the weather of each month in individual paragraphs (see Figure 3 for example layout). These descriptions can run to more than a single page per year and cover the period 1872–1883, although from 1876 onwards the focus of the diary shifts to Dublin, coincident with Rev. Kingsmill's retirement. It is worth noting that for the paragraph style entries, quantitative estimates are sometimes included alongside the qualitative descriptions, with the observer occasionally noting monthly precipitation totals and monthly mean temperature values. However, this information is often incomplete and offers only partial coverage of the period from 1873 onwards. Furthermore, it is not clear whether these values are recorded by the observer himself or taken from some other source.

Instrumental data

Daily weather observations of temperature, pressure, wind direction and rainfall were taken at the site for 8 years 1864–1871. Observations are presented in 96 monthly data sheets, together with a brief note on the weather for each day. Figure 4 provides an example of a typical monthly data sheet for July 1865. Little detail is available on the instruments used and/or their positioning, though it is likely that measurements were non-standard by comparison to modern approaches. Temperature was measured in degrees Fahrenheit (recorded to the nearest 0.5°F), most likely using a mercury thermometer. In terms of exposure, the observer writes in April 1864 '*Note the thermometer is exposed on the outside of window frame, faces the north – heat is affected by reflected heat in clear sunshine*'. It is not clear that any corrections were made, though comparison with observations from Armagh (below) suggests that mean monthly temperatures at Glendooen are higher than Armagh in summer months. It is therefore possible that temperature recordings are affected by heating due to glass, particularly during summer months. We make no attempt to correct potential biases and present only the raw data from the diary here. Observations were recorded at 0900h daily, apart from a number of months when they were taken at 1500h. At the end of each month, the observer often included the minimum night time and maximum daytime temperature recorded during the month, together with 0900h temperature each day. The only observations for which a continuous daily series is available are for 0900h temperatures, and we use this series below. No indication is given as to whether the observer had access to or used maximum and minimum thermometers.

Precipitation was also recorded, although not strictly on a daily basis. Rainfall totals are most likely cumulative. However, at the end of each month rainfall totals (in inches) were tallied and recorded. There is very little description of the rain gauge and its positioning in the diary; however, notes made in May 1864 indicate that the height of the gauge is nearly 108 feet. Ordinance Survey Ireland six inch maps from the 1840s give the elevation of the Rectory site as 107 ft (32.6m) above sea level. The ten-year rainfall books (Met Office, 2020) held by the UK Met Office contain monthly returns for Glendooen, Letterkenny made by Rev. Kingsmill for the years concurrent with the dairy. On these sheets, the gauge is described as being located in '*a walled garden 18 feet from an 8 foot wall to the NNW*'. The gauge is described as a Casella with a five inch diam-


January 1872 Jan

First week. Rain sleet hail & snow with S West winds also thunder on the 4th followed by a snow shower. Cold from 33° to 37°. Winds SW. W. & SE. fresh. Bar. about 29

2nd week. light frosts some nights – heavy rains. Temper. rises to more than 40 aver. Max. 13th 51°. Winds gener. from SW

3rd week. Mostly heavy gales & heavy rains. weather improves near the close (20th) – Temper. abt 40. 20th like a mild Febr. beginning. Birds singing

4th week. Frequent & heavy rains – storm in the South – floods – Temper. mild for the season. Closes with heavy rains

Febr. 1st week. less rain. closes mild. Max temp 9th 50. mean Temp. 43°. Winds SE. S. SW. Primroses seen

2nd week. 9th after 11 am. like a spring day

3rd week. Colder, changeable showers

4 week. at first cold with East winds, then var. ends most warm. 55°

Rain less than average

March. Begins milder than usual. 1st week breezy chiefly from SE to SW. only one days rain. Temp from 46 to 50, max – 58°

2nd week showery, colder – changeable. glass very unsteady

3rd week. cool drier. Wind shifts to NW NNW NE. Sowing oats begun 21st. Snow showers very cold NE winds.

4 week. part wintry. dry & keen. 29 & 30. very wet – flood –

April begins cold & with heavy showers 1 & 2nd & 4th – Early sowing broken – Late will be very late. 3rd from NE again. Very variable – moderate temp.

May. Cold, wet stormy after first week. Much Hail. Temp. below average. & apple blossoms gen. (here) blighted – Bad for growth of corn

June – Temper. until the end below average. & Rain greatly in excess.

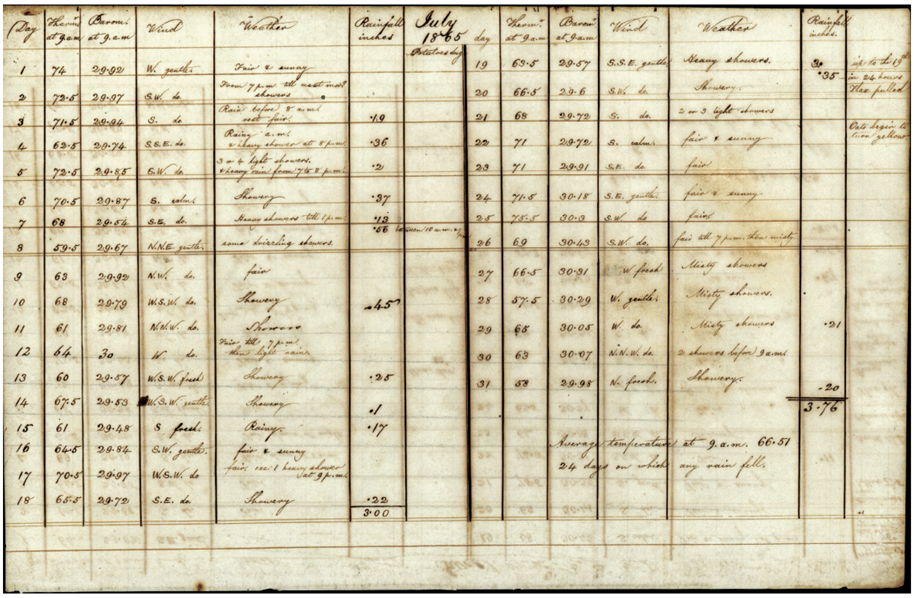
July. Begins warm & natural. dry with encreasing heat. Max Temp on the 4th in the shade 77°. South. wind – Turf cutting in July!

Fine hot month – Rain far below average. Turf dried & corn rap. adv.

August – A fair average month. Oats cut in the last week. good oat & turnip crop. Flax but middling. Potatoes failing extensively. In some places totally.

Sept. Oat cutting . . . begun 26 Aug ended 6 Sept. Great Thunder Storm 6 Sept. fog & heavy rains. Wet throughout, much stacking in the fields & great loss in corn & straw.

Figure 3. Example of paragraph type entry for January to September 1872. From 1872 onwards the diary is dominated by this type of descriptive note.



Day	Therm. at 9 a.m	Barom. at 9 a.m	Wind	Weather	Rainfall inches
1	74	29·92	W. gentle.	Fair & sunny	
2	72·5	29·97	S.W. do.	From 7 p.m. till next morn. showers	
3	71·5	29·94	S. do.	Rain before 8 a.m. rest fair.	·19
4	62·5	29·74	S.S.E. do.	Rainy a.m. & heavy shower at 8 p.m.	·36
5	72·5	29·85	S.W. do.	3 or 4 light showers. & heavy rain from 7 to 8 p.m.	·2
6	70·5	29·87	S. calm.	Showery	·37
7	68	29·54	S.E. do.	Heavy showers till 1 p.m.	·13
					·56 between 10 a.m. & [illegible] p.m.
8	59·5	29·67	N.N.E. gentle.	some drizzling showers.	
9	63	29·92	N.W. do.	fair	
10	68	29·79	W.S.W. do.	Showery	·45
11	61	29·81	N.N.W. do.	Showers	
12	64	30	W. do.	Fair till 7 p.m. then light rain.	
13	60	29·57	W.S.W. fresh	Showery	·25
14	67·5	29·53	W.S.W. gentle.	Showery	·1
15	61	29·48	S fresh.	Rainy.	·17
16	64·5	29·84	S.W. gentle.	fair & sunny	
17	70·5	29·97	W.S.W. do	fair, exc. 1 heavy shower at 9 p.m.	
18	65·5	29·72	S.E. do.	Showery	·22
					3·00

July 1865

Potatoes dug

day	Therm. at 9 a.m	Barom. at 9 a.m	Wind	Weather	Rainfall inches	
19	63·5	29·57	S.S.E. gentle	Heavy showers.	3·	up to the 19th
					·35	in 24 hours
20	66·5	29·6	S.W. do.	Showery.		Flax pulled
21	68	29·72	S. do.	2 or 3 light showers		
22	71	29·72	S. calm.	fair & sunny		Oats begin to turn yellow
23	71	29·91	S.E. do.	fair		
24	71·5	30·18	S.E. gentle.	fair & sunny		
25	75·5	30·3	S.W. do	fair		
26	69	30·43	S.W. do.	fair till 7 p.m. then misty.		
27	66·5	30·31	W fresh	Misty showers		
28	57·5	30·29	W. gentle.	Misty showers.		
29	65	30·05	W. do.	Misty showers	·21	
30	63	30·07	N.N.W. do.	2 showers before 9 a.m.		
31	58	29·98	N. fresh.	Showery.	·20	
					3·76	

Average temperature at 9. a.m. 66·51
24 days on which any rain fell.

Figure 4. Example of a typical monthly data sheet for July 1865.

eter, located one foot above ground level. Such descriptions match with the elevation of the gauge given in the diary. Notes in the ten-year books also indicate that the gauge was moved from Glendooen to Sprakburn in Letterkenny in January 1872, before being returned to Glendooen in July 1873. Monthly totals for Glendooen are recorded in the ten-year books from July 1873 to December 1874, with only an annual total given for 1875, after which observations cease, consistent with the retirement of Rev. Kingsmill. It is unclear if the positioning and exposure of the gauge was the same after its return from Sprakburn. Therefore, we only analyse data up to December 1871 below.

Surface pressure was most likely recorded using a mercury barometer, given that the units used were most likely mercury inches. Measurements vary between 29 and 31 which, if in inches Hg, would convert to between 982.05 and 1049.78mbar. In addition, the diary contains a newspaper cutting of an article by Admiral Robert Fitzroy, which gave instructions on correctly using a liquid barometer. Unfortunately, pressure data are not as complete as temperature or precipitation. For several years (1867–1868; 1870), the observer left no column to record air pressure, resulting in no consistent barometer data for those years. Finally, the observer also noted wind direction and strength every day and in the event there was a change in wind during the day, the observer would note details for both morning and afternoon.

Miscellaneous entries

The remaining contents of the diary are difficult to ascribe to a clear category. Some of this information pertains to the observations, while other pages contain more general weather and climate-related material. Additional contents include:

- Hand-drawn graphs of temperature and rainfall data from the diary.
- Summaries of recorded wind directions at Glendooen.
- Selected weather proverbs and superstitions.
- Notes on cycles in the weather.
- A newspaper cut out, as already mentioned, written by Admiral Robert Fitzroy, containing instructions on how to use a barometer.

Glendooen temperature observations

We developed an eight-year time series of monthly mean temperature at Glendooen from 1864–1871 using the 0900h temperature observations from the diary. The series is illustrated in Figure 5. The highest temperature of each year is recorded around July or August, while the lowest temperature is recorded around January or February, as broadly expected. The lowest mean monthly temperature is 0.4°C for January 1867. The highest mean monthly temperature is 19.5°C, recorded for August 1870. During this month, the highest maximum 0900h temperature of 23°C was recorded on the 11th and 12th. Written observations for the month of August 1870 are minimal, however, the observer does refer to a '*great drought in England*', while citing a particularly good harvest in the north of Ireland. The summary sheets describe the month as '*very hot and favourable for early harvest*', while on 7 August the observer notes of the winds that '*NE prevails during the great drought*', suggesting a dominant anti-cyclonic circulation, which would be expected for drought in this region. While the drought does not appear to be as severe in Ireland relative to Britain, rainfall totals for August 1870 are below average, with most of the monthly total collected in the latter half of the month (see below).

January 1867 was the coldest month in the series by a considerable margin, with the second coldest month, December 1870, measuring over a degree warmer. January 1867 was also more than 3°C colder than the eight-year mean January temperature taken at the site. During January 1867, cold was most severe in the first and third weeks of the month, with a minimum 0900h temperature of −9.7°C on 18 January 1867 and a total of 14 days with 0900h temperatures below 0°C. The observer's notes describe how extreme the cold was, referring to conditions before the 24th of the month as '*the severest weather known for years*'. The diary describes significant disruption to mail cars and trains due to heavy snow showers. On 14 January, the observer writes that the snow had reached a depth of six and three quarter inches (17cm) and there are several references to a nearby river being frozen over. The river in question, while not named, is most likely the River Swilly, which meanders past Glendooen. The river was frozen on at least three occasions on the 4th, 13th and 21st, when the ice was sufficiently solid to allow ice skating to take place. The second lowest value recorded was −5.6°C, recorded on 4th January 1868 and 28 December 1870. The highest daily temperature in the Glendooen record is 26.7°C, recorded at 1500h on 12 July 1866, while the highest 0900h reading is 25.8°C on 8 June 1865.

For comparison, Figure 5 plots the monthly mean temperature series for Armagh Observatory (Butler *et al*., 2005) alongside the 9am monthly mean series for Glendooen. Good agreement is evident throughout, although as mentioned previously, summer temperatures at Glendooen may be influenced by exposure. We examined the daily minimum and monthly mean temperatures at Armagh Observatory for the dates and months when temperatures at Glendooen were exceptional and found that the observations at the two sites were generally consistent. For instance, the exceptionally cold period observed at Glendooen in January 1867 was similarly cold at Armagh with 18 days of minima below 0°C at Armagh, as compared with 14 days in Glendooen. Likewise, the exceptionally high maximum recorded at Glendooen on 12 July 1866 are concurrent with similarly high values in Armagh on the 11th and 12th of that month.

Glendooen precipitation observations

The eight-year (1864–1871) time series for monthly rainfall at Glendooen is illustrated in Figure 5. During the period of

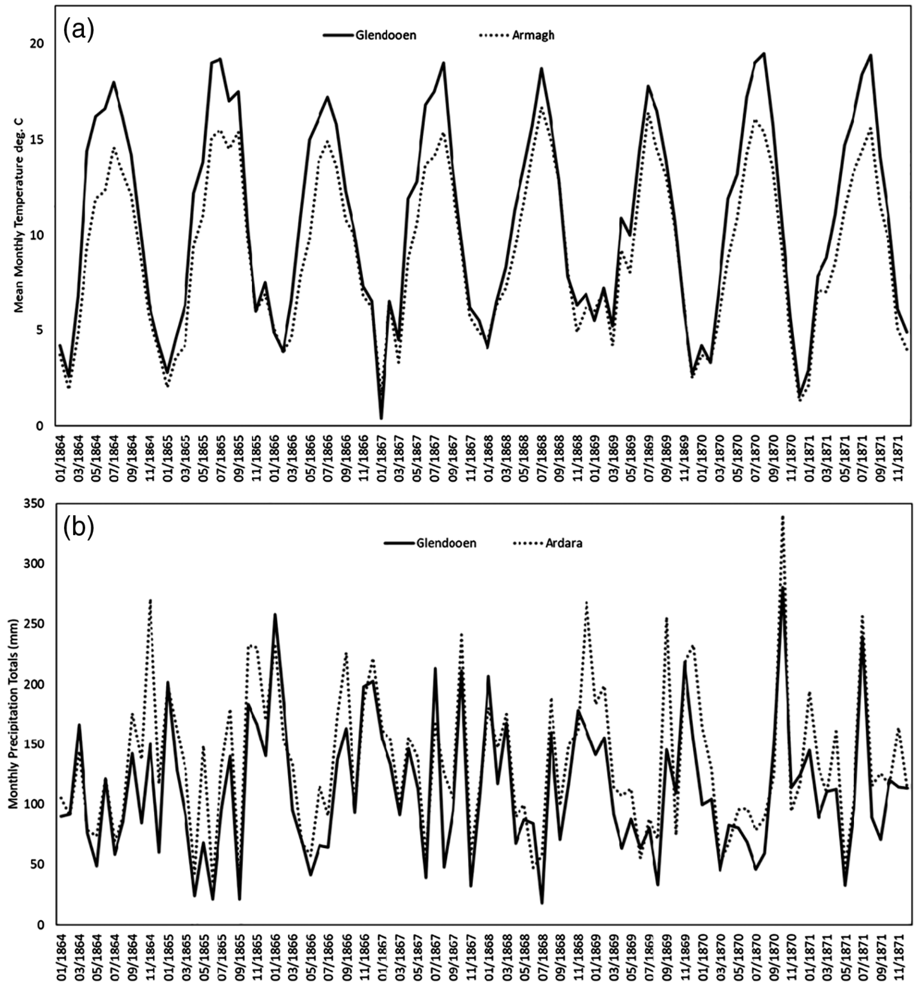


Figure 5. Mean monthly 0900h temperature (°C) at Glendooen (sold line) together with mean monthly temperature at Armagh Observatory (dashed line) (a) and monthly precipitation totals (mm) (b) recorded at Glendooen (solid line) and Ardara (dashed line) for the years 1864–1871.

observations, January is the wettest month and May the driest. The wettest individual month in the series from the site is October 1870 (280.7mm), followed by January 1866 (258.1mm). The driest month in the series is July 1868, with just 18mm of rainfall recorded.

Two significant dry periods are noted within the time series. For 1865, the observer recorded low rainfall totals for April (24.1mm), June (25.1mm) and September (25.1mm). These are considerably lower than the eight-year mean values for those months (80.3 mm, 70.1 mm and 107.3 mm, respectively). For April, the observer notes the fine weather, writing, '*after the 19th, fair and warm without a drop of rain*'. For June, the month is described as '*unusually hot and dry*'. Indeed, the mean 0900h temperature for June 1865 is 19°C, roughly 2.5 degC above average from the site. The summary sheets offer a similar description, describing June as hot and citing low river levels. The observer notes for September '*summer weather throughout*' and '*wells dried up and mills stopped working*'. While the dry spell continued into October, the end of the month is described as '*very fine harvest weather*'. Murphy *et al*. (2020) identify a severe drought event for Ireland and England and Wales for the period September 1864 to June 1866 using the Standardised Precipitation Index (SPI) at 12-month accumulations (i.e. SPI-12), which coincides with and adds confidence to these observations.

The second significant dry period, and the driest individual month in the time series, is July 1868 with just 18mm recorded compared to the eight-year July average of 101.9mm. However, written observations for this month are minimal with conditions simply described as '*fair and sunny*'. The observer does, however, refer to a severe drought in England, writing, '*worst drought remembered … with intense heat*'. According to the diary, the conditions were severe enough in England to lead to crop failure, as it notes, '*spring crop and pasture greatly damaged*'. Again Murphy *et al*. (2020) identify a severe drought in the England and Wales precipitation series for the period June 1868 to February 1869 using SPI-12, while for the same period they identify moderate drought conditions over Ireland.

As mentioned already, the wettest months in the Glendooen observations occur in January 1866 (258.1mm) and October 1870 (280.7 mm). January 1866 is described as persistently stormy with '*continued gales, thunder and lightning and prodigious rains*'. The observer notes that some form of precipitation fell on 26 of the 31 days in January. References to flooding are made on the 2nd, 7th, 8th and 13th of January 1866. In October 1870, the observer notes '*the wettest October recorded by me*' with reference made to local flooding on the 8, 12 and 20 and to a severe storm in Dublin on 13 October 1870.

Also plotted in Figure 5, for concurrent months, is the precipitation series for Ardara in Donegal derived by Noone *et al*. (2016). Ardara is located SW of Glendooen, at a coastal location and thus likely wetter. Overall, there is strong coherence between both series with October 1870 also the wettest month in the Ardara series during this time. Particularly dry conditions in 1865, discussed above for Glendooen, are also evident for Ardara.

The Great Famine years

The Great Famine of 1845–1852 wrought devastation on the island of Ireland, killing over one million people and causing another one and a quarter million people to emigrate. Estimates suggest that the total population declined from somewhere between 8.5 and 8.7 million in 1846 to just 6.55 million by 1857 (Smyth, 2012, p 18). The immediate cause of the famine was the mass failure of the potato crop as a result of the arrival of potato blight to Ireland from late August 1845. Potato blight (*Phytophthora infestans*) caused the potato crop to simply rot in the ground. The impact of the loss of a crop on which more than one third of the population depended for more than 90% of their food (Feehan, 2012, p 30), was mediated (and amplified) by a range of political, socio-economic and cultural factors giving rise to the unique geographies of the horrors of the Great Famine period. Donegal, which would have been expected to mirror the devastation of the rest of the western seaboard, is consistently an outlier in regional studies, faring relatively better than many areas. While this can be partially explained by a number of mitigating factors including the efforts of a cohort of 'improving' local landlords, and a more varied arable tradition in the county, few locally specific accounts of the period survive. Thus with the earliest observations at Glendooen commencing in 1846, this diary provides a rare insight into the weather conditions of northwest Ireland during this important period in Irish history. These observations take on a greater importance when considering the importance of mild, moist conditions to the spread of blight. As part of their work with the relative humidity time series at Armagh Observatory, Butler and García-Suárez (2012) identified a peak in the time series during the mid-1840s that coincided with the major infestation of *Phytophthora infestans*. Here we also draw on comments from the diary about the state of the harvest, however, it is at times unclear whether these relate to local or national crop harvests.

Figure 6 provides the summary comments from the diary describing monthly weather conditions for the years 1846–1851. The year 1846 began mild, with some frost in March. May was cold and wet, while June was exceedingly hot. After a cool July, August and September were fine and warm. The year ended cold and wet, with much snow in December. In summarising the overall year, the observer writes of an '*excellent corn harvest*'.

The year 1847, often referred to as Black '47, is generally considered the worst year of the Famine. The year began mild, but the weather turned cold and wet from March until May. The next few months were characterised by great heat and rainfall providing optimal conditions for the spread of blight. In August, the observer describes similar conditions, but also writes of '*great heat in the South and [a] fine harvest*'. This clearly does not extend to the potato harvest as he notes in closing the '*almost total destruction of the potato crop*'. The weather was stormy and wet from September to November. No snow was recorded for December.

The first 3 months of 1848 were severely cold and the observer writes that 24 March was the first sowing day that year. The next few months were warm, with April noted for being exceedingly hot in the south. The end of July and the majority of August are described as '*unusually cold and exceedingly wet*' apparently reducing the loss of potatoes as the observer notes '*less of the potato crop lost*'. The next few months were fine, until the last week of November, which was stormy, while December saw showers of snow, hail and rain.

In 1849, the first several months were largely cold and stormy. June was moderate in Donegal, but hot and dry in the south. The next 2 months were cold and changeable. September was fine, with the observer citing a good harvest. The year ends with stormy, unsettled weather. The closing remark reads, '*Potato rot somewhat late and more partial. Fine wheat harvest*'.

In 1850, the start of February was described as stormy but ended fine. March was also fine, apart from one storm on the 23rd. The next few months were showery, although June was drier than usual. The latter part of July was cold and wet. August and September were unsettled and variable. October and November were showery, but December was fine and mild. The observer writes of an '*inferior wheat harvest*', citing an unfavourable August as the cause.

January 1851 saw frequent and heavy rain, but the next few months were more stable. May was cool and showery with sunshine, favourable for agriculture. Heat was less than usual from June until August, while September was fine and warm. The weather in October was stormy and, as a result, very unfavourable for the late harvest. November and December were fine and mild. In the closing remarks, the observer writes of apples being destroyed by high winds in June.

The notes reveal that the potato crop was badly affected in the north-west, particularly between 1847 and 1849. However, while a primary description of the potato crop failure is valuable, arguably the most significant notes taken are those which refer to other crops, such as wheat and corn, illustrating the varied nature of arable agriculture in the county. These also highlight the extent to which other crops remained healthy and abundant, even during the famine. It is important to note that the existence of a good harvest for other crops did not necessarily mean that these were accessible to the poorest in the county.

Figure 6. Monthly weather descriptions, including state of potato harvests for the years 1846–1851, coincident with the Great Irish Famine.

The wet year of 1872

Following the cessation of direct weather observations in 1871, the diary provides summaries of monthly weather conditions in paragraph form. While the detail available for analysis decreases from this point forward, it is important to highlight the wet conditions noted for the year 1872. Symons (1873) and Burt *et al*. (2015) have previously commented on the exceptional rainfall totals recorded across the British and Irish Isles during this decade. The year 1872 also ranks as the highest annual total in the Island of Ireland Precipitation Network 1850–2010 (Noone *et al*., 2016). From the descriptive notes kept at Glendooen, June is described as cold with high rainfall, with turf cutting delayed. The summary of the month ends with the statement '*bad prospects*'. While a relatively fine July and August followed, September 1872 is described as '*wet – disastrous for northern counties*', with the harvest badly impacted. The end of October and beginning of November 1872 are described as '*stormy*' and by the end of November the observer notes '*great floods everywhere in Europe*'. December 1872 is described as '*continuing stormy with disastrous floods across Europe*', while the observer notes particularly calamitous flooding in coastal areas of Denmark. In summarising the year 1872, the observer writes that '*rainfall in the year* [is] *nearly double* [the] *average in many places, here only 3 inches in excess*', suggesting that Donegal may have fared better than many parts.

Weather folklore and periodicities

Additional points of interest are also worth noting about the diary. First, throughout the diary the observer seems to be interested in weather folklore and proverbs. A table of such proverbs appears in the diary and on different occasions, proverbs are recorded in the descriptive notes and are associated with different monthly and seasonal summaries. It is not clear whether the observer was aiming to verify these proverbs with his data or simply noting the correspondence. Interestingly, however, these notes come from a period when observers must have been increasingly interrogating the validity and applicability of such proverbs using their weather instruments. Table 1 provides a list of the weather proverbs that appear in the Glendooen diary. While some remain familiar today, others are not, at least to the authors.

Table 1

Weather Proverbs that appear throughout the diary.

'If the latter end of February and beginning of March be rainy, the Spring and Summer will be so'.
'If ending of October and beginning of November be warm and rainy, January and February will be frosty and cold, unless a dry summer have preceded'.
'Thunder in December with fine and moderate weather, betokens a Spring cold'.
'If the oak leaves before the ash, the summer will be hot'.
'If there be no storm at the vernal equinox, the summer will be dry – otherwise wet'.
'Abundance of haws precedes a severe winter'.
'Abundance of bloom in the broom is a sign of a plentiful year'.
'If Candlemas day be dry and fair, the half of winter is to come and mair'.
'When halo rings the Moon or Sun, rain's approaching on the run'.
'Red sky in the morning, shepherd's warning'.
'Birds singing in the rain indicates fair weather approaching'.
'March comes in like a lion, goes out as a lamb'.
'After Lammas Day, corn ripens as much by night as by day'.
'If the wind is south-west at Martinmas, it keeps there till after Christmas'.

Secondly, following his retirement to Dublin, Rev. Kingsmill seems to have taken an interest in analysing the data he collected at Glendooen, together with data available to him from other locations. In particular, he seemed to be interested in identifying cycles or periodicities in his data that may relate to cycles in sunspot activity. Following his analysis, of which little detail is given, he concludes that '*the cycle of 11 years does not appear to be confirmed. This was imagined to depend on the spots of the sun. Bacon mentions the belief prevalent in the Lower Countries that there is a cycle of 35 years after which the seasons are similar. On comparison of a good number of years I found a recurrence of like seasons in 7 years, or in a multiple of 7*'. Butler *et al*. (1998) in their analysis of precipitation for Armagh Observatory find a 7-year cycle in summer precipitation, likely associated with the North Atlantic Oscillation; however, such modes of variability were likely unknown to Rev. Kingsmill.

Conclusion

The weather diary for Glendooen, Co. Donegal, provides important insights into the historical climate of a poorly observed part of the island of Ireland. The descriptive accounts of weather and crop conditions during the Great Irish Famine similarly provide important insight into a formative period of Irish history. While the siting and exposure of instruments were most likely non-standard relative to today, key periods of drought tally with modern assessments of the period and add confidence to records kept, most likely by Rev. Kingsmill. The observations contained in the weather diary should be considered for their use in future updates of the Island of Ireland precipitation network (Noone *et al*., 2016) and subject to assessment using relative homogenisation methods.

It is noteworthy that observations in the diary began at the onset of the Great Famine and it is interesting to speculate if this was the reason for interest in weather recording. Even in more recent times, the occurrence of extreme events have precipitated investment in monitoring, such as the commencement of river flow measurement by Local Authorities during the drought conditions of the 1970s (Murphy *et al*., 2013). The Glendooen diary is an important weather diary from the nineteenth century but it is unusual that a greater number of such diaries for this period have not been unearthed in Ireland. Future work should aim to reach out to local and national libraries, historical organisations and other interested parties to compile a register of documentary sources of weather information from across the island. Such a database would be of high value both scientifically and culturally.

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Obituary

Sir John Houghton, CBE, FRS

John Theodore Houghton was born on 30 December 1931 in Dyserth, North Wales. In his early years, the family moved to Rhyl where he attended Rhyl Grammar School. Throughout his childhood, together with his two brothers he enjoyed exploring the Welsh hills, countryside and seashore. The family attended the Plymouth Brethren Assembly in Rhyl and John's devout Christian faith remained steadfast throughout his whole life.

From an early age John showed an interest in physics. When he was eight, he was given a copy of Alfred P. Morgan's book '*The Boy Electrician*'. At age 16 he won a Scholarship to Jesus College, Oxford, and he graduated from there three years later with a top first in physics and mathematics. He then completed a DPhil at Oxford, under the supervision of Alan Brewer, designing and using radiometers.

In 1955, he moved to the Royal Aircraft Establishment at Farnborough working on the detection of infrared radiation emitted by warm bodies in the atmosphere. There, he met Desmond Smith who became a long-term collaborator and friend. On 4 October 1957, the Russians launched Sputnik, the first artificial Earth satellite: it was then that John and Desmond realised that the infrared radiation emitted from the atmosphere could be measured from a satellite.

Both moved on from Farnborough, John returning back to Oxford. However, they continued to work together on an instrument to measure emissions from atmospheric carbon dioxide, in order to deduce the atmospheric temperature profile. Their ingenious solution was to split the beam from the atmosphere, passing one part through a CO_2 cell on the instrument to filter out the CO_2 signal from the atmosphere, and then comparing it with the unfiltered part to reconstitute the CO_2 signal. They used a grating filter, which was light, robust and gave a high spectral resolution and hence more detail in the vertical temperature profile.

To their great delight, the instrument, known as the Selective Chopper Radiometer (SCR) was accepted by NASA to fly on the Nimbus 4 satellite. John was seen with a great grin on his face as he scrolled through the 10-foot long telex telling him of the decision. Nimbus 4 was launched on 4 April 1970 and the SCR revealed for the first time the detail of the large planetary-scale waves in the stratosphere known as stratospheric warmings. John's group developed further radiometers which flew on the next three Nimbus spacecrafts, and with Fred Taylor, produced a Pressure Modulated Radiometer which flew on NASA's Pioneer Venus Orbiter.

By 1979 NASA was turning its attention to the Space Shuttle. John was persuaded to become Director of the Appleton Laboratory, which was being merged with the larger Rutherford Laboratory. John showed considerable skill in maintaining the morale of the staff whilst modernising the overall research programme.

In 1983 John was appointed Director General of the Meteorological Office. On his first day he was asked to lose a hundred of its staff (he refused). During his tenure, he arranged for the Met Office to become one of the new Executive Agencies (which it did in 1990, John becoming its first Chief Executive), giving much greater control over its financial planning and the development of new facilities and services. On the night of 15/16 October 1987, a poorly forecast severe storm caused havoc over the southern half of England, killing 18 people in the UK (22 if including deaths in France, according to the BBC and the Met Office) and causing damage estimated at £2 billion. An internal inquiry showed, amongst other things, that with improved resources the storm could have been better forecast. As a result, the Met Office received enhanced computing resources. In 1988, following a speech to the Royal Society by the Prime Minister Mrs Margaret Thatcher, in which she highlighted the prospect of anthropogenic global warming and consequent climate change, the idea of a national climate centre was raised. John then initiated discussions between the Met Office and the then Department of the Environment (DoE) which led to the setting up of the Hadley Centre for Climate Prediction and Research in 1990. This built upon the pre-existing long-term climate research, modelling and monitoring work taking place in the Met Office. John retired from the Met Office in 1991 and was then appointed chairman of the Royal Commission on Environmental Pollution. By then, much of his time was being devoted to the issues and challenges of climate change.

Through his earlier research, John had become involved with the World Climate Research Programme, under the auspices of the World Meteorological Organization (WMO) and the International Council of Scientific Unions. He chaired its overarching Joint Scientific Committee from 1982 to 1984. In 1987, following growing concern about the potential effects of increasing greenhouse gases on climate, the Intergovernmental Panel on Climate Change (IPCC) was set up jointly between WMO and the United Nations Environment Programme. At its first meeting in 1988, the IPCC created three working groups, and John was appointed Chairman of Working Group 1 (WG1). This was tasked to conduct an assessment of the science of climate change, to be written and reviewed by world's leading scientists, but made accessible to policy makers and to the public.

As WG1 reported first, John was able to set the tone for the other two working groups. He persuaded the DoE to fund a small technical support unit in the Met Office to manage the process including its meetings, reviews and publication of the report. This freed the contributing international scientists to concentrate on the science. He ensured that the report included an assessment of the uncertainties of the main findings and also that scientists from outside of the developed nations were