

WEATHER COMPILATIONS AS A SOURCE OF DATA FOR THE RECONSTRUCTION OF EUROPEAN CLIMATE DURING THE MEDIEVAL PERIOD

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Abstract. Research into the climate of the Middle Ages has relied heavily upon data provided by compilations of references to weather and related phenomena extracted from a variety of historical texts and source documents. These compilations, produced from 1858 onwards, have generally neglected the essential need for source validation. While a considerable amount of reliable and useful information about medieval climate is to be found in documentary sources, it occurs together with material which is spurious, inaccurate, or whose reliability cannot be properly authenticated. Because they were, for the most part, scientists, unfamiliar with historical methodology and techniques of source analysis, the authors of the compilations were either unaware of the problematic character of their sources, or ignorant of the techniques developed by historians for dealing with them. The material included in the compilations must be regarded as suspect until its authenticity has been checked by validating individual sources. Unless this is done, a misleading picture of the climate of the Middle Ages may emerge from uncritical use of the compilations. In particular, the climate may appear to have been more extreme than authentic sources alone would suggest.

Introduction

In the absence of systematic weather observation and instrumental records, reconstruction of the climate of the Middle Ages (A.D. 500–1500) depends on other types of data. Dendrochronology, pollen analysis, ice and sediment cores, etc., provide information about annual fluctuations and longer term trends, but for more detailed and more direct descriptions of the weather it is necessary to make use of documentary sources. Medieval manuscripts contain references to many different types of weather events such as frosts, rain and hailstorms. They also make mention of parameteorological phenomena such as parched ground and frozen or flooded rivers, as well as of harvests, vintages and famines from which conclusions about the weather can sometimes be drawn.

Documentary material exists for much of the medieval period, especially from the eleventh century onwards. It is found in a variety of historical forms including universal chronicles, monastic annals, *gestae*, *vitae*, sagas and, for the later Middle Ages, town and metrical chronicles, diaries and memoirs. While there are many hundreds of these, the weather references in them are scattered, often only a few to each source. Furthermore, the sources which contain weather references are themselves dispersed throughout a number of large collections such as the *Rerum Britannicarum Medii Aevi* (1858–1896)¹ and the *Monumenta Germaniae historica* (1826–1934),² the latter alone consisting of more than thirty volumes. Though some of the works have been translated, many of them

are still only available in medieval Latin, Old Icelandic or Middle High German. So an essential preliminary to research is the extraction and translation of widely diffused references to weather and related phenomena from the extensive documentary material available.

Compilations of such references were produced as early as the sixteenth century and works like Thomas Short's *A General Chronological History of the Air, Weather, Seasons, Meteors, in sundry places and different times, etc.* (London, 1749. Published anonymously.) became quite common by the eighteenth century. In the last hundred years or so, some fifteen compilations* have been published, absorbing much of the material contained in earlier ones. These modern compilations list, in chronological order, references extracted from a variety of historical texts and secondary sources. When quoting a reference, many compilations also indicate other sources in which further references to the same event occur. Such compilations make accessible, in comparatively few volumes, information which is otherwise dispersed throughout several hundred volumes of source material, and in consequence have been used extensively by historical climatologists.

The quality of presentation of material in the compilations varies considerably. Weikinn, the most thorough of the compilers with regard to presentation, reproduces the relevant passages verbatim from the text, and, in addition, offers complete translations of the medieval Latin. Some compilers either quote the original text in full and give summaries in translation, or they omit the original texts and include only translations. Most commonly of all they do no more than provide summaries or paraphrases. If the summaries are pertinent and accompanied by full source-references the data may be usable. But this is not always the case. Occasionally the summaries distort or truncate the original; Arago, for example, renders "Frigus erat validissimum, et hiberna siccitate arebant omnia, in tantum ut flumina non superficietenus glacie constricta, sed tota preter solitum in glaciem conversa viderentur"***³ as "L'hiver est tellement rude que tous les fleuves en Flandre et en Allemagne sont complètement gelés"***⁴ omitting the reference to the dryness of the winter. Lowe and Hennig sometimes neglect to name their sources, while Arago, Hennig and Thoroddsen combine material from two or more sources into a single summary, without identifying the source of each individual item of information.

Furthermore, most of the compilations contain inaccuracies in the reproduction of material from the sources. The compilers were not always aware of the different styles of dating used during the Middle Ages. Towns and monasteries frequently had their own style of dating, and might begin their year at Christmas, or the 1. of January, the 1. of March, the 25. of March or at Easter.⁵ In one case, for example, Vanderlinden is led to date the winters mentioned in the 'Annales Cameracenses' in the previous year.⁶ Mistakes in copying occur too. Weikinn incorrectly records the date of a storm flood on 2. June A.D. 1042, as the 2. June A.D. 1062.⁷ Frequently the information given about sources is

* See Appendix at end.

** "The cold was so extreme, and everything so parched from the dryness of winter that the rivers seemed not merely to be iced over on the surface but entirely turned to ice. It was extraordinary."

*** "The winter is so harsh that all the rivers in Flanders and in Germany are completely frozen."

also incorrect. In *The Coming Drought: or, The Cycle of the Seasons* Lowe cites as his source for the years A.D. 1276, 1277 and 1278 the 'Saxon Chronicle',⁸ now generally referred to as the 'Anglo-Saxon Chronicle', the latest entry in which is actually for A.D. 1154. He also gives Short as an authority for information dated as late as A.D. 1796, although Short died in A.D. 1772.⁹ Nevertheless, with the exception of Hennig who, on his own admission, compiled his work hurriedly,¹⁰ most contain comparatively few such inaccuracies. Far more serious is the fact that, with the exception of those produced within the last decade, all the compilations, even the most scholarly ones, quote as many unreliable, as reliable, sources. Perhaps because the compilers were themselves scientists unfamiliar with historical research and methodology, they did not check the validity of, or further analyse, the individual sources from which the weather references were taken. Such source analysis is fundamental to historical research based upon data from medieval documentary material, and its neglect by the compilers has serious consequences for the reliability, and hence the utility, of their work.

The Need for Source Analysis

The need to check the validity of individual sources derives largely from the character of the sources themselves. The compilers made use of sources belonging to different genres, whose various origins, purposes and development render them problematic from an historical point of view. Universal chronicles, for example, were written throughout the Middle Ages, flourishing as an historical genre from the eleventh century to the sixteenth. They were modelled on a work by Eusebius of Caesarea (ca. 265–340) which became widely known after a version of it, translated by Hieronymus in A.D. 380, was quoted by St. Augustine in his *de Civitate Dei* (412–427).¹¹ The primary aim of the chronicles was to provide a chronological framework within which to place what was then 'known' of the pre-medieval and early medieval period. However, since they lacked adequate methods for researching the past and had insufficient sources at their disposal, this aim was quite beyond the capability of the chroniclers. They were unable to distinguish fact from legend, the accurate from the erroneous, or to identify contemporary and non-contemporary sources, often, indeed, seeming unaware of the need to do so. Consequently, the universal chronicles represent a predominantly speculative tradition which, while sometimes providing reliable information about the times at which they were themselves being written, are largely useless as a source of data for earlier periods.

Similar problems of distinguishing reliable from unreliable information arise with monastic annals, and again owe their origin to the historical development of the genre itself. Unlike the universal chronicles, whose primary purpose was history on a world-wide scale, and whose chronological framework was provided by Ages, reigns and generations,¹² the monastic annals record year by year, noteworthy events often of purely local importance to the monastery or nearby town. Where universal chronicles recount the history of the Church, of empires, cultures and races, annals, in contrast, record such events as a failed harvest or epidemic in the vicinity of the monastery, or the death of a particular bishop. These annals evolved from the distribution of Easter Tables.

In the early Christian period, the complicated task of calculating the date of Easter was apparently performed annually in Alexandria and in Rome and monasteries were informed of the date by messenger.¹³ However, as Christianity spread to Britain and to Gaul and the problems of distributing information increased, a different solution was sought. In the early sixth century, Dionysius Exiguus compiled a set of tables, rows of columns indicating for each year the date on which Easter would fall, as well as the epact or number of days the solar and lunar years were out of phase, and like information, reckoned from the Year of the Incarnation. These tables were eventually adopted officially by the Church and distributed to the monasteries, enabling them to calculate the date of Easter for themselves. The Easter Tables had margins, and before long the monks began to note interesting and unusual events against particular years. As the practice developed comments spread to the top or bottom, with arrows indicating the relevant year.¹⁴ Copies of the annotated tables passed from monastery to monastery and were recopied, including the marginal records. Later these records were transcribed onto sheets separate from the tables, and finally independent annals began to be written. Both copies and annals were 'continued' by later writers. The process of copying produced errors, especially in the recording of dates, since the originals were often illegible and the copyists careless. Moreover, once the historical value of annals was realised, the annalists tried to augment records of earlier periods from other sources where they were confronted by the same difficulties as the universal chroniclers. Where sources were lacking they looked again to legend.¹⁵ As a result, the annals provide a mixture of valuable reports often dated to within a year, together with a mass of worthless material reproducing unreliable information and copyists' errors.

This problem of disentangling fact from fiction in the universal chronicles and monastic annals is also present in the case of the sagas, prose narratives composed in Iceland primarily during the thirteenth century. Certain of these, the sagas of Icelanders, or family sagas, recount events in the lives of the early settlers and great families of Iceland during the 'Saga Age' (ca. A.D. 930–1030). Factual and apparently objective in style, the family sagas were, at one time, assumed to be reliable historical accounts. Modern scholarship, however, suggests they were written primarily as literature rather than as history, with truth sometimes altered in the interests of the narrative.¹⁶ Furthermore, while the family sagas date mainly from the thirteenth century, the events they describe occurred some two or three hundred years earlier.¹⁷ Like the universal chronicles and annals therefore, they contain a mixture of historical description, both reliable and unreliable, together with a deal of fictitious material.

While universal chronicles, annals and sagas are part spurious, part genuine, and pose the problem of distinguishing fact from fiction within an individual source, other medieval sources are almost completely spurious. Between the eleventh and seventeenth centuries numerous forgeries were written, often centuries after the events they purported to describe, inventing ancient lineages for rich families, or seeking to further in some way the cause of monastic communities. In A.D. 1115, for example, the Abbey of Crowland in Lincolnshire, which was engaged at the time in disputes over the ownership of land, produced a forged document bestowing on Crowland rights to the disputed land.

Despite this, the wrangling still continued, and several centuries later, in about 1413, in a final effort to stake its claim, the Abbey combined the twelfth-century forgery and a number of fictitious charters into a single continuous narrative entitled 'Historia Croylandensis'.¹⁸ Authorship of this history was attributed to Ingulf, Abbot of Crowland, who died in A.D. 1109, and a twelfth-century continuator called Peter of Blois. Similarly, numerous documents were faked by humanist* scholars, influenced by classical texts, seeking to establish for their own countries a rich and heroic heritage comparable to that of Ancient Greece and Rome.¹⁹ In his *Compendium* and *Hirschauer Chronik*, for example, Abbot Trithemius of Sponheim and Wurzburg (1462–1516) refers to deeds from early medieval German history recounted by Megefnried, Benno and Hunibald,²⁰ who as far as modern scholarship can detect, existed only in the Abbot's imagination. Borchardt sums up this aspect of humanist historiography when he writes of the "demand for historical knowledge that moved the coterie of German humanists to search out and publish Germanica wherever they could find it – and where they could not find it, to invent it".²¹

Prior to the nineteenth century, a critical approach to medieval sources by historians was virtually unknown. Consequently, the problematic character of the sources themselves is preserved undiminished in numerous post-medieval editions which do no more than reproduce the medieval material unanalysed.²² From the sixteenth to the eighteenth century, many such uncritical editions of medieval sources were published, for instance, by Aegidius Tschudi in the sixteenth century, Marquard Freher in the seventeenth, and Bernhard and Hieronymus Pez in the eighteenth. Not only did writers like these sometimes misread the texts they were editing because of difficulty in following the handwriting, semantic differences between the old and contemporary Latin, or the use of abbreviations in the original; they also failed, in general, to distinguish between original sources, copies, continuations or later compilations. When Pez, for example, published his *Scriptores rerum Austriacum veteres ac genuini* (1720–1745) he included in it a document called 'Anonymi Leobenses Chronicon' covering a period of some four hundred years from A.D. 935 to 1347 and containing information from places as far apart as Bavaria, Rhineland, Vienna and Ancona. It has since been shown in a critical edition of the same text²³ that the original entries were made only from the early twelfth century, and describe events which occurred in or around Leoben in Styria about which the monks in the monastery at Leoben were personally informed. By implication, the description of events occurring at earlier times or in other places must derive from different sources which themselves require separate validation. In Pez's edition, however, all descriptions were accorded the same status, no distinction being drawn between original and derivative entries.

The need for analysis does not stop with the identification of independent and derivative sources. Not all independent sources, for example, are reliable; indeed, none of

* Humanism was an intellectual movement which flourished from the fifteenth century onward and was characterised by a renewed interest in the language and style as well as the content of classical scholarship.

the information contained in them can be regarded as wholly beyond question. Factors such as the writer's relation to the events described in point of space and time provide important indicators of reliability. Local events tend to be relatively accurately reported; and more nearly contemporary accounts are less likely to be distorted by their author's memory than are later ones, though, occasionally, accounts of events witnessed years previously by the writers can be shown to be reliable. Similarly important are the writer's aims and preconceptions in his approach to his records. A process of cross-checking can reveal bias in the selection of events for record or distortion of the account itself.

The Development and Use of Source Analysis

A full appreciation of the complex character and wide variations in the degree of reliability of medieval source material first developed early in the nineteenth century when a group of German historians involved in the publication of the *Monumenta Germaniae historica* began systematically to analyse documents in ways which enabled them to distinguish independent material from derived sources and copies. Their method was based on the fact that, while independent witnesses to the same events tend to produce recognisably different accounts, a writer who extracts information from the text of another rarely succeeds in concealing his dependence. Independent witnesses vary in their interpretations, in the details noted, and in the expressions used to describe events.²⁴ A copyist, on the other hand, may reveal misunderstanding of the original, report events he could not have witnessed, or be betrayed by his use of alien modes of expression.²⁵ If certain passages in several documents agree in content and also verbally, other than in their use of set phrases, then these passages are unlikely to have been written independently and are more likely to be derived from a common source or from one another.²⁶ Application of such analytic techniques to individual sources began to reveal the different origins and development of each documentary genre, the extensive copying, the writing of continuations, and the amalgamation of material from a variety of sources into single documents. It became possible to identify independent sources and even to reconstruct lost independent sources.²⁷

Furthermore, sources could be classified according to the above criteria and their reliability could be assessed. Much of the 'Scalacronica' of Sir Thomas Gray, for example, begun while the Northumbrian knight was held in captivity by the Scots and continued after his release in A.D. 1358, contains a record of events which the writer had experienced personally, and is considered authoritative for the Scottish wars of Edward II and Edward III.²⁸ Similarly, reliable information is contained in the annals written by Flodoardi (894–966) who kept a record of personal experiences and local events in his home town of Rheims.²⁹ A number of diaries and memoirs produced by lay writers also exist providing valuable information from the fourteenth and fifteenth centuries. More extensive information is contained in monastic records detailing events in the day-to-day running of the monasteries, and local events in the vicinity. Again, some of the Icelandic sagas, the so-called 'contemporary sagas', such as the 'Bishops' Sagas' and 'Sturlunga Saga'

were written primarily by men who were either themselves participants in the events recounted or who derived their information from eye-witnesses.³⁰

In addition to such contemporary eye-witness accounts, other types of record can be shown by analysis to be authoritative and well-informed. Among these are histories by authors with access to documentary material and to people with first-hand knowledge of the events described. Sturla Thordarson (1214–1284) for example, one of a number of outstanding Icelandic historians, compiled his history of King Håkon of Norway in A.D. 1265, two years after the death of Håkon. Writing at the request of Håkon's successor, Magnus Lagabøte, Sturla travelled to Norway and had access to official documents, as well as to members of Håkon's court and other personal informants.³¹ Thietmar of Merseburg (975–1018) who wrote extensively about the Slavs came from a noble family with influential connections, and as well as being able to draw on information from Heinrich II and the Archbishops and Canons of Magdeburg, he also had access to official documents of both Court and Church.³² A further example is provided by the Danish historian, Saxo Grammaticus, author of the 'Gesta Danorum'. Saxo was engaged in writing this work from ca. A.D. 1185³³ under the patronage of Bishop Absalon and again had access to official records.³⁴ The contemporary part of the gesta is now regarded as the chief Danish source for the twelfth century.³⁵

Some of the best informed 'histories' were produced by writers like Matthew Paris, official historiographer of the Abbey of St. Albans from A.D. 1236 to 1259, who were able to take advantage of the monastic tradition of record-keeping and the unique inter-monastic system of communication and co-operation. In historical work, this co-operation was international in scale, and information, sometimes provided by visiting travellers, flowed freely between monasteries.³⁶ Thus, a writer like Ekkehard, Abbot of Aura in central Germany, was able to accumulate accurate information about events in France, England, Italy and Spain.³⁷

Furthermore, in marked contrast to those writing in the often speculative or non-historical traditions represented by the universal chronicles, family sagas and some annals, certain medieval authors show considerable understanding of historiographical problems and methodology. For example, in the preface to his chronicle, the English monk, William of Malmesbury (d. ca. 1142) writes that he has tried to give a true account and stresses the value of reports by eye-witnesses.³⁸ In Iceland, in the thirteenth century, there was an established historical tradition which placed great emphasis on the writing of a correct account and Icelandic historians had even acquired a reputation abroad for their accuracy.³⁹ At the head of this tradition was Ari Thorgilsson (1068–1148), whose 'Íslendingabók', according to one modern Icelandic scholar: "is not only a first-rate historical source, but also a kind of manual of the method and aim of historical research, where it is emphasised, both in plain words and by the author's own example, that the task of the historian is to seek the truth and nothing but the truth."⁴⁰ Ari's influence is evident in, to name but one example, the preface to 'Heimskringla' by Snorri Sturluson (1178–1241) which emphasises the importance of naming one's sources and of writing a true account.⁴¹ This is not to imply that Icelandic sources may be used uncritically.

Frequently, when a writer had insufficient information he would draw on his own imagination, and much of the early part of 'Heimskringla' deals with myth, not history. The point is that some medieval writers were concerned with historical accuracy and analysis of their work shows it to contain much valuable information from an historical point of view.

In effect then, a considerable amount of important information about the Middle Ages does exist in documentary form. But it is found conjoined with material which is spurious, inaccurate, or whose reliability cannot be properly authenticated. Without a critical approach to medieval and post-medieval sources involving detailed analysis of individual documents, it is impossible to begin to distinguish the reliable from the unreliable and hence to build up a true picture of the medieval period.

Shortcomings in the Weather Compilations

Despite the growing emphasis on source analysis among historians from the early nineteenth century, many of the compilers of weather references seem to have remained unaware both of the problems, and of the existence of techniques for their solution. Arago, for example, writing in 1858, makes no mention whatsoever of the problems of source validation in his long and detailed introduction, and, in listing information about climate in the Middle Ages, includes, indiscriminately, references from dubious seveneenth- and eighteenth-century compilations alongside those from contemporary medieval sources. As late as 1924, Vanderlinden often places as much emphasis on enlarged references in later adulterated texts by such writers as Jean des Preis (d. 1370) as on the original references from which they derive. Hennig (1904), while distinguishing between notes he made from newspaper articles, town guides and travelogues on the one hand, and references taken from historical documentary sources on the other,⁴² nevertheless remains wholly uncritical of the latter, drawing his information almost entirely from secondary sources, including the works of Trithemius and unreliable editions by, for example, Tschudi, Freher and Pez.

Other compilers are certainly aware of the problems posed by the sources they are using. Writing in 1914, Norlind explicitly raises the question of the reliability of medieval sources in general, and comments specifically on Hennig's uncritical approach.⁴³ Britton (1937) claims to attempt to clear up uncertainties and inaccuracies, and to distinguish authentic from inauthentic material "and thus to place the subject upon a proper basis".⁴⁴ Weikinn (1958) complains that the weather compilations of the eighteenth and nineteenth centuries either have no bibliographies at all or their data derive from older compilations which contain errors.⁴⁵ Yet these writers fail to translate their recognition of the existence of problems into the sort of critical evaluation of their sources which such awareness should imply. Weikinn, for example, quotes precisely those early compilations, like Short's *General Chronological History* and Anton Heimreich's *Nordfresische Chronik* (1666), which he criticises in his preface. While Speerschneider implies that earlier sources are more valuable than later,⁴⁶ and criticises other compilers like Arago for copying errors and amplifying references,⁴⁷ the great majority of his own sources are

later derivative works. Britton, despite his claim to a systematic methodology, still quotes a high proportion of unreliable sources using, for example, the spurious part of the 'Historia Croylandensis'. Norlind and Curschmann, while recognising the unreliability of many post-medieval sources, and deliberately making use only of medieval ones, nevertheless do not extend their criticism to medieval sources themselves. Some of the sources they use, such as 'Balduini Ninovens', 'Magnum Belgicum Chronicon' and 'Chronicon Alberici' are late medieval compilations which contain unreliable records of events of several centuries earlier. Buchinsky, who uses only sources written during the Russian medieval period and makes some partial attempt to investigate them, stating whenever possible, where, when, and by whom, they were written, still makes use of material he himself shows to be non-contemporary by many centuries. Thus, with the exception of very recent work,^{4,8} the weather compilations used extensively in historical climatology are almost wholly uncritical as regards the sources from which their data derive. Not even those writers who show an awareness of the problems successfully attack them at their root through systematic source analysis.

The shortcomings displayed by the weather compilations from an historical point of view, resulting from the uncritical approach of the authors to the sources on which they relied, are many and various. Relatively unimportant, for instance, is the consequence that failure to investigate relations between sources can produce a quite illusory 'corroboration' of information in one source by others. Thus, Weikinn quotes two sources, 'Annalista Saxo' and 'Annales Quedlinburgenses' for information about Central Germany for the years A.D. 1009, 1014 and 1200^{4,9} and he quotes both the 'Chronici Saxonici' and the 'Chronica S. Petri Erfordensis moderna' for information about Thuringen for the years A.D. 1263 and 1309.^{5,0} But since, in both cases, the first of these sources is largely a copy of the second, the authenticity of his information in fact rests entirely on the latter.

A second, more important, consequence is that the compilers sometimes prove unable to resolve conflicts in information appearing in different sources. Easton, for example, records two entries for the winter A.D. 1356, one from the 'Chronicon Moguntium', saying that it was mild, the other from 'Annales Francofurtani' saying it was cold.^{5,1} No other source substantiates either report and Easton can only comment that his entry contains inconsistent information. Analysis of the sources, however, shows that while 'Annales Francofurtani' contain reliable contemporary entries between A.D. 1342 and 1364,^{5,2} the earliest contemporary entries in the 'Chronicon Moguntium' date from around A.D. 1389,^{5,3} and the Chronicon cannot be considered authoritative for earlier years. It is probable, therefore, that the reference in the former to a cold winter in A.D. 1356 is correct.

More serious than failure to resolve conflicts is the fact that compilers often resolve them incorrectly. Easton tries to resolve conflicting dates resulting from copyists' or other errors in his sources, and to identify the correct date of the single event to which the various conflicting reports undoubtedly refer. But lacking systematic methods for identifying original sources, he is often influenced in his choice by such factors as the number of sources specifying a particular year. In one instance,^{5,4} for example, he selects the date A.D. 1128 for a reference to a cold winter, on the basis of four late medieval and

post-medieval sources, Jean des Preis (fourteenth century), Giuseppe Toaldo (eighteenth century), Trithemius (fifteenth century), and P. d'Oudegherst (fifteenth century), although he also quotes the more reliable and more nearly contemporary Admont chronicle and Robert de Monte (d. 1186) which both date the reference in A.D. 1127.

Frequently, compilers fail even to realise that several statements which mention different dates may refer to a single event. As a result, many compilations list events which are almost certainly fictions created by copyists' errors or the deficiencies of later editing. The apparent frequency of events then becomes exaggerated. A specific illustration of this kind of false multiplication of events occurs in Weikinn who includes the following seven references to storm floods in the 1370's:

1374	(Chronicon Moguntinum)	Weikinn p. 257
1374 Oct.	(Joh. Adolfis Chronik)	p. 257
1375 Oct. 10	(Auctoris incerti chronic. Tielense; Remmers von Seedieck Annalen)	p. 258
1376	(Valois)	p. 258
1376 Oct. 10	(Auctoris incerti chronic. Tielense)	p. 259
1377 Oct. 10	(Chronik d. Ernst Friedrich von Wicht)	pp. 259–60
1377 Nov. 16	(Chronicon comitum Flandrensi- um; Ubbo Emmius etc.)	pp. 260–61

Taken at face value such a list suggests that storm floods occurred on at least five different occasions, but analysis of the sources indicates conclusively that all the references derive from a single original source, the 'Chronicon comitum Flandrensi-um', and, thus, that only one storm flood is known to have occurred, on 16 November, A.D. 1377.

A further example of this process occurs in Hennig who says that between the years A.D. 988 and 1000 there were numerous unusually hot and dry summers,⁵⁵ a claim which he supports by reference to eighteen sources. Examination of these reveals that the two earliest, most nearly contemporary, sources, Sigebertus (who was born about 1030) and the 'Chronik des Klosters St. Gallen', possibly an edition of 'Annales Sangallenses majores' which contains references from the early tenth to late eleventh centuries, each record the occurrence of only a single hot summer and make no mention of any succession of similar years. Since the remainder of the quoted sources are of much later origin, many being seventeenth- and eighteenth-century compilations, it seems probable that the succession of hot summers never occurred, and merely represents Hennig's own summary of unreliable information, resulting in the erroneous 'multiplication' of a single event recorded in one authentic source.

Uncritical acceptance, particularly of late medieval and post-medieval sources, also means that compilations often include descriptions of events which are exaggerations, amplifications or otherwise distortions in point of detail of the original references from which they derive. Information may, for instance, be recorded for particular locations or areas although the authentic source from which it originates refers to another area. Gerhard Outhof and Simon Gabbema, seventeenth-century Frisian compilers quoted by Hennig and Vanderlinden, based their information about Friesland on references to storm

floods occurring in places sometimes as far afield as England and the Baltic.⁵⁶ Likewise, Speerschneider assumed the relevance to Denmark of information in the Icelandic annals about the winters of A.D. 1192 and 1202.⁵⁷ A possibly purely local occurrence may, thus, appear as a widespread weather event or a major catastrophe.

The way in which such statements by contemporary medieval writers may be amplified by later writers has been clearly demonstrated by Britton.⁵⁸ In an entry for A.D. 1099, he shows how references to a severe storm flood came to be interpreted as an event of unusual significance. The earliest records of this flood, in the 'Anglo-Saxon Chronicle' and other contemporary sources, simply state that many villages were inundated and their inhabitants drowned; one contemporary writer, William of Malmesbury, specifies that a flood tide occurred in the Thames estuary. During the course of the centuries, the formation of the Goodwin Sands came to be attributed to this one particular flood. In A.D. 1696, John Seller refers to a sea flood in A.D. 1099 which affected the coast of Kent and inundated Earl Goodwin's entire estate, an area of some 4,000 acres, causing the deaths of many people and cattle, and devastating many villages. By A.D. 1789, William Camden is found stating less ambiguously in an entry for A.D. 1097 that: "off Broadstairs are the Goodwin Sands which tradition supposes the estate of Earl Goodwin swallowed by the sea".⁵⁹ Finally, in an entry for A.D. 1100, an anonymous twentieth-century researcher wrote: "Goodwin Sands formed".⁶⁰ Writers of later works may therefore radically transform information contained in medieval sources.

Perhaps the most serious defect in the compilations is their inclusion of information from sources which can in no way be regarded as establishing its historical authenticity. The information may, for example, relate to such distant periods of time as to exclude the possibility of cross-checking with written contemporary sources. Rather than recording historical events it appears to have emerged from the realms of prehistory and legend. An obvious example is Britton's inclusion of references to floods in Ireland during the second and third millennia B.C. whose source is the Irish annals,⁶¹ which cannot be considered reliable for this early period.⁶² Compilers also frequently include information which was written down by authors who lacked critical historical methods, who failed to name their sources, or whose sources are still not identified. Easton quotes references for the early Middle Ages, sixth to ninth centuries A.D., whose sources are Sigebertus, Cedrenus, Aimonius and Hermannus Contractus, all later medieval authors writing within the tradition of the universal chronicles.⁶³ Hennig refers to a hot summer in A.D. 1321 solely on the basis of eighteenth- and nineteenth-century sources, M. M. Villard (1889), Noah Webster (1800) and Short (1749),⁶⁴ without inquiring further into the origin of the information. Such information remains wholly unsubstantiated despite a multiplicity of sources in which it occurs.

Moreover, close examination and cross-checking of sources like these suggests they frequently contain completely erroneous information. For instance, detailed investigation of fourteenth-century texts throws doubt on statements made by the seventeenth-century Frisian chroniclers Andreas Cornelius (b. 1589) and P. Scriverius (1576–1660), according to whom the channels between the Wadden Islands were formed or widened by a storm flood in A.D. 1395, which resulted also in the enlargement of the Zuyder Zee. No such

specific information occurs in earlier contemporary sources and a text dated A.D. 1334 invalidates Scriverius's claim that the land round Wieringen was surrendered to the Zuyder Zee as a result of this flood.⁶⁵ Similar conclusions were reached about Thoroddsen's source, 'Setbergsannáll', which covers the period A.D. 1202–1713, but was only compiled in the late seventeenth or early eighteenth century. According to Jóhannesson, the editor of the annal, when its author failed to encounter authentic material for past centuries, he too invented his facts. This spurious data subsequently found its way into later scholarly works;⁶⁶ thus, reports of sea ice, and severe weather in Thoroddsen's compilation for the years A.D. 1279, 1360 and 1470 are mere fabrications.⁶⁷

Conclusion

Such shortcomings in the weather compilations inevitably compromise the historical value of the data they contain. Any reconstruction of medieval climate on the basis of that data, as it stands, will reflect errors in dating, an intermixture of fact with much fiction, and above all a failure to apply basic principles for the proper evaluation of historical evidence. The effects on our picture of medieval climate can be quite dramatic, creating the impression, for example, that the climate was more extreme than authentic sources alone would suggest. Documentary sources tend in any case to record only extreme weather events and related phenomena since their primary concerns are not with climate as such. This can be allowed for in interpreting the information they provide, but when the frequency of extreme conditions is magnified by the inclusion of unreliable data a quite misleading picture of the normality of such conditions may be produced. Thus, Hennig's references for the years A.D. 988–1000^{o s} may be taken to support the hypothesis of frequent, unusually hot and dry summers in the latter part of the tenth century.⁶⁹ Some current writers⁷⁰ have also recently suggested an increased frequency of storm floods during the thirteenth century. However, detailed analysis of the references to storm floods during that period, upon which the current theory is partially based, reveals that contemporary sources do not bear this out. Those sources which can be counted reliable suggest only that three major storm floods occurred in the second half of the twelfth century and six throughout the thirteenth, in the Northern Netherlands at least.⁷¹

If it is important to recognise the shortcomings of the compilations and the pitfalls inherent in their uncritical use, it is equally important to understand the origins of those shortcomings. Otherwise, a false impression can be given that there is much less reliable data available for the Middle Ages than, in fact, is the case. While there are indeed some inconsistencies between original sources, even between those deriving from the same area, mainly on points of detail such as the length of particular frosts, or the depth of flood water, the majority of contradictions in both the sources and the compilations can be shown to arise from their inclusion of data of unreliable origin. Failure to recognise this leads some writers to exaggerate the unreliability of contemporary medieval material. Speerschnieder, for example, comments on what he considers two instances of exaggerated descriptions of sea ice, one for the year A.D. 1460 which states that the ice reached

as far south as the Orkney Islands, and one for A.D. 1323 which says that ships were frozen up in the sea between Norway, England and Flanders. He then remarks on how unreliable the old sources can be and suggests that the main fault lies with medieval writers themselves.⁷² The sources he gives for the references, however, are eighteenth- and nineteenth-century compilations and not original accounts.⁷³

Once having recognised the character of the problems posed by medieval sources, it is also important to recognise the possibility of solving them systematically by source analysis. Hitherto, writers have tended to look elsewhere for a solution. Flohn, for example, who describes the information from the chronicles as confused and contradictory, resorts to averaging techniques as a method of minimising errors which he sees as likely to accrue from having to use such unreliable data.⁷⁴ But this is to misdiagnose the nature of the problem. Since most of the inconsistent, spurious and unreliable information included in compilations results from the uncritical approach of compilers to their heterogeneous sources, detailed source analysis offers a better technique which tackles the problem directly. And a much more consistent body of information emerges as a result.

In fact, the process of critically reworking the material of the weather compilations has already begun, with the publication of works like Gottschalk's *Stormvloeden en rivieroverstromingen in Nederland*⁷⁵ and Alexandre's *Le climat au moyen âge en Belgique et dans les régions voisines* (Rhenanie, Nord de la France).⁷⁶ Gottschalk's book is a critical commentary on the documentary sources of references to storm and river floods in the Netherlands and neighbouring North Sea countries for the period A.D. 516–1600. It provides not only a new compilation of reliable flood references for the period, but also an illustration and explanation of the process of source analysis. The sources she analyses include all those quoted by Weikinn in *Quellentexte zur Witterungsgeschichte Europas* as well as new material not found in earlier weather compilations. Similarly, Alexandre provides a revised, critical compilation of references for Belgium and neighbouring areas, including those from sources used by Vanderlinden in his *Chronique des événements météorologiques en Belgique jusqu'en 1834*, and again includes material not found in earlier compilations.

Nevertheless, research on medieval climate still remains heavily dependent on compilers like Arago, Hennig, Easton, Speerschneider, Thoroddsen and others, whose work has not yet been subject to systematic critical re-evaluation as has Weikinn's and Vanderlinden's by Gottschalk and Alexandre. If the shortcomings of these compilations are to be avoided in making use of the data they contain, it is essential that each individual source quoted be checked for authenticity, by reference to one of the major analytical works on medieval documentary sources, for example, Graves for English sources,⁷⁷ Wattenbach for German,⁷⁸ Jörgensen for Danish,⁷⁹ or Potthast for Germany and neighbouring countries.⁸⁰ Failure to do so will only produce results which must be considered insufficiently substantiated from a scientific point of view.

How then, is one to judge the compilations? From one point of view, they must be regarded as defective in the extreme, harsh as such a verdict may appear. But from another, it is possible to take a less negative view. One of the compilers himself, Lowe,

aptly makes the point when he writes of meteorology generally in 1870: "Some of its edifices have been built on the sand, and these time will destroy; yet the same materials may again be used, which, when reared on a rocky foundation, shall stand the test of time".^{8,1} The real achievement of the compilers is to have begun the collection of material which, when properly evaluated by modern techniques of analysis, can provide historically sound data for use in the reconstruction of past climate. Seen in this light their work is both important and of lasting value.

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Appendix

List of weather compilations for the medieval period published between 1858 and 1976, with area covered and dates of earliest and latest references.

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Belgium, Rhenanie and Northern France. A.D. 1003–A.D. 1399.
- Arago, François (1854–62) *Oeuvres Complètes*. Publiées, d'après son ordre sous la direction de M. J.-A. Barral. Paris, Leipzig. Vol. 8. (1858).
Western Europe, etc. 396 B.C.–A.D. 1858
- Britton, C. E. (1937) *A Meteorological Chronology to A.D. 1450*. Meteorological Office Geophysical Memoirs No. 70. Published by His Majesty's Stationery Office, London.
The British Isles. 2668 B.C.–A.D. 1450.
- Buchinskiy, I. E. (1957) *Past Climate of the Russian Plain*. Translation by T. C. Marwick of *O klimate proshlogo russkoy ravniny*. 2nd Edition, Leningrad (Gidrometeoizdat). British Meteorological Office Translation No. 64.
The Russian Plain, with special reference to the Ukraine, the Moscow region and Poland. A.D. 866–A.D. 1800.
- Curschmann, Fritz (1900) 'Hungersnöte im Mittelalter. Ein Beitrag zur deutschen Wirtschaftsgeschichte des 8. bis 13 Jahrhunderts'. *Leipziger Studien aus dem Gebiet der Geschichte* VI. Band, 1. Heft. B. G. Teubner, Leipzig, pp. VI–218.
Information about famines and weather, especially in western Europe. A.D. 709–A.D. 1317.
- Easton, C. (1928) *Les Hivers dans l'Europe Occidentale* Étude statistique et historique sur leur température. E. J. Brill, Leydon.
Information about winters, especially in western Europe. 396 B.C.–A.D. 1916.
- Gottschalk, M. K. Elisabeth (1971–75) *Stormvloeden en rivieroverstromingen in Nederland*. Van Gorcum and Comp. N.V., Assen. 3 Vols.
Information about sea and river floods in the Netherlands and neighbouring countries. A.D. 516–1700.
- Hennig, R. (1904) *Katalog bemerkenswerter Witterungsereignisse von den ältesten Zeiten bis zum Jahre 1800*, A. Asner and Co., Berlin.
Central Europe, etc. ca. 1754 B.C.–A.D. 1799.
- Lowe, E. J. (1880) *The Coming Drought: or, The Cycle of the Seasons*, with a chronological history of all the droughts and frosts as yet found recorded from A.D. 154 to the present time, being Introductory to 'Chronology of the Seasons'. Bemrose & Sons, London.
The British Isles. A.D. 134–A.D. 1880.
- Lowe, E. J. (1870) *Natural Phenomena and Chronology of the Seasons*; being an account of remarkable frosts, droughts, thunderstorms, gales, floods, earthquakes, etc., also diseases, cattle plagues, famines, etc., which have occurred in the British Isles since A.D. 220, chronologically arranged. Bell and Daldy, London.

The British Isles. A.D. 220–A.D. 1753.

Norlind, Arnold (1914) 'Einige Bemerkungen über das Klima der historischen Zeit: nebst einem Verzeichnis mittelalterlicher Witterungserscheinungen'. *Lund Universitets Årsskrift*, S.1, AFD 1, Bd. 10, Nr. 1, pp. 3–53.

Central Europe, etc., A.D. 709/710–A.D. 1499.

Speerschneider, C. I. H. (1915) *Om Isforholdene i Danske Farvande i ældre og nyere tid, aarene 690–1860*. Publikationer fra Det Danske Meteorologiske Institut, Meddelelser Nr. 2, Copenhagen.

Ice conditions in the Baltic, Skagerrak and Kattegat, with some reference to the rest of Scandinavia and Northern Germany. A.D. 690–A.D. 1860

Thoroddsen, Thorvaldur (1916–17) *Arferði Á Íslandi í þúsund Ár*. Gefið út af Hinu Íslenska Fræðafjelagi i Kaupmannahöfn. Prentað hjá S. L. Møller, Copenhagen.

Iceland. A.D. 865–A.D. 1915.

Torpor, N. (1963) *Ani ploiosi si secetosi in Republica Populare Romina* (Rainy and drought years in the Rumanian Peoples' Republic). Institutul Meteorologic, Bucharest, pp. 9–21.

Information from central and western Europe for the period from 912 B.C.–A.D. 1460. Additional material from Rumania for the period A.D. 1462–A.D. 1846.

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Belgium, also Germany. A.D. 120–A.D. 1834.

Weikinn, Curt (1958) *Quellentexte zur Witterungsgeschichte Europas von der Zeitwende bis zum Jahre 1850*. Hydrographie 1, 1–4, Akademie-Verlag, Berlin.

Information about river and sea floods, frozen and dry rivers, especially in western and central Europe. 27 B.C.–A.D. 1750.

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