**Weather watching in the twentieth century**

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**INTRODUCTION: CLIMATE ANXIETY AND WATCHING THE WEATHER**

In recent years, historical geographers have forged new connections with the historians of geography as scientific practice and a body of scientific knowledge. While this rapprochement between previously distinct intellectual projects, which have now virtually merged, has often focused on narratives of key (mostly male) individuals, recent work reconnecting historical geography and the history of science has begun to focus on the diffusion of geographical knowledge and scientific understanding among a wider public sphere. By focusing on popular attitudes to, and understanding of, the natural world, it has been possible to consider the interplay between everyday human activities and a physical environment. Whereas earlier generations of historical geographers viewed nature as a determining, independent influence on human activities and even human characteristics, more recent work highlights the complexity of this relationship. This chapter will focus on the public interest in, and knowledge, of the environmental arena which, on a daily basis, impacts most directly and intimately on human life and livelihoods – the weather. By focusing on weather, rather than climate, and on popular and local scientific practices rather than technologically sophisticated and global scientific analyses, this chapter complements Martin Mahony’s contribution in the preceding chapter.

Anxiety about climate change is far from new. People have apprehended, feared, anticipated, and tried to understand and modify climate for millennia (Jankovic and Fleming 2011). The twentieth century, however, was undeniably a period of momentous transformation in our understanding of global climate change. As Weart (2010, 67) has noted, “of all the ideas that took hold during the twentieth century, the belief that humans can severely change the entire planet’s climate stands among the most significant and astonishing”. It became understood that climate was not simply “local and static on the scale of a human lifetime” but was changeable and, importantly, humans were recognised to be a major influence on these changes (Weart 2010, 67).

Climate change has now become a very visible and very vocal topic and the ‘imminent’ threat posed by anthropogenic global warming has become one of the most dominant environmental narratives of the twenty first century. The path to this recognition, however, has been far from straightforward. The debate on climate change and the anthropogenic influence on planetary climate has a long history, and one that has been traced elsewhere. The determination of key individuals, the architects of investigations into climate change and global warming, and their positions as solitary voices in climate change debates surrounded by dissent, has also been the focus of numerous studies (e.g. see Weart 2003: Anderson et al. 2016; Fleming 2013).

It is also recognised, however, that the emergence of anthropogenic climate change as a phenomenon is not just a function of developments in scientific understanding, but changes in popular thinking about climate, shifting attitudes towards the constitution of credible evidence and communication between scientists and lay audiences, (and changes popular understanding and interpretations of how climate changes over time (Bronniman 2002; Hulme 2009; Weart 2010, 68). Historical geography approaches can contribute to a tracing of these shifting attitudes around credibility and the changing relationships between expert and lay knowledges.

Different and sometimes contrasting climate narratives have co-existed and it is thus important to place emphasis on better understanding the “spatiality and temporally subtle patterns of the social effects of climate variability as climate crisis” (Daniels and Endfield 2009, 216). Gaining this ‘better understanding’ demands a “new way of thinking about …the hybrid phenomenon of climate change” and a reframing of climate change in terms of local geographical scales. Climate change itself is not directly observable by individuals, it being a reference to average climate conditions over a long period of time rather than observed on a daily or seasonal basis ((Hulme 2008 6; Spence et al. 2011, 46). Climate is a “statistical construct consisting of trends and averages that individuals can observe only indirectly (Goebbert et al., 2012: 132). Weather, in contrast, can be experienced. Indeed, as Eliza de Vet (2013: 198) argues, “in terms of everyday human experience, climate and long term climate change takes expression through specific local weather patterns”. It follows that it is through a better understanding of how weather has changed, and how changes in the weather have been experienced, that we might more fully understand the localised implications of climate change.

The work of weather watchers - those that have observed and commented on the weather in different contexts and periods as scientists, lay or amateur practitioners, both individually and in networks, whether purposefully or incidentally - takes on a new importance in this context. As Vetter (2011a, 262) notes, the role of weather knowledge in everyday life in itself “makes it a suggestive locus for examining the interaction between lay and expert observation in field networks, as well as the lay - expert divide itself.” Yet weather observations, be they quantitative, qualitative, systematic or anecdotal, provide insight into the local historical geographies of climate change. Experiences of weather and weather events at the local level, and the ways in which people have attempted to comprehend changes in the weather drawing on local knowledges, practices and experiences, tend to be concealed by global, predominantly scientific metanarratives of climate change. Moreover, it may also be the case that everyday engagement through local weather observation and experiences could prove pivotal in communicating risk and raising awareness of climate change in an era when its negative impacts are beginning to be felt.

In this chapter, drawing mainly on historical evidence from the UK and USA, I highlight the significance of weather watching in shaping and framing our understanding of local historical geographies of climate change in the twentieth and early twenty first centuries and the potential for tapping into weather watching traditions in fostering broader public engagement with climate change. Weather watching generated materials which collectively represent an archive to be analysed not simply for information on ‘raw’ weather information, but in terms of what it can reveal about the lives and activities of the individuals, groups, classes and societies which generated this body of popular information. The materials, combined, provide an invaluable lens on the kind of popular historical geographers considered elsewhere in this collection.

I will first explore key shifts in weather watching over time, set against the fundamental and necessary yet changing relationships between so called amateur and professional weather observation over recent centuries. I will provide an overview of scholarship on the weather observers, amateur scientists, their interaction with professional science communities and the extent of amateur contributions to research, to illustrate how the study of the weather has been shaped as much by such dispassionate enthusiasts, the lone observer, as by those engaged with the production and communication of replicable, depersonalised and quantitative prediction. I will also draw on different genres of weather observers/ observation in the twentieth century and different modes of recording local weather to provide insight into the range of sources for exploring local historical geographies of weather watching. Finally, I will highlight the pivotal role that the new citizen science approaches to weather watching, observation and recording is now assuming in contributing to- and sharing a more informed understanding of -climate change and will make the case for how this type of approach to observing and recording weather might afford opportunities for more nuanced communication of climate change risk in the early twenty first century.

**AMATEUR AND PROFESSIONAL WEATHER WATCHING THROUGH TIME**

In the March 1973 issue of *Weather*, the journal of the Royal Meteorological Society (RMetS), J M Craddock, a meteorologist based at the Met Office’s headquarters in Bracknell, asked a pivotal question: “What can an amateur meteorologist do now, to have good prospects of making a worthwhile contribution to the science” (Craddock 1973, 90). Craddock, who was the author of several books on long range weather forecasting, phenological indicators of past climate, and a long-serving RMetS member, was writing at a time of burgeoning interest in the use of ‘scientific techniques’ in meteorology which, it was argued, posed a potential threat the very status of the so called amateur weather observer- those who were not salaried scientists, but who possessed a passion for actual, physical weather observation and recording, whether this was for “personal interest and satisfaction” or for contributing in some general way “to the advancement of science” (Craddock 1973, 90; Vetter 2011a).

Paradoxically, however, the same period was to witness something of a ‘renaissance’ in organized weather watching as new networks of ‘amateur’ enthusiasts emerged who observed, recorded and exchanged information on the weather and changing climate (Gharesifard et al. 2017, 382). The simultaneous rise of weather recording technologies and the re-formation of amateur and enthusiast networks and communities of observers marked a major transition in the history of weather watching. Yet it is important to acknowledge that this was but one transition in a much longer history of flux and changing practice in weather watching more generally in which amateur and professional branches of meteorology have sometimes conflicted and sometimes mutually supported each other.

As Munger (2015, 15) has shown in his study of early nineteenth-century amateur climatologists: “observers and recorders of weather phenomena have been the subject of significant historical studies, often relating to how observers affected the development of the scientific disciplines of meteorology and climatology, or particular institutions related to weather study.” Weather observations featured in many forms of narrative dating back many centuries but there have been very different ‘genres’ of weather narratives reflecting different cultural and epistemological contexts (Jankovic 2000). Weather observations in the late seventeenth century, for example, tended to focus on local weather and meteoric phenomena, on singular unusual or extreme events, often explained as omens or manifestations of divine retribution for mortal sin. By the late eighteenth and early nineteenth centuries, interpretations of the weather within a rationalising Enlightenment discourse were increasingly linked to a “vulgar” or “subversive” meteoric interest (Jankovic 2001, 55). As Jankovic demonstrates, this period witnessed a pronounced shift “from the experimental philosophy of air to the rationalization of prognostic signs, from theoretical knowledge to prediction, from causal explanation to forecasting rules and more generally from the science of meteors to the science of weather and seasons” (Jankovic 2001, 125).

Many individuals, from colonists and seafarers to soldiers and amateur naturalists, adopted more quotidian recording practices and started to assemble daily local weather records across the globe, (Golinski 2007; Fiebrich 2009). These disparate individuals shared an interest in unearthing and documenting, whether for financial reasons or loftier intellectual motives, a wide range of local natural and weather histories. In so doing, they sought to normalise and reduce the weather to order and regularity. This was when observers first began to devote attention to daily weather recording using instruments- barometers and thermometers which were widely circulated and used. As Munger (2015, 11) notes, by the early nineteenth century, “enthusiastic observers of weather phenomena … weather watchers… neither identified themselves as professional scientists nor were generally regarded as such by peers yet they searched for broad patterns in their data and used it to construct scientific- sounding theories about how they thought weather and climate worked”.

New networks of meteorological observers were formed, such as the Meteorological Society of London, which was established at an inaugural meeting in October 1823. Similar networks formed elsewhere in Europe and the USA (Fiebrich 2009). Weather recording became progressively more institutionalised throughout the nineteenth century (Naylor 2006). The British Meteorological Society, established in 1850 and later renamed the Royal Meteorological Society in 1866) and the Scottish Meteorological Society, founded in 1856, represented a formalisation of weather watching (Walker 1993, 371). Yet weather enthusiasts, societies and meteorological networks, including those referred to above shaped and influenced the development of the study of meteorology in diverse ways, a subject that has already been explored by historical geographers (Naylor [2006](https://link.springer.com/article/10.1007/s10584-012-0415-7#CR41)). The British Meteorological Society, for example, rapidly and quickly instituted a network of voluntary observers throughout the country, all of whom helped to generate popular support for investigative meteorological science. From this period onwards, however, a new professionalism in weather watching became increasingly evident. From the second half of the nineteenth century, “comprehensive surveys of national climate” began to appear across Europe, the USA and Russia, along with meteorological handbooks and University training programmes (Nebeker 1995, 24-25).

As Vetter (2011a, 129) notes, coincident with the active promotion of the standardization of meteorological information was a hardening of the “the demarcation between expert and lay observer.” Around the same time, communication between amateurs and professionals generally declined as these groups ceased to share common goals. But as was the case with other observational sciences, alongside a progressive professionalism in meteorology, there was also a parallel process of ‘amateurization’, with some sectors of the amateur community actively seeking to promote the value of the amateur contribution as credible in its own right (Ogilvie 2000; Alberti [2001](https://link.springer.com/article/10.1007/s10584-012-0415-7#CR1)). New clubs and societies, bulletins and journals as well as also less formalised groups that directed activities towards public goals served to institutionalise an amateur presence.

As many scholars have indicated, however, the relationship between amateurs and the professionals was often complex, reciprocal subject to continued negotiation and in fact continues to be both “complicated and contested” (Ogilvie 2000, 67; Vetter 2011a, 129).There has bene long standing debates in the history of science about the relative merits and strengths of what might be considered the more informal, amateur cultures and the more formally institutionalised but often politically influenced scientific cultures that emerged in Britain from the late eighteenth century, a stark contrast with more directly state controlled scientific groupings that emerged in France and across much of continental Europe in the same period (Lux and Cook 1998). The distinction between expert credibility and non-expert amateur is far from clear. History is replete with amateurs who practiced what could be argued to be more ‘scientific’ weather observation practices, who adopted or invented novel technologies to identify and systematically record changes in the weather and who bridged gaps between amateur weather observations and professional meteorological science. Moreover, in as much as the science of meteorology can be seen to have been founded on the basis of long standing amateur efforts and born of a provincial interest in weather observation, the modern amateur has also informed important developments in meteorological science into the present day. Furthermore, and as I would like to argue, amateur meteorologists and enthusiast communities could play a pivotal role in better understanding and communication of future climate change risks.

In the remainder of this chapter I wish to add texture to the fundamental and yet fuzzy boundaries between amateur and professional weather watching. I focus on examples of individuals, but also networks and communities of enthusiasts, to demonstrate a variety of weather watching practices revealed through hitherto unpublished materials from various UK based archives as well as secondary information from further afield. I will then consider how at the close of the twentieth century and into the twenty first century, amateur weather watching is facing something of a (re)invigoration as a result of a drive towards citizen science approaches developed to better understand climate change risks at the local level.

**WEATHER WATCHERS AND LOCAL GEOGRAPHIES OF CLIMATE CHANGE**

The meteorological community has been, and remains today, a very heterogeneous group. Despite the gradual professionalization of the science of meteorology through the nineteenth and twentieth centuries, weather watching has always been practiced by a broad constituency. There were, and are, many different types of observer, including those who study weather lore, those who have maintained a commentary on the weather as part of a diary or journal, sometimes with weather observations as no more than incidental remarks, as well as those who maintained a more purposeful and detailed weather recordings. In addition, some have routinely recorded the weather for agricultural or scientific purposes, while still others have commented on the weather anecdotally in letters, postcards and other forms of correspondence. There are myriad examples of observers, and incidental observers, who refer to weather as part of wider observations and commentaries. Collectively their written legacies- their records, charts, diaries, accounts - provide an archive through which to view the local historical geographies of weather observation on a range of scales. Below I draw on a range of unpublished materials held in various UK based archival collections to consider a range of different types of weather observations and practices from the twentieth century to provide a flavour of different observational and weather watching practices.

Weather diaries, and diaries that refer to weather in a consistent manner, provide an invaluable lens through which to view the mundane, the regular, the normal, whether they include qualitative or quantitative information on the weather. Such sources are firmly established as key sources in investigations of historical changes in weather at the local level in that they provide place and date specific observations on the weather. These sources are geographically-specific and intensely personal narratives that tell us something of what it was like to live through particular, everyday weather conditions. As sources of historical and geographical information, they are also offer insight into the nature of diary keepers and weather observers as well as experiences of past weather in place.

The weather diaries of famers and landowners constitute everyday weather recording though with a precise and practical purpose. The Fisher family farming records, are one example among very many available to chart weather in place for a good proportion of the twentieth century. The Fishers were tenants on the Suffield Estate in Hanworth, Norfolk, and the diaries that family members maintained span the period 1887 to 1968.[[1]](#footnote-1) Now held in the Norfolk Record Office, these documents offer brief descriptive daily weather observations, (Sundays being the exception), as well as weekly reports on labour and receipts and expenditure on farm and a daily memorandum. Entries tend to be brief, for example, recording “snow showers last night & all day” on 29th January 1902 or “snow at night, snow storms with bright intervals during day” the following day. Entries clearly served a practical purpose for this family whose livelihood depended on expectations around seasonal weather. Yet these diaries, like many other similar records, provide a place-specific continuum of weather watching over many seasons.

As Jankovic (2000) has shown, British clerics were often required by the terms of their appointment, or otherwise took it upon themselves, to compile records of local events, including weather commentaries. The diaries of the Reverend W. H. Cory of Wilden, near Stourport-on-Severn in Worcestershireare one example. Cory, like very many prominent community leaders in earlier centuries, maintained a record of key changes in his parish. His diaries contain a variety of newspaper clippings, orders of service, programmes, letters and many other papers reflecting local and national events, ecclesiastical matters, educational and leisure activities such as sport, music and theatre, gardening and, of course, the weather.. Cory’s local weather entries were central to all his other records and encompass both normal, seasonal weather reports as well as references to unusual events and phenomena such as the ‘lunar halo’ that occurred on 23rd April 1907 and the effects of the good or bad weather on congregational attendance at Church. “A wet day”, noted Cory on 20th Oct 1907 had resulted in “few people at church”.[[2]](#footnote-2)

Weather was often recorded by those involved in economic sectors directly affected by its influences. John Aaron Stevenson, a mineral agent and geological consultant in the Derbyshire lead trade around the turn of the twentieth century, spent much of his time outdoors and regularly also ventured underground to assess local mine workings. Heavy rainfall and other episodes of poor weather had a direct bearing on Stevenson’s working routines and so were meticulously recorded in his diary. While his entries include regular reports on visits to disused mines, his day to day activities were shaped by weather events, such as the disruption caused by the “very great snow” which fell …continued falling all night” on 12th Dec 1900, the flooding on the Derwent on 30th Dec 1901, and the “very high wind” and associated damage on 18th February 1907.[[3]](#footnote-3)

School log books also included references to the weather, especially when events affected attendance. There are many examples of such records across the UK, including the weather logs from schools across St Kilda, Barra, Harris and Lewis now held in the Hebridean Archives in Stornoway, Isle of Lewis. Accounts detail disruption to school attendance associated with severe, stormy or cold weather during winter months across the northwest of Scotland. One entry from the St Kilda School log book on 27th February1905, for example, notes that “On account of the day being so wild, the majority of the scholars are kept back in the afternoon and I had to close the school”. On 23rd January 1920, the weather was too “stormy and wet for the children to come out, [so]no school was held”.[[4]](#footnote-4) Often it was lack of warmth that prevented children from attending school, despite school teachers contributing their own fuel supplies. One entry from Mingulay School on 18th February 1910 notes that the “little ones made poor attendance this week on account of storm and want of fire. The teachers own fuel now being exhausted”.[[5]](#footnote-5) A combination of lack of adequate footwear and clothing and bad weather seems to have compounded school attendance on some occasions: “Owing to very cold and stormy weather the attendance is again still lower this week. Want of shoes and scarcity of clothing suitable for this cold weather are the excuses of the times”.[[6]](#footnote-6)

There are also examples of daily school weather logs that were maintained specifically to record the weather. George Higgens, born 12th March 1865 in Sutton Valence, near Maidstone in Kent was headmaster of the Church of England school in Waltham-on-the-Wolds, near Melton Mowbray in Leicestershire and ‘keeper’ of the school’s weather records which extended from 1860, (when the first entries were made by his predecessor, Mr Edwin Ball), until 1942. Higgens also made weather recordings at his home in Burgins Lane in the same village, sending them on a regular basis to the Met Office in Bracknell. His own records included observations on rainfall, temperature, wind and barometer measures and the number of sunshine hours. He also used these ledgers as a personal diary of national events, particularly during World War Two. His recordings tended to be brief, perfunctory and quantitative in nature:

1900: 17th Jan - hail storm evening of 17th

19th Jan - storm of wind all day, rain in evg

Higgens occasionally included more detail, allowing unusual or extra ordinary weather events to stand out among the more day-to-day norms. Between 10th and 12th June 1900, he wrote of a “great heat, heavy thunderstorm all around, very heavy hail near…short heavy thunderstorm at noon, 2 mill sails either struck or blown off, great wind for few minutes, 0.395 fell in 14 minutes”. After his death, weather observations and recording were continued by Higgens’ wife and son, and in1977 the Met Office installed a self-recording gauge near the weather station he had tended for so many years.[[7]](#footnote-7)

That Higgens’ wife and son continued the recordings is worth exploring. There were of course individual women who have now been identified as ‘exceptional’ for maintaining their own records including Margaret Mackenzie of Delvine in Perthshire who compiled a meticulous record of daily temperatures at her home between 1780 and 1802 (Wheeler 1994).[[8]](#footnote-8) Similarly Caroline Molesworth began recording a weather diary in 1823 when she moved from London to Cobham in Surrey and continued thereafter for the next forty four years, the format for her observations being influenced by her reading of meteorological works by Luke Howard, John Frederick Daniell and Thomas Forster (Anderson 2003, 11). As Golinski (2007) has argued, however, women, for so long excluded from traditional academic institutions, more commonly assumed a prominent role as audience and receptor of weather information and “eagerly trod the path to learning through polite conversation” about the weather (Golinski 2007, 68). Other women, like Higgen’s wife, also clearly assisted the recording of historical weather journals for their husbands and relatives as “invisible technicians” (Shapin and Schaffer 1994).

There are, however, many examples of women who made detailed qualitative but less formal observations and whose records remain for us to explore. Ruth Bourne, who was born in September 1865 at Grafton Manor near Bromsgrove, is a less systematic weather watcher. The daughter of a prosperous country gentleman and later chairman of Herefordshire County Council, Bourne moved with her family to Cowarne in Herefordshire in 1883. One of nine children, she began to keep a diary in 1874 at the age of eight and continued on and off this until her death in 1951. Her diary covers three specific time periods – 1874-8, 1927-8 and 1942-51 - and provides a lens through which to consider how the weather was observed, recorded and perceived across the span of a twentieth-century lifetime.[[9]](#footnote-9)

The majority of Ruth’s weather-related diary entries are brief and inconsequential, often comprising no more than the date and a very brief description. The 26th February 1874, for example, was described simply as: ‘a very rainy day, it rained all day’, whereas on 18th August 1927, it was evidently ‘pouring rain again’ While Ruth’s weather recordings were usually incidental to other important events in her life, there were times when the weather assumed particular importance, especially during unusual or extreme climatic events. On 1st February 1945, for example, Ruth noted:

The weather has been arctic for the last fortnight & the snow has lain thick on the ground. We had phenomenal degrees of frost - 2 nights there were 27 degrees of frost: the roads were icy & dangerous - no one went out unless they had to for necessary shopping. I have been a prisoner to the house feeling wretchedly cold & achey & miserable; I have stayed in bed till 12 o'clock most days - & then for the rest of the day have sat by the dining room fire with a rug over my knees & glad to have a hot water bottle on my legs...

The extremity of this occasion led to consideration of the effects of weather on Ruth’s health and wellbeing, a common theme in many personal diaries. The majority of the weather content in Ruth’s diary, however, is remarkable for being unremarkable and provides no more of a backdrop to her daily activities.

Weather provides a similar contextual backdrop in the diaries of William (Bill) Clarence Lisle Richards.[[10]](#footnote-10) Bill Richards was born in Nottingham on 29th February 1888 and worked as a teacher in St Mark’s Trust School in the city during his early twenties when he lived at with his parents Evelyn Alfred and Emma Richards, his younger brother Cecyl and sister Maud. Although Bill’s diary only covers two years, it offers a fascinating insight into the aspects of his life that were influenced by the weather. A private document that was never intended to be read widely by others, yet now housed in a public records office and thus very much publically available, the diary, like countless others no doubt, raises important moral and ethical questions for the contemporary historical geographer. Much of what Bill writes about reflects what one might expect of a young man, pertaining to his social life and friendships, and especially to his affection for Doris Raynor a local girl about whom he writes regularly. Bill played football and he provides detailed accounts of his performances for the Alfred Street Methodists. He was also a keen photographer, cricketer, musician and cyclist, and these weather-dependent activities are also recorded in some detail, including his cycling trips around the English East Midlands during which he took dozens of photographs of local landmarks. Bill documents his regular trips ice skating, the "new craze roller skating" and his visits to local theatres, picture houses and other local attractions. The diary provides a fascinating insight into the life, relationships, political and sporting leanings of this young man but it is down to the scruples of the reader to consider what should and should not be shared. But for this reader, it is the fact that weather provides the routine backdrop to Bill’s life that is of interest. Between 3rd and 9th March 1909, he notes:

3rd March - A heavy fall of snow took place during the night & continued all day. Walked to & from school.... went on Forest sliding etc.
4th March - walked to school. Went on Forest with Bert Cox watching the sledges.
5th March - Fetched C's sledge & went on Forest
6th March - Slight fall of snow...Cup Tie Forest v Derby County postponed
7th March - streets still very bad
9th March - wet snow at night

The 27th July 1909 he noted: “What a miserable day it has been. One of those days which looks as though it will never clear up again. Raining morning, afternoon & night without ever a stop”. The cancellation of sporting events due to bad weather was discussed in great detail, as on 22th December 1909:

During the night, the wind had changed and the weather had been quite mild all day. The roads in the morning were in an awful condition. On the pavements the snow was thawing rapidly - unfortunate pedestrians having to walk through a mixture of snow and water [continued at beginning of volume] towards evening the outlook was more favourable and in the principal thoroughfares the last vestige of snow had disappeared. 24 Dec - Called at Doris’s to leave Xmas card. She herself answered the door and delighted me by coming out for a walk. Proceeded to her brother’s and while she was there I wandered along Trent-side. There was little side left the major portion being feet under water. The snow during the last few days had melted - the result being one of the biggest floods I have seen for a long time…. The YMCA Ground was easily two feet under water and hovers walk could only be located by the numerous trees lining the path on either side. Another two feet and the record would have been broken. Fetched Doris to look at this uncommon sight. She was in a good mood - the best that I have caught here in for weeks. 26 Dec - Spent the afternoon in repairing punctures and now my bike's alright again. Called for Cis and Doddy and went down to Trent Bridge. The flood had subsided considerably…Our football ground is four feet under water - so that tomorrow’s match is “off”.

Weather punctuated Bill’s everyday diary entries, and extreme and unusual weather emerge with particular force when they affected his hobbies and interests.

Throughout the course of the twentieth century, amateurs in many parts of the world collected meteorological data for official purposes. In the UK, the Met Office played a key role in the centralisation of responsibility for all routine observations (Eden 2009). This “resulted in a refinement and tightening of procedures and practices, and of rules for the exposure of instruments. It might be argued that this process went too far, and that isolated examples of slackness and dishonesty in actual observational practice meant that the stringent adherence to rules required elsewhere was excessive”, leading to a decline in the contribution to official networks of private observers “who were no longer able to meet those standards, even though the assiduousness of their record-keeping may have been beyond criticism” (Eden 2009, 241-242).

As Miller–Rushing et al. (2012, 285) note, however, “many amateurs were recognized experts in their field and conducted research indistinguishable – and sometimes superior to- that done by most professional scientists of the time”. Some weather station sites, such as that of George Higgens mentioned earlier, were clearly recognised to be of a standard such that they were used for official professional meteorological data collection. Furthermore, as Vetter (2011a: 129) notes, “amateurs could be and often were, the leading experts” in various branches of observational science.

Some climate experts recognised the value of amateur observers and those who occupied roles that combined the elements of professional and amateur weather observation, including Gordon Manley (1902-19980), a now legendary figure in the history of British climatology and geography. Manley is perhaps best known for his pioneering work on climate variability in the UK, for establishing the Central England Temperature series - the longest instrumental record of temperature in the world - and for his pivotal role in demonstrating the powerful relationship between climate, weather and culture in post war Britain (Manley 1974). Manley made many contributions, both professional and popular, to climate change debates in the twentieth century, where climate change is understood as changes over a range of temporal and spatial scales rather than simply anthropogenic warming. Throughout his long career, Manley showed great respect for the contributions of amateur and local weather observers, past and present (Endfield et al. 2015). A strong believer in the great potential of records produced by these assiduous local observers, Manley felt that “British science probably owes more to the “amateur” than that of any other country” (Manley 1945, 73). Thanks to this body of “volunteer enquirers” with an interest in meteorology, there exists a vast body of recorded observations and descriptive comments on the British weather which afforded “indispensable” information for Manley’s endeavours (Manley 1952, 255). Manley himself was an avid weather observer, recording his own weather observations on the Lancashire Plains from the age of 12, developing his interests during his professional career through his observations at Moor House and establishing a small meteorological station on the summit of Great Dun Fell (Radcliffe 1993, 268). He spent more than 30 years searching out and painstakingly transcribing old weather records in archives, county record offices and private collections across the country to create the Central England Temperature Series which Craddock argues resisted “the tide of fashion at the time for finding solutions to meteorological problems in mathematics, and computer technology” (Craddock 1981, 230).

In some situations, amateur scientists were central to major breakthroughs in climatic understanding. James Rodger Fleming (2013) has investigated the contributions of one such individual, Guy Callendar, an engineer by training who worked for the British Electrical Research Association. Callendar was also an amateur meteorologist who “began collecting measurements off the properties of gases, the structure of the atmosphere, the sunlight at different latitudes, the use of fossil fuels, the action of ocean currents, the temperature and rainfall in weather stations across the world and a host of other factors, It was a hobby, but a remarkably ambitious one” (Mann 2018). Inspired by the Swedish physicist Svante Arrhenius, whose work established a theoretical link between variations in atmospheric C02 and global temperature changes, Callendar based his own work on actual historical measurements. Drawing on monthly average temperature data series recorded in the World Weather Records, Callendar’s work established the link between the dumping of carbon dioxide in the atmosphere and global warming. Described in some accounts “as the lone voice in the greenhouse”, Callendar is recognised today the “one man who challenged the consensus of the experts” (Waert 2003, in Hamblyn 2009, 327-328; Charlson 2007, 254).

**OBSERVER AND ENTHUSIAST NETWORKS: TECHNOLOGY AND CITIZEN SCIENCE**

While commonly a solitary endeavour, groups and networks of amateur weather enthusiasts have engaged and cooperated in the search for “broad patterns in their data and used it to construct scientific-sounding theories about how they thought weather and climate worked”.Indeed,as Vetter (2011b: 261) notes, “weather observing networks, probably more than any other kind, have been continuously dependent on a regular distribution of collaborators” (see also Locher, 2008).

One of the most obvious examples of an amateur network is the British Rainfall Organisation (BRO). Founded as a voluntary body in 1858 by George Symons, an employee of the Meteorological Department of the Board of Trade under Vice-Admiral Robert Fitzroy, the BRO was a network of voluntary rainfall observers who sought to better understand variations in rainfall across the country (Pedgley 2002). The BRO was established following several years of anomalous weather. As many weather watcher had noted in their recordings, and in their correspondence, the 1850s were remarkably dry. A number of dry episodes were, for example, recorded by Mr. H O Nethercote Esq, a farmer based in Moulton in Northamptonshire. His weather records, maintained between 1857 and 1883, highlight “the dryness” of July 1858 which “formed so striking characteristic of the last month” and which continued into August and “caused to the growing crops considerable injury. Turnips, swedes and other root crops are in places entirely destroyed”. These hot and dry conditions led to insect infestations and a plague of red spiders “whose ravages …extended to such an alarming rate as to threaten the destruction of the plants in beds”.[[11]](#footnote-11) The dry 1850s prompted “public concern over the possibility of permanently decreased rainfall” and highlighted how there had been “no general collection of all reliable records and no thorough investigation of rainfall trends” in Britain up to that point. In fact, it was recognised that there was a “supreme inadequacy of available observations of rainfall” for different parts of the British Isles (Symons, cited in Pedgley,1).

The information collected from the network of voluntary observers coordinated through the BRO was collated and published by George James Symons in an 1860 pamphlet, *English Rainfall*, which contained results from 168 stations across the country. This was soon reprinted and continued thereafter as an annual publication.Through the late nineteenth and early twentiethcenturies, 126 volumes of *English Rainfall* were published. The BRO was formally transferred to the Meteorological Office in July 1919, but the journal continued as an independent publication until 1963 (Burt 2010).

Although the demise of the BRO suggests that organised and self-consciously amateur weather watching was in decline, at in an institutional sense, weather watching has proved remarkably resilient as a less formal networked endeavour and has successfully resisted the processes of professionalization (Morris and Endfield 2012). As Vetter (2011a, 136) notes, networks of amateurs interested in weather became increasingly intertwined with wider debates about citizenship, national identity and political participation, allowing “lay participation in scientific networks” to be “simultaneously functional and symbolic”.

The importance of informal networks of amateur weather watched for national forecasting agencies was evident in other countries as well. In the United States, the US Weather Bureau was responsible for taking meteorological observations but relied heavily on thousands and unpaid volunteers to collect sufficient records to establish nationwide, coast-to-coast climatic characteristics (Vetter 2011b, 136). An “extensive system of cooperative volunteer observers” emerged across the USA in the late nineteenth and early twentieth centuries and with the passing of the Organic Act of 1890, which effectively established [territories of the United States](https://en.wikipedia.org/wiki/Territories_of_the_United_States) and specifies how they were to be governed, the Cooperative Observer Network (COOP) came into being. The COOP was established to provide observational meteorological data and helped to define the climate of the United States. By 1958, the COOP programme had grown to nearly 14,000 observers (Vetter 2011b: 136; Fiebrich, 2009). [[12]](#footnote-12)

This link between observation, amateur networks and the official, federal agencies in a US context is borne out by the achievements of Moonwatch, a citizen-based programme initiated as part of the International Geophysical Year of 1957. Fred Whipple, an astronomer and former Director of the Smithsonian Astrophysical Laboratory, sought the participation of ordinary citizen satellite spotters for this programme in the “spirit of scientific co-operation”. Both professionals and amateur groups contributed to the formal research programme, despite obstacles presented by professional astronomers and also notwithstanding Whipple’s opinion that amateurs were often quarrelsome (McCray, 2008).

Historically, access to sophisticated technology has generally marked the distinction between amateur and professional meteorology (Anderson [2003](https://link.springer.com/article/10.1007/s10584-012-0415-7#CR3), 303). For professionals, expensive scientific equipment and instruments have brought intellectual credibility and have supplied much larger volumes of primary data, allowing far more elaborate calculations, predictions and projections designed explicitly to reduce subjectivity, bias and human error in the generation and communication of scientific knowledge. Amateur scientists, on the other hand, have traditionally laboured in small, technology-free private spaces where traditional observational and recording skills have played a key role (Silvertown 2009). The second half of the twentieth century, however, was a time of technological revolution in weather observation and monitoring, and marked the start of a new period of computer intensive weather watching which, according to Nebeker (1995, 3), turned meteorology into “a unified, physics based and highly computational science.”

There was significant Investment in computers in the UK Met Office, based on initial research by Sawyer and Bushby (1953) and Bushby and Timpson (1967). The first computer was a Ferranti Mercury installed in 1958, followed by an English Electric KDf9 in 1965 and an IBM 360/195 in 1971, at the time “one of the most powerful computers east of the Atlantic” (Craddock 1973, 90). A few years earlier, the desk multiplier, deemed at the time “the most advanced aid to computation available to most meteorologists”, also became available (Craddock 1973, 90). As Mahony and Hulme (2016, 446) note, this period also witnessed the emergence of “complex scientific models of the climate system”, specifically general circulation models (GCMs), which offered “quantitative assessments and qualitative visions of putative futures which have found their way into broader cultural narratives of climate change”.

While these momentous shifts were taking place, Craddock argues that there was “no real reason why amateurs should not be able to do useful work” both in data collection and “computer intensive branches of meteorology” and in “finding past data on weather and climate, especially for years before 1860 in the less obvious places such as records and archives not primarily concerned with meteorology”. The amateur could also work towards improving the quality of existing known records, providing calibration and also “organizing statistical calculations” on data “if the professionals do not have time to do so” (Craddock 1973, 95). The implication, however, was that such roles were now firmly in the service of a ‘top down’ science of meteorology dominated the ‘professional’, government-funded scientists. Nevertheless, and as Craddock (1973, 99) also notes: “for amateurs to work together”, there needs to be “some central units or focal points to coordinate the contributions and it may be too much to expect a private person to spend not only his time, but also his money, on secretarial and similar work”.

As if to respond to this ‘call to arms’, two UK-based amateur meteorology networks, the Climatological Observers Link (COL) and the Tornado and Storm Research Organisation (TORRO), were established in the early 1970s, heralding a new phase of networked amateur weather observation (Morris and Endfield 2010; Endfield and Morris 2012). COL, which was established in 1970, is perhaps the most significant organization representing UK amateurs who observe, record and exchange the weather from different parts of the country on a daily basis and currently has around 400 members. TORRO, by contrast, is a mainly UK-based community of storm and extreme weather enthusiasts and is also a privately supported research body. Founded in 1974, TORRO has between 300 and 400 members who share an interest in storms, storm chasing and site investigation following storm events. Data-collection, research and co-ordination is undertaken by the Directors of TORRO, reflecting the split between observers and interpreters (Morris and Endfield 2010). There is an increasingly important role to be played by such individuals and networks. Indeed “looking to the future, the limitations of remote sensing by satellite over land surfaces mean that the UK Met Office envisage a future role for ground based human observers to fill in gaps and add detail in the near term” (Overton 2006, 209).

In addition to these networks, however, there has emerged “a new kind of network for scientific observation”, a technology enabled network which has often gone under the label of “citizen science” (Charvolin 2004; Charvolin et al., 2007; in Vetter, 2011a:136). Ordinary citizens are increasingly seen as vital components in identifying and addressing anticipated climate changes, particularly in scenarios where local citizen knowledge can be used to augment the research of “professional experts” and contribute to the collection and collation of ubiquitous, real time ‘big data’ data on climate changes (Fischer 2000; see also the chapter in this volume by Jeremy Crampton). Lay and amateur observers are currently emerging as legitimate if very different producers of equally valid knowledge about weather and climate. Indeed, it is fair to say that the past two decades has witnessed something of a renaissance in the amateur science of weather watching through citizen science endeavours, reflecting a change a shift in the general perception of the competencies of citizens to participate in weather observation but also a concomitant increase in the availability of information communication technologies (Gharesifard et al. 2017).

Advances in technology, and accessible technology, are facilitating this shift in emphasis and “information regarding the state of the atmosphere can now be obtained from many non-traditional sources… amateur weather stations, and sensors, smart devices and social media/web 2.0” (Muller et al. 2015, 3185). Groups of observers can more easily interact with each other on weather topics. Amateur meteorologists are, as a result, being re-valued by professional meteorology in various ways, as knowledgeable and trustworthy contributors of weather data created by ‘official’ meteorological networks, and as on-the-ground witnesses to confirm the timing, features and immediate impacts of unusual or extreme weather episodes.

In the first decade of the twenty first century, the boundaries between amateur and professional have, perhaps surprisingly, narrowed still further by the more widespread adoption of technology, the very factor which previously separated the two constituencies. In partnership with the RMetS, for example, the Meteorological Office has taken a lead in the establishment of the Weather Observations Website (wow.metoffice.gov.uk) which provides “a hub for the sharing of data with the wider community, allowing amateurs to access not only historical data but also near real-time observations anywhere in the world, and to compare their data with other amateur stations nearby” (Bell et al 2013, 36). Moreover, as Gura (2013, 259) notes, there is a potentially much broader constituency of observers who could contribute to this collective weather observing endeavour “equipped with smartphones, computers and do it yourself sampling kits.” Currently there are over 1700 citizen weather stations across the UK, observing and recording weather compared to 250 official meteorological monitoring systems.

Reflecting almost a re-establishment of older overlaps in the scientific and more popular domains, there are other examples where technology has facilitated citizen science engagement with specifically weather or weather related projects. More than 10,000 citizen volunteers take daily observations for the US National Weather Service and thousands more contribute to on-line community networks that aggregate and visualise citizen contributed weather-through e-participation (Mims, 1999; Gharisfard et al. 2017). ICT enabled citizen observatories are providing new modes for citizen participation in meteorology and offer real potential for lay servers to engage in endeavours that could simultaneously improve digital literacy and provide synoptic real time reports.

There are a number of global citizen science projects that seek to capitalise on amateur weather enthusiasts in the reconstruction and reanalysis of historical weather data. Among these is Oldweather.com (http://oldweather.org), a project which forms one of the many supported though the Zooniverse initiative. The project engages a large community of interested volunteers, who are recovering the millions of archived historic weather observations held within historical ships logs books and which can contribute to reconstructions of the past weather and climate. More than 12,000 volunteers have been reading the logbooks of 300 Royal Navy ships from the period 1914-22, and transcribing the frequent and regular weather observations they contains (Brohan, 2012). Another example is the Community Collaborative Rain Hail and Snow (CoCoRHaS) project – a grassroots effort consisting of citizens measuring precipitation right in their own backyards (Cooper 2016). The interactive Web-site facilitates the sharing of the collated data for natural resource, education and research applications. Similarly the Data Rescue: Archival and Weather' (DRAW) initiative at McGill University, Canada, (<https://citsci.geog.mcgill.ca/>) allows volunteers to participate in the transcription of historical weather logs captured at the McGill weather observatory since 1863. Such innovative modes of working may well play a crucial role as we face more unexpected and unusual and extreme weather (Gharsefard and Wehn, 2016: 189).[[13]](#footnote-13)

**CONCLUSION**

The twentieth century witnessed momentous change in climate science, allowing for the recognition of anthropogenic climate change as a legitimate phenomenon and heralding a new and unprecedented level climate anxiety. Yet while climate change has arguably become the most important environmental narrative of the twenty first century, a lack of public engagement and disinclination to action remains a major challenge (Spence et al. 2012, 958; Lejano et al. 2013). To some extent this lack or disengagement is a function of two key parameters. There is still a “legitimate uncertainty about the exact impacts of climate change, as our understanding of how climate systems work and interact with the human and biological systems is far from complete (Poortinga et al. 2011, 1021). Yet it is also becoming clear that climate change is perceived to be a “psychologically distant” issue on a number of different dimensions, both spatially and temporally (Spence et al. 2012, 957).

Locating climate change through local weather could represent a vital step in the process of reducing this distance (Hulme, 2008; Spence et al. 2012, 957). Local weather knowledge renders climate change more immediate and more salient and the degree of particularity derived from ‘on the spot’ weather observations could reveal much about how climate change might be affecting and could affect different places and communities in the future.

Such local approaches to climate through weather observation, accounts and narratives as illustrated, have a long history, a history which can be traced through historical geography approaches. Weather watchers, amateur meteorologists and networks of enthusiasts have proved pivotal to shaping the study of climate and local weather narratives and accounts have the potential to provide a better understanding of changing weather in place over time. Moreover, although “the role of lay people in scientific observation has varied over time and space” (Vetter, 2011a: 137), the role of the amateur observer, has continued to remain prominent in climate observation and in shaping climate change science. The collective archive of materials produced by these amateur communities provides insight into the prevalence and influence of these popular climate knowledges.

In an era in which there is increasing recognition of the value of citizen science in weather observing and interpretation of historical weather materials, however, it could be argued that we are entering a new phase of enormous potential with respect to amateur engagement. New technological developments are enhancing the range of opportunities for non-expert, local engagement therein and have the potential to allow for far greater insight into the local manifestations of climate change. Furthermore, as Miller Rushing et al (2012:289) note, citizen science approaches are increasingly being seen as a means to engaging the public in key scientific debates and at once improving scientific literacy and helping to educate and inform participants about climate change. This represents “a major departure from most of the history of citizen science when projects were set up mainly to achieve scientific objectives”. The potential to use the same technologies that facilitate citizen science approaches in weather work to educate and engage, and to “communicate science, engage in outreach” as well as accomplishing real research aims (Gura, 2013, 261) represents a major shift in the status and purpose of amateur weather watching in the early part of the twenty first century.

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1. BR 112/2, Norfolk Record Office [↑](#footnote-ref-1)
2. 705/1030/1/iii Worcestershire Records Office. [↑](#footnote-ref-2)
3. D2429/22 Derbyshire Records Office. [↑](#footnote-ref-3)
4. GB3002 IN4/50 [Tasglann Nan Eilean Siar (Hebridean Archives)](http://www.cne-siar.gov.uk/archives/) [↑](#footnote-ref-4)
5. GB CL IN4/45 [Tasglann Nan Eilean Siar (Hebridean Archives)](http://www.cne-siar.gov.uk/archives/) [↑](#footnote-ref-5)
6. 'GB3002 RC4/18/4 [Tasglann Nan Eilean Siar (Hebridean Archives)](http://www.cne-siar.gov.uk/archives/). [↑](#footnote-ref-6)
7. DE7316/9 Leicestershire, Leicester and Rutland Record Office [↑](#footnote-ref-7)
8. The journal in fact covers the period between February 1780 and May 1805 when the author passed away though the entries are less consistent and more sporadic after 1802. [↑](#footnote-ref-8)
9. AK22/1 in repository Herefordshire Record Office [↑](#footnote-ref-9)
10. DD/2641/1 Nottinghamshire Archives [↑](#footnote-ref-10)
11. Box 125 43 MO National Meteorological Library and Archive [↑](#footnote-ref-11)
12. Currently, the number of COOP observers who measure air temperature across the United States totals between 5000 and 6000, while the number that measure (Fiebrich, 2009). [↑](#footnote-ref-12)
13. [↑](#footnote-ref-13)