Advanced Review

Gordon Valentine Manley and his contribution to the study of climate change: a review of his life and work

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British climatologist and geographer, Gordon Manley (1902–1980), is perhaps best known for his pioneering work on climate variability in the UK, for establishing the Central England Temperature series and, for his pivotal role in demonstrating the powerful relationship between climate, weather, and culture in post-World War II Britain. Yet Manley made many contributions, both professional and popular, to climate change debates in the twentieth century, where climate change is broadly understood to be changes over a range of temporal and spatial scales rather than anthropogenic warming per se. This review first establishes how Manley's work, including that on snow and ice, was influenced by key figures in debates over climatic amelioration around the North Atlantic between 1920s and 1950s. His research exploring historical climate variability in the UK using documentary sources is then discussed. His perspectives on the relationship between climate changes and cultural history are reviewed, paying particular attention to his interpretation of this relationship as it played out in the UK. Throughout, the review aims to show Manley to be a fieldworker and an empiricist and reveals how he remained committed to rigorous scientific investigation despite changing trends within his academic discipline.

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On April 19, 1944, British meteorologist Gordon Manley delivered the Royal Meteorological Society's G.J. Symons Memorial Lecture. Established in 1926 in memory of George Symons, a leading member of the Society from the 1860s, these lectures were intended to provide surveys of recent developments within meteorology and affiliated subjects. Manley used this opportunity to present a synthesis of the 'varying distribution of weather itself- the study of climatic change.'[1] The content of his lecture provides an opportunistic lens through which to view key developments, debates, and anxieties within climate research at the time.

Manley focused on a set of sub themes: climate changes and the course of history, the interpretation of post-glacial and historical changes in climate, recent work in Scandinavia and glacial variations around the Norwegian Sea and the suggested causes of these variations. Throughout the lecture, Manley pointed out the uncertainties, explained complexities and highlighted fruitful areas for further field based enquiry, particularly in the UK. He alerted his audience to 'the

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tremendous variety of engrossing problems awaiting us after the war' (Ref 1, p. 217). Most significantly, he identified several areas of research into climate change at a range of temporal scales, to which he had made, or was to make, major contributions. Here, we revisit some of these contributions and in doing so, highlight the work of one of 'the best known, most prolific and most expert on the climate of Britain of his generation' (Ref 2, p. 87).

BACKGROUND

Gordon Valentine Manley (1902–1980), President of the Royal Meteorological Society, 1945–1946, founder of its 'house' journal, *Weather*, and Honorary Fellow of the Society (from 1976), was born on the Isle of Man but brought up in Blackburn, Lancashire. He completed his first undergraduate Bachelor's [B.Sc. (Hons.)] degree in Engineering at the University of Manchester and went on to study for a Bachelor of Arts in Geography at Cambridge, in the 1920s. At Cambridge he studied under Frank Debenham, Professor of Geography (1930–1949) and geologist on the British Antarctic Expedition of 1910–1913 with Captain Robert F. Scott.[3] Debenham was influential in nurturing in Manley a long standing interest in the study of polar regions and these formative years at Cambridge provided a training in science 'with a practical bent and in endeavour far beyond the usual frontier' (Ref 4, p. 220).

Graduating with a double first in Geography, Manley spent a year working at the Meteorological Office before participating in an expedition to Northeast Greenland in 1926, under Sir James Mann Wordie. He contributed to the appendices for the expedition reports and also published his own paper on some of the findings in the Danish series *Meddelelser om Grønland* in 1932.[5] Manley then accepted an assistant lecturing post at Birmingham University and then moved to Durham where he was appointed in May 1928 to lead the new Geography degree program.[4]

At Durham, Manley developed his interest in the collection and analysis of long-term instrumental weather records for the UK, and his associated investigations of the people who created them. This work was shaped by his appointment as curator of the Durham Observatory between 1931 and 1937 [6] and his interest in long series derived from historical sources at Durham and elsewhere. It is from such sources that Manley assembled the Central England Temperature (CET) series of monthly mean temperatures, stretching back to 1659,[7,8] with daily data available from 1772.[9] The CET is the longest continuous instrumental surface temperature series available and is based directly on thermometer readings drawn from various sites forming an approximately triangular area, enclosed by Bristol, Lancashire, and London. Now maintained and updated by the Hadley Centre,[10] the CET is used to calibrate proxy records of climatic change[3] and represents the most studied climate record in the world.[11]

While at Durham, Manley also maintained his own field stations, first at Moor House, in a gamekeeper's cottage on the exposed moorlands of Upper Teesdale at 1840 ft, and later at nearby Great Dun Fell, on the cusp of one of the bleakest summits in the Northern Pennines. He was a pioneer of such upland weather studies, and his run of personally collected data helped to establish Great Dun Fell as a leading weather station.[12,13] Manley held particular affection for the Pennines throughout his life. This was an area in which he regularly walked alone, with his students, or with his wife Audrey Fairfax Robinson whom he married in 1930. Manley maintained detailed commentaries on the walks he had undertaken and there remain four notebooks, now held in the Gordon Manley papers in the Department of Manuscripts and University Archives, Cambridge University, recording these walks and associated field and weather observations from his teenage years into the 1930s.[14]

In 1939, after 11 years at Durham, and having completed, as an external candidate, a Master of Science in the Faculty of Science at the University of Manchester the previous year, Manley returned to Cambridge as a demonstrator (supporting practical and laboratory-based teaching) and later as a lecturer. Here he published over 30 papers, a number of which are discussed in this review. He then moved to Bedford College, London, where he was Professor of Geography from 1948 to 1964.[3] During this time, he was awarded a Doctor of Science (D.Sc.) from the University of Manchester in 1958. This is a higher doctorate conferred on a member of the university with a proven track record of producing internationally recognized scholarship. Manley would in fact receive another (honorary) D.Sc., awarded by Durham University in 1979.

At the age of 62, Manley established a new Department of Environmental Studies at Lancaster University. In the words of one of his former research assistants, this meant returning to a part of the country 'he knew and loved with warmth, respect, lively imagination and a fine eye for detail' (Ref 15, p. 228–229). It is perhaps no surprise then that he developed an interest in what the features of this relict

glacial landscape could reveal about past climatic episodes in Earth's history. In all such work, Manley was a 'painstaking empiricist, testing imaginative and broad ranging theories against the wealth of complex and contradictory field evidence' (Ref 15, p. 228–229). Throughout his career Manley would maintain a conviction in the importance of fieldwork in such areas, promoting the countryside as 'our laboratory' (Ref 16, p. 19) and highlighting the value of hands on, rigorous scientific investigation.

Manley played a pivotal role in demonstrating the powerful relationship between climate, weather, and culture. His classic text, *Climate and the British Scene*, published in 1952, volume 22 in the Collins 'New Naturalist' series, illustrated the significant role that climate, but specifically its day to day manifestations through weather, played in shaping British landscapes, national identity, and character. Manley also considered secular variations of the British climate and instrumental records. His final chapter—Climate and Man—afforded Manley an opportunity to indulge in discussion about the effects of the British climate on livelihood, health and wellbeing, death rates, and also climate's 'influence on moulding the British mind' (Ref 17, p. 277). As the editors of the series explained in their preface, 'realizing the fundamental influence of climate on every aspect of the natural history, ecology and scenery of Britain' presented a challenge, but Manley 'succeeded in his difficult task as no one else could have done' (Ref 17, p. xiii).

Manley's talent for and commitment to engaging the public in all matters related to the British climate extended beyond this popular text and he published many articles in the *Manchester Guardian* (renamed in 1959 as *The Guardian*).[18] 'Erudite, entertaining and beautifully written' (Ref 2, p. 87), the articles covered a broad range of themes relating to British weather, including reflections on recent weather experiences, often placing them in historical context, weather's cultural imprint, regional weather stereotypes, and weather sayings and lore.[19] He also regularly discussed these themes on local and also national radio, featuring, for example, in a range of documentary and light entertainment programs for the BBC between the 1930s and 1960s. His key purpose in setting up the Royal Meteorological Society's journal, *Weather*, in 1946 was to encourage 'the exchange and dissemination of information by means of articles, notes and correspondence' and not only among the Fellows, 'but also the wider public which nowadays increasingly demands some subject of universal interest as a recreation for the mind' (Ref 20, p. i). He thus invested considerable effort in public engagement, long before it was an expectation of academic posts.

In the remainder of this paper, we consider Manley's many contributions, both professional and popular, to climate debates in the twentieth century. We also explore the influence of other scholars in the field on Manley's approaches and perspectives. Given the sheer volume of material Manley produced during his lifetime, we cannot hope to provide an exhaustive review. Instead, we use Manley's G.J. Symon's Lecture 'Some contributions to the study of climatic change' as a frame of reference, and draw upon some of the themes it contains.[1]

SNOW, ICE, AND POLAR WARMING

For Manley, studies of climate changes over a range of temporal and spatial scales had been somewhat neglected by British climatologists. There were notable exceptions, not least C.E.P. Brooks whose 'extensive work' influenced Manley's own thinking, particularly with respect to investigations of the causes of ice ages (Ref 1, p. 197) and with whom Manley would correspond on a range of climate issues.[a] Yet it is fair to say, the subject of Manley's Symons Lecture was inspired by the work of scholars outside of the UK and specifically that of Hans W. Ahlmann. An 'eminent Swedish authority' working on the 'economy of glaciers' (Ref 1, p. 205), and one time Swedish ambassador to Norway, Ahlmann was arguably, 'one of the first to draw attention in this country to a notable change of world climate within our own times' (Ref 21, p. 118). He undertook field-based studies of glacier variations, his results pointing to a marked diminution in the size of the Norwegian glaciers during the first half of the twentieth century, a phenomenon that was referred to as 'polar warming'.[22–25] The evidence for this climate 'amelioration' was supported by other contemporary climatic scientists. For example, Danish scientist, Leo Lysgaard, whose work Manley also cited, had made similar observations and would later state that 'over great parts of the earth, especially in temperate and arctic zones, both winter and summer temperature seem to have been subject to an appreciable increase' (Ref 26, p. 443).

By the time Manley delivered his Symons Lecture, there was a growing body of evidence that some parts of the world, particularly in the Arctic Seas, had been warming up (Ref 27, p. 34). Moreover, the amelioration was something that 'ordinary people' were beginning to acknowledge (Ref 24, p. 165). Manley later confirmed that 'the present improvement appears to have set in about 1925-30' (Ref 28, p. 44).

Swedish scientist, Anders Ångström had attempted an explanation of this warming in a 1939 publication, suggesting a link with an intensification of the atmospheric circulation over the North Atlantic.[29] Remaining circumspect on causality, Manley felt that more data was needed before any concrete conclusions could be drawn (Ref 1, p. 214). Notably, links were not made with the work presented by Guy Stewart Callendar, a British steam and combustion engineer, who had demonstrated in his 1938 paper in the *Quarterly Journal of the Royal Meteorological Society*[30] a relationship between the artificial production of carbon dioxide and warming trends. As Sorlin has demonstrated, Ahlmann and Callendar both identified a warming trend, but they disagreed on the cause of this warming, 'Ahlmann always denying human impact, Callendar always advocating it' (Ref 25, p. 69). Ahlmann's theory would not figure in later work on global scale anthropogenic climate forcing, while Callendar's work would be fundamental therein. Manley did cite Callendar in his Symons Lecture. He also corresponded with Callendar, and with others, about Callendar's work[b] and would later acknowledge in a letter of condolence to Callendar's widow Phyllis, that her husband's 'classic paper' on carbon dioxide made 'an original contribution', which preceded any scholarly publications on this theme from the United States by about 20 years (Ref 31, p. 90). Yet for Manley, the material evidence Ahlmann had presented for ongoing climate change in the Arctic and the North Atlantic region in the 1920s and 1930s was of great interest and served several purposes. Primarily, he felt that Ahlmann's and others' work opened up enormous potential for research into climate changes and alerted him to the 'wide vistas for future work in Great Britain.' He was convinced that 'Ahlmann's researches on the relationship between glaciation and climate in Scandinavia may well bear fruit in Britain even though glaciers are absent' (Ref 32, p. 192).

The study of glaciers, and also of snow and ice more generally, had already featured in Manley's research. While studying at Cambridge, he had developed his interest in polar and high altitude environments, taking part in the British East Greenland Expedition of 1935–1936, where he had made his own observations of climatic 'amelioration'. His notes for the General Report on the expedition, read that 'ice conditions are undergoing change' and, citing evidence from oral history observations with local inhabitants, he added 'apparently in their father's and grandfather's time there was ice all the year, but during the last 20 years the ice has usually disappeared in August as we found.'[c]

Manley helped to establish the Association for the Study of Snow and Ice in 1937, and was also instrumental in developing and administering the National Snow Survey of Great Britain.[33,d] He also later began mapping the average yearly frequency of snow and sleet over the British Isles, producing the first publications on this theme, latterly included in the Climatological Atlas of the British Isles.[34,35]

Spurred on by Ahlmann's research, Manley felt that there was scope for further work on snow beds as sources of climate information in the UK. Thus it was that in a paper published in the *Scottish Geographical Magazine* in 1945 he implored 'cannot more be done in Scotland?' with specific reference to long term observations of the semi-permanent snow beds of Ben Nevis and the Cairngorms—or what he referred to as 'Scotland's natural thermometer' (Ref 36, p. 76). Ahlmann had suggested that the higher Scottish mountains lie near enough to the snow line for estimates to be made of the height at which glaciers would develop under present climatic conditions, a lead that Manley pursued in his 1949 paper 'The snow line of Britain.'[32] Attempts could be made to estimate accumulations and ablation areas of the small glaciers, which laid down moraines 'representing the last re-advances', and Manley argued that 'if this is done for a number of examples an estimate for the height of the firn line [glaciation level] might be available' (Ref 32, p. 192). He thus presented a challenge to the glaciological community, though Manley himself also later published on ice domes and permanently snow covered summits[37] and on the subject of glaciers and the changing climate more generally in his role as the UK correspondent for glaciology (1955–1961) during the International Geophysical Year.[38]

Manley's interest in snow and ice persisted throughout his professional career and continued into his retirement. The subject of his Margary Lecture for 1968, delivered before the Royal Meteorological Society on 6th March, focused on 'snowfall in Britain over the past 300 years.' The frequency of snowfall in the British Isles would remain a particular interest for Manley and was a subject upon which he regularly wrote.[39,40]

Manley was also influenced by other aspects of Scandinavian climate research and particularly work relating glacial studies to long term instrumental weather observations, most notably the Stockholm Observatory temperature record, beginning in 1756.[41] Publications on the Utrecht record which dated back to 1706,[28] Labrijn's work on a number of long records in the Netherlands, the oldest dating back to 1735,[42] and, as noted, Callendar's work drawing on historical instrumental temperature data,[30] also all provided

stimuli to Manley's important work using historical records in the study of climate changes over recent centuries. 'Further instrumental records may now be analysed' Manley argued toward the end of his Symons Lecture 'to provide evidence of the manner in which climate changes might occur' (Ref 1, p. 217). It is to his endeavors in this arena that we now turn.

MANLEY AND THE AMATEUR TRADITION

It is entirely fitting that Manley had been invited to present the G.J. Symons Lecture. Like Symons, who had spearheaded the establishment of the British Rainfall Organisation—a network of voluntary rainfall observers, set up in order to better understand variations in rainfall across the country following a period of low rainfall in the 1850s.[43] Manley had great respect for the contributions of the local weather observer, past and present. Such contributions were in fact central to Manley's work on standardizing overlapping historical temperature records for the UK, which would culminate with the publication of the CET series, arguably 'Manley's greatest legacy to climatology' (Ref 44, p. 331).

Most of his sources consisted of records produced by 'assiduous observers' (Ref 45, p. 1), many of whom were 'amateurs'. A strong believer in the great potential of this material, Manley felt that 'British science probably owes more to the "amateur" than that of any other country' (Ref 36, p. 73). Thanks to this body of 'volunteer enquirers' with an interest in meteorology, there was (and is) a vast body of recorded observations and descriptive comments on the weather which afforded 'indispensable' information for Manley's endeavors (Ref 46, p. 255).

Manley began homogenizing temperature records while he was curator of Durham University Observatory (1931–1937), assessing approximate mean annual temperatures for each of the years 1843–1846, and thence monthly means for subsequent years. This resulted in 'The Durham Meteorological Record, 1847-1940'[47] for which he was jointly awarded the Buchan Prize (together with Dr T.E.W. Schumann). This record represented, as it still does, the second longest continuous record at a British university observatory (after the Radcliffe Observatory at Oxford University).[48] Following his move back to Cambridge in 1939, and notwithstanding his commitments to the war effort as a Flight Lieutenant in the Cambridge University Air Squadron from 1942 to 1945,[4] Manley began to work with temperature data from the Lancashire Plain, extending his record there back to 1753.[45]

Many people had maintained meteorological diaries across the UK prior to the advent of official observing in the mid nineteenth century.[49] These included, 'those with a passion for recording meteorological events … [the] Colonial so and so who has kept a rain gauge for twenty three years … the retired engineer who hangs a six's maximum and minimum thermometer outside his back door and makes a daily note of his readings' (Ref 50, p. 11), as well as amateur observers of some renown, and of whose work Manley wrote, including the likes of John Dalton,[51] Thomas Barker,[46] Robert Hooke and John Locke.[52] Manley spent over 30 years searching out and painstakingly transcribing these old weather records in archives, county record offices and private collections across the country in the creation of the CET, a pursuit which in Craddock's terms resisted 'the tide of fashion at the time for finding solutions to meteorological problems in mathematics, and computer technology' (Ref 53, p. 230). Much of the material for this lay 'buried in many places' and as such had 'never been incorporated into any present day series' (Ref 45, p. 2), such that Manley was responsible for discovering many new sources, though often in collaboration with very knowledgeable archivists. There were interpretive challenges associated with the inconsistent and highly idiosyncratic source documents, which he likened to 'drilling an amateur army; each man must be persuaded to fit in with the rest and anyone who has ever tackled the problem realises after a time why it is that with such a number of observers we have in Britain so few long records' (Ref 45, p. 2). This was pioneering and difficult work that required incredible skill and patience. Manley's sources were indeed extremely varied and included non-standard sources, recorded with a variety of instruments, at a variety of sites (and exposures) and in a range of formats and units.

Notwithstanding such challenges, Manley pursued his task with persistence and patience, rigor and attention to detail and a 'dogged determination' (Ref 4, p. 222), enabling him to gain a uniquely detailed insight into climate fluctuations, particularly in terms of temperature, across a substantial part of England, dating back to the mid seventeenth century. This was and remains an astonishing piece of work in every sense, from its inception and creation, through to its recognition and acceptance as the longest temperature series in existence.

His record afforded opportunities to investigate changes at a range of scales, and to reflect upon key episodes in British climate history. Among those years that warranted dedicated papers were 1684,[54] 1740,[50] and 1947.[55] He also drew attention to periods such as the 1940s, which he argued 'taken overall were one of

the most favourable periods … since the outstanding series of favourable warm summers about 1772–1783 which stand out in the Stockholm and Utrecht records as well as our own' (Ref 28, p. 44).

His approach also afforded an opportunity to better understand how the clergymen, landed gentry, and early scientists who had authored the records, themselves perceived how climate could change over different timescales and the implications of those changes. Among his many papers from the early 1950s, for example, was a piece based on eighteenth century contributions to observational meteorology and the links that were drawn between weather and disease.[56] Although he was acutely aware of the variability in the quality of the observations that were made by such individuals, leading him to produce his own classification of observer 'alertness' (Ref 39, p. 430), he also argued that 'we cannot fail to be impressed by the assiduity and regularity of some of those amateur enthusiasts whose records remain' (Ref 57, p. 7).

As Radcliffe has highlighted,[58] Manley must have felt something of an affinity for such individuals. Like his subjects, those weather observers pursuing a very peculiar kind of 'nature-worship', he too had spent a good deal of energy and time producing his own 'orderly and precise set of measurements' (Ref 59, p. 6). He had begun recording his own weather observations on the Lancashire Plains at the age of 12,[3] developing his interests during his professional career through his observations at Moor House (Ref 58, p. 268) where he recorded temperatures in a standard screen from early in 1932 to 1937. This data formed the basis of a paper on the climate of the Northern Pennines.[60] Then between 1938 and 1940, supported by a Leverhulme Trust award, Manley set up a small meteorological station on the summit of Great Dun Fell.[3] Manley's primary aim in running this weather station was to discover under what circumstances blew England's only named wind—the Helm Wind—and to add some measure of the strength of the wind to the existing accounts.[61] He was also keen to further develop his set of continuous meteorological mountain records and the observations at Great Dun Fell still constitute the longest unbroken set of mountain temperature records in the UK.[13]

In total, Manley wrote over a dozen papers on the weather of the Northern Pennines and surrounding areas.[3] Although his fascination with the North Pennines continued through the rest of his life, Manley's interests also extended further afield. All over Britain, he argued, one could find 'small scale examples of almost every meteorological phenomenon' (Ref 62, p. 241) and the British weather in general could 'provide statistics to satisfy almost any enthusiast from time to time' (Ref 63, p. 2). His work with historical observations also allowed him to identify areas of potential in terms of untapped historical records, and to highlight opportunities for contemporary amateur communities. Linking with his work on climatic amelioration, he argued that long term observational work on snow beds 'to note the extent of such beds from time to time, especially in September, should be a splendid job for students' as opposed to 'overworked professionals'. After all, 'the amateur', Manley noted, 'especially with some training can rove more freely.' Volunteers could also be put to use, he suggested, on the 'straightforward observation of miscellaneous phenomena', something that had also been highlighted by a young Hubert Lamb in 1938 (Ref 64 cited in Ref 36, p. 76). Manley had helped spearhead the volunteer based collection of information about snow fall in the UK through the National Snow Survey and in 1938 he had placed a 'snow book' on behalf of the Association for the Study of Snow and Ice in the Scottish Mountaineering Club's (of which he was a member) hut on Ben Nevis 'for the recording of comments on the state of the snow.'[e] He had also regularly monitored the snow coverage to assess change over time (Ref 40, p. 459). Through such work Manley was able to record the disappearance, on more than one occasion since 1933, of the reputedly 'permanent' Scottish snow beds (Ref 28, p. 47).

Manley was generally skeptical of identifying patterns or trends from his long-term records. At the start of his Symons Lecture he noted that 'it would appear to be a property of our make up to seek for rhythmic changes' in climate, something that, he acknowledged, 'almost every amateur meteorologist attempts to find', particularly with respect to hard winters (Ref 1, p. 197). However, reflecting on the severe winter of 1947 in an article for *Weather*, he highlighted that assumptions drawn from any recognizable trend were 'very risky', such was the complexity of the history of climate changes over recent centuries that Manley had been able to identify for the UK from his work with historical records (Ref 55, p. 272).

While Manley seemed cautious about identifying climatic 'rhythms' through history, he was keen to draw out relationships between climate, weather, and culture. Moreover, his incredible work in pulling together the multitude of early records and observations for the UK provided him with a unique view on the potential role of climate in socio-economic and cultural change, a subject to which we now turn.

CLIMATE, WEATHER, AND CULTURE

Manley assiduously followed work in the genre of climate and cultural history while acknowledging it to be, in the mid twentieth century at least, a controversial topic (Ref 1, p. 199). The controversy was strongly associated with environmental determinists, such as Ellsworth Huntington, an influential US-based 'geographer, determinist, eugenicist and popular writer' of the period (Ref 31, p. 95). Huntington was broadly concerned with the 'response of living things … to their environment,' (Ref 65, p. 98), with the impacts of climate and climate changes over centuries and millennia on the development and location of civilisation and the influence of weather types on human efficiency.[66] Such 'simple determinism' faced considerable criticism,[67] not least because of the way these arguments were interpreted and applied in racist dogmas in the early twentieth century. Climate was brought to bear to argue for the superiority of some culture groups over others in the ideological wars of the twentieth century,[68] an issue to which Manley was sensitive. In his Symons Lecture he acknowledged the work of the 'travelled historian' and 'experienced field archaeologist'—the likes of Aurel Stein, archeologist of Central Asia, where much of Huntington's theories had focused—and 'the infinite complexity of the relationships between man and his surroundings.' To Manley, this complexity emphasized the need for detailed field-based investigations rather than 'categorical generalizations smelling of the lamp and preconceived ideas arising from a reverential attitude to the printed word' (Ref 1, p. 198). He urged 'caution in drawing inferences with regard to climatic change from the progress or regress of human culture' (Ref 1, p. 202), pointing out that 'more work in the field is necessary before we can come to final conclusions regarding the effect of climatic change on the course of history' (Ref 1, p. 217).

Yet, equally, Manley credited Huntington with stimulating debate and he considered him to be a 'pioneer' in this respect (Ref 1, p. 202). Furthermore, despite the fact that environmental determinism of any sort became 'discredited and marginalised' within mainstream academic geography (Ref 68, p. 252) and many academics feared engaging in any work that focused on the relationship between climate and society, Manley seems to have resisted this move. In a set of lecture notes entitled the 'Geography of British History,' written from Bedford College in the 1960s, and strongly echoing Huntington's own theories, Manley reflected on the relationship between geography and environment more broadly, beginning his lecture as follows:

> "Have you ever wondered why we in this country have been so active? Have you ever looked at a world population map and wondered why the great 'blobs' of world population are where they are? Have you ever wondered why the active subscribers of world civilisations are primarily in Europe?"

Sometimes, he argued, "the answer lies in history," but "there are other factors which have in part made history. These are the facts of geography."[f]

His later work also demonstrated some sympathy with Huntington's 'forthright promulgation of his doctrine of the effects of climate- and therefore of climatic variations- on the welfare of peoples' (Ref 65, p. 99). He was particularly fascinated by the way in which climate helped shape and frame the British landscape and its people. This theme was pursued in *Climate and the British Scene*, where he highlighted the significant role that climate has played in shaping not only landscapes but also national identity and character. As he indicated in the introduction to the volume, the British climate was 'a factor in the moulding not merely of landscape but of the many other elements that go to make up the British scene' (Ref 17, p. 4). His *Manchester Guardian* articles similarly drew attention to these relationships. Through his many pieces on idiosyncratic regional weather types, and his inferences of links with spatially distinctive regional identities and stereotypes, he highlighted the importance of considering the connections between climate and the peculiarities of people and places.[19]

Manley also charted some of the possibilities and problems that climate variability over decadal and year to year timescales might bring. In his 1951 paper addressing the range of variation in the UK, he asserted that even 'small changes of temperature in our maritime climate are capable of giving rise to widespread effects' (Ref 28, p. 63). The climatic amelioration of the early twentieth century had stimulated concerns in this vein. Yet this period of warming also brought with it opportunity, and Manley highlighted the agricultural potential of an increasingly raised snow line, arguing that 'the promise of return from our uplands is evidently considerable' (Ref 28 p. 48).

His views on the negative influences of climate for society, however, would be consolidated by research into the consequences for humans of living in climatically marginal conditions in some Scandinavian regions,[69] and more particularly by a paper written by economic historian Gustaf Utterström in 1955 entitled 'Climatic fluctuations and population problems in Early Modern Europe.'[70] In his *Geographical Review* article from 1958,[65] Manley reflected upon a potential 'Revival of Climatic Determinism' stimulated in part by some of Utterström's assertions regarding the

effects of historical climatic changes on the welfare of populations. With the exception of the French Annales School, and the likes of Braudel and his students, including Emmanuel Le Roy Ladurie, historians had hitherto been somewhat indifferent toward studying the impacts of climate on society.[71] Utterström's was thus a radical argument to make within the field of Economic History at the time, and yet seems to have chimed with Manley's own perspectives. Indeed, he found some of Utterström's arguments, particularly those relating population growth and better health with mild weather in eighteenth century Sweden, to be 'entirely acceptable' (Ref 65, p. 101).

Manley remained acutely aware of the 'multiplicity of variables that affect the climate of Great Britain but also its economic welfare' but highlighted that while 'climatic fluctuations may be small … in our overpopulated island, failure to allow for them may now jeopardise our success in other fields. Hence they are deserving of the utmost study' (Ref 65, p. 103).

Just two examples from the 1950s serve to illustrate Manley's concerns in this respect. Moreover, they position Manley's work at this time within an applied geography approach, made popular by L. Dudley Stamp (from whom an invitation was received by Manley to sit on the maps committee of the Inter-Allied Committee for Physical Planning and Reconstruction in 1944[g]). First, in a paper delivered to the British Association for the Advancement of Science, in Sheffield, in 1956, he reported specifically on the implications of year to year climate changes and even seasonal weather for fuel requirements, highlighting how changes in weather mapped onto the demand for fuel for heating. He drew on historical trends of both fuel consumption and seasonal weather variability to demonstrate how fuel use increased dramatically during poor winters. This intervention came at a time when there was widespread concern over the sustainability of coal supplies across the UK and, symbolically, when the UK had become an importer of fuel (Ref 72, p. 19).

Second, Manley regularly expressed concern over the implications of year to year changes in temperature and precipitation for Britain's water supply. A warm and generally dry summer in 1953 contributed to high levels of evaporation. Compounded by a dry spring in 1954, a dry late winter in 1954–1955 and another dry spring in 1955, the threat of 'a national water shortage' the following year received significant media coverage. Manley predicted a problem in May 1956 in an article entitled 'This year's dry spring: the prospects of drought.'[73] Then in a report for *The Manchester Guardian* published on November 12th 1956 with the title 'The National Shortage',[74] he alerted readers to several historical examples of work on rainfall and drought. He referred to the work of Richard Towneley of Burnley whose observations covered the period between 1677 and 1704, 'the great drought and consequent diaries of 1828' which stimulated further enquiry especially in Lancashire, and Atkinson of Carlisle, who, he noted, had in 1840 produced the world's first attempt at a rainfall map. He also drew particular attention to British Rainfall Organisation data, 'the finest assemblage of rainfall data in the world', all of which he used to suggest that the mid 1950s drought was not unprecedented. It was possible to recognize 'runs of years when for a decade or so wetness or dryness has prevailed'. But he also highlighted, how such episodes could nevertheless be particularly damaging for socio economic well-being, arguing that 'the consequences of such a succession of dry years today would be extremely serious' (Ref 74, p. 8). Most parts of Britain would in fact experience another exceptionally dry summer in 1959, resulting in surface water scarcities in some regions.[75,76] The problem was not merely one of water supply, but demand and extraction. As Manley had already noted in 1956, 'we are 50 million people trying to live on an island of limited resources' and water scarcity should, he argued, be considered one of the inevitable outcomes.

Manley's assertions on fossil fuel consumption preceded scholarly debates over environmental resource scarcity by over a decade,[77] and as an Emeritus Professor, he even found himself reviewing more radical work on 'Iceberg utilisation for fresh water production' (Ref 78, p. 305). Through such activities, Manley maintained a strong interest in exploring the power of climate to shape human well-being.

CONCLUSION

Between 1927 and 1981, Manley produced around 182 published papers.[3] What is even more impressive is the breadth of topics he covered and the multiple audiences he reached. His 'many sided' interests (Ref 4, p. 220) made their way into his papers, commentaries, and newspaper articles. He was recognized for his program of observational work at the local level, specifically in the Pennines, but also made major contributions to national and international scholarship on climate. His work appealed, and continues to appeal, to geographers, economic historians, meteorologists, and historians of science and he has had a major influence on research into the climate in Britain and climate history more generally. Yet he also engaged popular audiences with his entertaining, witty and informative articles in the *Manchester*

Guardian, *Guardian* newspapers, *Weather* magazine, and through his radio broadcasts. His contribution to the New Naturalist book series, not only appealed to the target popular audiences of the series, but is still regarded by many contemporary climate scientists as a classic text. Within the first 20 years of its publication it had been reprinted five times[44] and there have been many subsequent, important publications in their own right, that have demonstrated the book's influence, not least Hubert Lamb's (1982) *Climate and Human History*,[79] Wheeler and Mayes' (1997) *Regional climates of the British Isles*,[80] Chandler and Gregory's (1976) *Climate of the British Isles*,[81] Hulme and Barrow's (1997) *Climates of the British Isle: Past, Present and Future*[82] and most recently, Kington's (2010) *Climate and Weather*, no. 115 in the New Naturalist series.[49]

We have sampled but a few themes with which Manley engaged. There is little scope here, for example, to consider his work on late Pleistocene climate reconstruction—research he pursued while at Lancaster. He was particularly interested in explanations behind the ice age in Europe, arguing that 'anything we can do towards solving it may throw light on the reasons for the smaller climatic fluctuations that are occurring today' (cited in Ref 15, p. 228). He wrote about variations in frost free seasons and undertook reviews of diminishing ice caps in Antarctica as well as in the northern hemisphere.[83] He also actively explored with his research assistants and PhD students 'the palaeoclimatic significance of summit tarns, possible nivation hollows and the few clear cirques' in the North Pennines (Ref 15, p. 229–230). He worked on the relationship between relief and temperature in the north of England, [62,84] as well as the influence of water bodies and urban growth on temperature.[4] He published on the subject of antiquarian maps and atlases,[85–87]and through his collaboration with L. Dudley Stamp, contributed several papers to the Land Utilisation Survey of Britain.[88] He also explored the relationship between climate and landscape architecture,[89] co-edited major geography texts,[90] and commented on the relationship between nuclear testing and the weather.[91] Some of these themes he continued to pursue in later life and during his stay as a visiting professor at Texas A and M University, a position he held until 1970.

Manley can be regarded as something of a pioneer in terms of methodological approaches to studying climate. Through his painstaking work piecing together and overlapping discontinuous, historical weather observations to construct the CET series, and his endeavors with the Snow and Ice Association, he highlighted the potential for scientists, amateur and lay contributors alike to engage with weather observation. In as much, it could be argued that Manley anticipated by several decades work on the co-production of scientific knowledge.[92] His approach may have gained renewed significance in a contemporary context where crowd sourcing is being advocated, and where recognition of the complexity and uncertainty associated with both the physical and social aspects of climate is thought to be reinforcing the value of non-expert engagement.[93]

Manley was also intrigued by the interplay of climate and culture and pursued a goal to encourage a culturally driven and local-scale consideration of climate as an expression of the 'integrated experiences' of weather in Britain in the mid-twentieth century (Ref 17, p. 1). His work in this vein also has renewed significance today, especially amid calls to 'reculture' climate change discourses by exploring 'the relationship between local weather and cultural practices' (Ref 94, p. 6). Indeed, recent research, albeit focusing on anthropogenic climate change, is also arguing for much the same as Manley, that is to say a 'need for the public to begin talking about climate change and integrating it into their everyday lives' (Ref 95, p. 62).

Somewhat unfashionably and with some degree of academic risk, given the stagnating wake of the more extreme deterministic views of the early twentieth century, Manley maintained his conviction that climate exerted an important influence on society. While his arguments were made with sensitive assertions regarding the 'remarkable complexity' of human–environmental relationships (Ref 96, p. 186), he did remind people of the constraints that nature could impose on human society,[64] foreseeing a period when climate change would achieve heightened importance. Indeed, only a year before his death, Manley was advocating the adoption of 'some of those oft despised geographical virtues,' that is to say perspectives on climate that might be considered, by some at least, to be environmentally deterministic.[b]

Manley was convinced by the mid-1950s that 'the study of climatic variation' was 'of quite fundamental importance' for society and 'variations in temperature in more northern lands' he felt would 'assume enormous potential importance' in the second half of the twentieth century (Ref 96, p. 185–186). These references perhaps point more toward Ahlmann's influence and theories of polar warming than they do anthropogenic global scale changes, but Manley did anticipate the need for multiple approaches to address the complex problems posed by climatic change at different temporal and spatial scales. Specifically he highlighted the need for some level of international coordination for what he correctly anticipated would,

within 20 years, become a growing global concern. In 1953, for example he suggested:

> coping with day to day changes of weather is now largely a matter for individual effort and decision; coping with seasonal changes in respect of water supply or grain shipment is a matter for communities; we are just beginning to confront the need to insure against longer term variations which may in time require action on an international scale. (Ref 96, p. 185).

Manley worked as an independent scholar throughout his life and followed his interests and convictions rather than fashionable trends in academic enquiry. His reviews of new geography texts in the late 1960s revealed a certain frustration with the shifts within the discipline. He questioned whether the geographer was 'expected to become a critical compiler for examination purposes from other's writings, in place of knowing what he is doing through sound experimental work on the material under investigation'. He also seems to have been irritated by what he felt was a developing 'anxiety' among the geographical community about the future of the discipline. This was also manifest in geography texts that he was invited to review and which he felt focused far too much on arguments about what geographers should or should not study. Yet he also seems to have been discouraged by geography's increasing focus on 'fashionable statistical analysis, and the design of analogs and models'.[97] Manley was certainly no supporter of studies which were not based on first hand scientific investigations and does not seem to have been enthralled by developments toward environmental modeling, arguing instead that 'turbulent studies by the experimental method might provide better models of what goes on in both time and space on the earth's surface', a theme which he discussed in his earlier 1953 paper reviewing modern climatology.[96] He thus 'stood almost alone', Craddock notes, as a meteorologist pursuing his meticulous climate history work at a time of great investment in atmospheric computerized modeling (Ref 53, p. 230). The indicators of Manley's dissatisfaction with developments within his 'home' discipline and his own position therein, may, to some extent, account for his departure from it to set up the Environmental Studies Department unit in Lancaster in 1964 where he stayed till his retirement in 1968.

After retiring, Manley remained committed to the study of British climate history. His unpublished correspondence from the late 1970s suggests that he had been planning a book with the working title 'Studies of the British climate: a history of the British weather'—a proposal influenced by Le Roy Ladurie's (1967) *Histoire du Climat Depuis L'An Mil*,[98] for which Manley had written the preface. He had noted 'we need something of the kind for Britain and it will certainly have a European market as a mine of necessary meteorological materials'.[i] This was to be a reading on the British climate, the sources of instrumental weather observations for the UK, the makers of these observations and the records themselves, including information on extremes in history, and the way in which human activities had led to changed experiences of the weather and the effects of climate on economic and social history. The book proposal, presented to Cambridge University Press, was not without controversy. Manley was reluctant to publish the piece as part of the Cambridge Geographical Studies series. To some extent, this decision may again reflect Manley's disillusion at some of the developments taking place within geography at this time, specifically shifts away from field based science and toward the use of analogs and models, and his resolute position on the importance of scientific investigation noted above. 'I should prefer' he notes 'to stand as a scientist'.[j]

Manley passed away before bringing the book to fruition, though some of the chapters were published posthumously as papers.[99] There have been other books focusing on climate and society in the UK, including those noted above, which can be positioned squarely within a Manley tradition. But it is perhaps telling of Manley's unique capacity to undertake such an endeavor, based upon decades of painstaking research and resulting wisdom on British climate, that no one has yet attempted the daunting task that Manley proposed.

NOTES

[a] Letter to Manley from CEP Brookes on the Little Ice Age, dated March 25, 1947. Department of Manuscripts and University Archives, Cambridge, Gordon Manley Papers, GBR/0012/MS Add.8386/Box 24/3.

[b] Callendar's work was mentioned in CEP Brookes letter to Manley (see footnote 'a'), and there is one letter from Callendar to Manley at Cambridge GBR/0012/MS Add.8386/ Box 3/3 regarding the Durham series and dating from 12/12/ 1959. In Callendar's words, he had 'been studying the difference in temp trend between rural & urban sites. For England I have been using your Durham reductions as a rural site, owing to its good open situation.' He wanted to check whether Manley had 'data to give the effect of the 21h to 9hr change of setting times at Durham on the annual mean.'

[c] Gordon Manley Papers, Cambridge, GBR/0012/MS Add.8386/ Box1/5, Meteorological General Report, Greenland.
[d] In 1953 the work of the Association terminated and the collection of the records was then undertaken by the Meteorological Office.
[e] The 'snow book' from Ben Nevis survives and is now held in the Gordon Manley Papers, Cambridge GBR/0012/MS Add.8386/Box 12/5.
[f] Lecture notes, Bedford College, Gordon Manley Papers, Cambridge, GBR/0012/MS Add.8386/ Box 23/9.
[g] Correspondence 1944 Inter Allied Committee for Physical Planning and Reconstruction, Maps Committee. GBR/0012/MS Add.8386/Box 24/9.
[h] See Manley's draft review of Chandler and Gregory (eds) *The Climate of the British Isles* (1979). Gordon Manley Papers, Cambridge, GBR/0012/MS Add.8386/Box 17/8.
[i] Notes relating to his proposed book '*Collectarea Meteoroligica Britannica*' or '*Studies of the British Climate*.' Gordon Manley Papers, Cambridge, GBR/0012/MS Add.8386/Box 24/6.
[j] Manley's approach, and philosophy, was possibly seen as out of step with contemporary trends in geography at the time. One of the anonymous reviewers of his book proposal seems to have irritated Manley. In a letter to the commissioning editor, Manley notes, for example, 'I may be wrong in my assumption that your referee has been so much concerned with geography that he fails to read the major scientific journals' (Gordon Manley Papers, Cambridge, GBR/0012/MS Add.8386/Box 24/6).

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Gordon Manley Papers,GB-0033-MAN, Durham University Library, Archives and Special Collections