Engaging with new knowledge in Low Countries' Chronicles (1500-1850)

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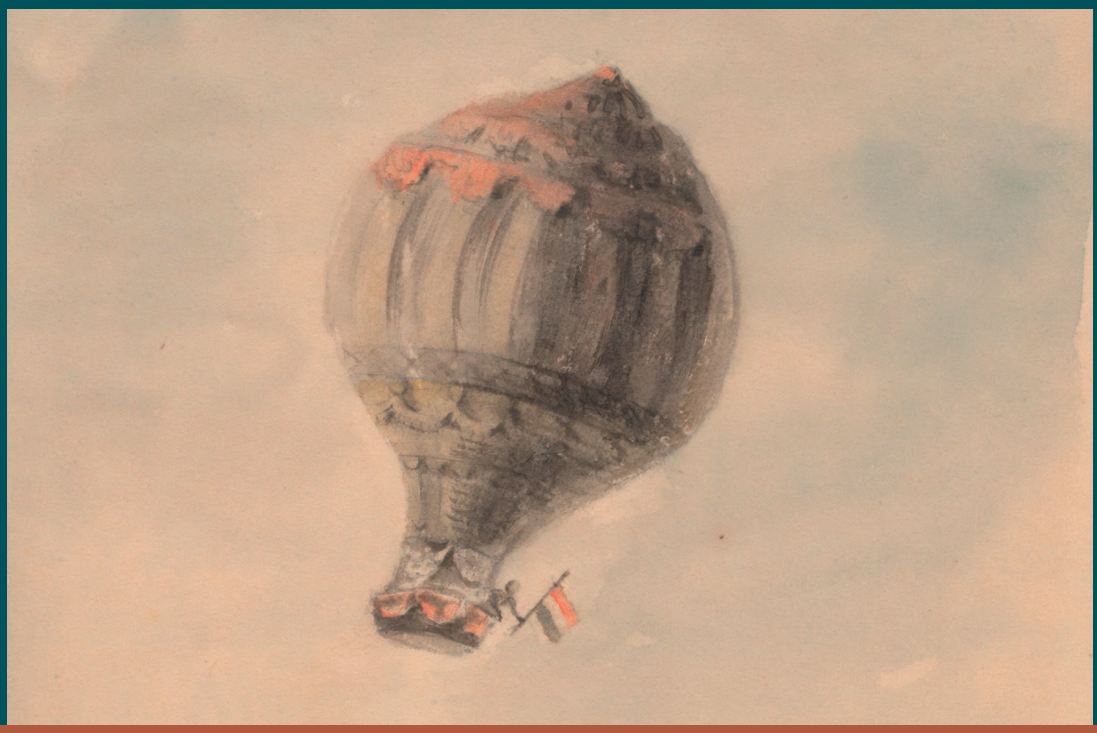

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Introduction

If no one had picked up their pen, no one would have known what had happened.[1]

– Chronicler Augustyn van Hernighem (c.1540-c.1617), Ypres.

1 'Waere niemant diet tscryven hadde gheuseert Men zoude niet weten watter waere ghepasseert.' Augustyn van Hernighem, 'Beschrijving der stad Yper, deel 5', Rijksarchief Kortrijk, Fonds Goethals-Vercruysse, ms. 296, 187.

In 1808 the Catholic master baker Joannes Baptista Rybens (1757-1818) from the Flemish town of Nieuwpoort recorded a new entry in the manuscript in which he chronicled the events in his hometown.

> With the beginning of the year [1808], new weights and measures were introduced. The worst thing in the beginning was that no one understood them. It was very different from the old measures and weights. The measures were called a hectolitre, and a half hectolitre. The beer measures were litres and halves. The weights were called kilograms and decigrams and other lesser units.[2]

The entry related to the introduction of the metric system, which replaced the wild variety of local measures to which inhabitants of the Low Countries had been accustomed. With hindsight, this innovation was a huge improvement. Yet, Rybens was not impressed:

> After all, everything had changed completely. No matter what the French did to implement the new measures, from levying fines or removing the old units, nothing worked. The new units of measurement were bought by the community at great cost, because they were expensive, but were on display in the shops and seldom used, unless converted against the old Flemish pound.[3]

Why did the people of Nieuwpoort not use the new system? If we are to believe Rybens, the advantages of the system were not immediately evident because it seemed more complicated than its predecessor. The passage also hints at another reason for the scepticism of the people in Nieuwpoort; the changes were forced upon them by 'the French'. The metric system came from the French government, which had been in charge in Flanders ever since the French revolutionary armies had ousted the Austrian-Habsburg rulers of the Southern Low Countries in 1794.

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2 'Met het begin van het jaer moste in wesen gebragt werden de nieuwe maeten en gewigten, maer het ergste in het eerste begin niemant verstond sig aen dese. Het was gants verschillig aen de al oude maeten en gewigten. De maeten wierden genaemt een hecktoliter, en alven hecktoliter, de bier maeten waeren liters en alve, de gewigten waeren genaemt killogramen, decagramen en andere mindere.' Joannes Baptista Rybens, *Beschryving der stad ende haven van Nieuport om het Graefschap Vlaenderen, benevens alle merkweerdigheden er in begrepen, voorgevallen zoo binnen deze stad als in de omliggende plaetsen ende landen +/- 1770-1876*, ed. Heemkring Bachten de Kupe V.Z.W., Thomas De Roo Jr., and Thomas De Roo Sr., Dokumenten 10 (Nieuwpoort, 1966), 285.

3 'Emmers het was alle verandert. Dog wat order de Franschen gaeven om dit in wesen te brengen, ofte daer op boete stelden, ofte de oude gewigten af haelden, het was even eens. De nieuwe wierden van de gemeenten wel gekogt tot groote kosten van hun, want die waeren dier, maer laegen tot parade in de winkels en wierden selden gebruijkt of ten sij gerekent tegen het oude Vlaemsch pont.' Ibid.

However that may be, to students of innovation, the reluctance to change that Rybens displayed will come as no surprise. When experts develop better or more accurate knowledge or technology, this does not mean that it is willingly appropriated by the rest of society. This is as true today as it was in 1808.[4] The success of new knowledge and technology depends on socio-cultural factors, which change over time, and differ between cultures and groups within them. This dissertation aims to better understand how such processes of cultural change worked in the Low Countries between 1500 and 1850.

For the early modern period, existing studies of these processes have focussed on 'experts', such as scholars, practitioners, entrepreneurs, and engineers.[5] Yet, to understand cultural change we also need to know how new ideas spread beyond expert circles, and under which conditions they were accepted by society at large.[6] In order to do so I have studied the spread of new knowledge among 'non-experts' like Rybens, who recorded their view of local events in 'chronicles'. Such chronologically structured records of local events in the past and in the lifetime of the authors were written across the Low Countries by (upper-) middle-class men, and some women, throughout the period 1500-1850.

My research was conducted in the context of a team project entitled, *Chronicling novelty. New knowledge in the Netherlands, 1500-1850*, that was carried out between 2018 and 2024 at Leiden University and the Vrije Universiteit Amsterdam and directed by Judith Pollmann and Erika Kuijpers. In this project we collected, digitised, and transcribed 204 chronicles in Dutch from across the Low Countries, with a view to studying change over time. Together with Roser Morante, colleague Alie Lassche focussed

4 Ineke Sluiter, 'Anchoring Innovation: A Classical Research Agenda', *European Review* 25, no. 1 (February 2017): 21; Benoit Godin, *Innovation Contested: The Idea of Innovation over the Centuries*, Routledge Studies in Social and Political Thought (New York, 2014); Marcus Popplow, 'Die Idee der Innovation – ein historischer Abriss', in *Handbuch Innovationsforschung*, ed. Birgit Blättel-Mink, Ingo Schulz-Schaeffer, and Arnold Windeler (Wiesbaden: Springer Fachmedien, 2019), 1–9; C. A. Davids and Bert De Munck, eds., *Innovation and Creativity in Late Medieval and Early Modern European Cities* (Farnham, 2014); David Edgerton, 'Innovation, Technology, or History: What Is the Historiography of Technology About?', *Technology and Culture* 51, no. 3 (2010): 680–97; Everett M. Rogers, *Diffusion of Innovations* (New York, 1995). See for example the project of Ineke Sluiter: Anchoring Innovation. Sluiter, 'Anchoring Innovation'.

5 Joel Mokyr, *A Culture of Growth: The Origins of the Modern Economy*, The Graz Schumpeter Lectures (Princeton, 2017); Deirdre Nansen McCloskey, *Bourgeois Equality: How Ideas, Not Capital or Institutions, Enriched the World* (Chicago, 2017); Marcus Popplow, 'Economizing Agricultural Resources in the German Economic Enlightenment', in *Materials and Expertise in Early Modern Europe: Between Market and Laboratory*, ed. Ursula Klein and E. C. Spary (Chicago, 2010), 261–87; Simone Lässig, 'The History of Knowledge and the Expansion of the Historical Research Agenda', *Bulletin of the GHI Washington*, no. 59 (2016): 36.

6 For the debate on expertise, see: Ursula Klein and Emma C. Spary, *Materials and Expertise in Early Modern Europe: Between Market and Laboratory* (Chicago, 2009); Eric H. Ash, *Expertise: Practical Knowledge and the Early Modern State*, Osiris 2 (Chicago, 2010); J. Andrew Mendelsohn and Annemarie Kinzelbach, 'Common Knowledge: Bodies, Evidence, and Expertise in Early Modern Germany', *Isis* 108, no. 2 (2017): 259–79; Eric H. Ash, 'What Is an Early Modern Expert? And Why Does It Matter?', in *Praktiken Und Räume Des Wissens: Expertenkulturen in Geschichte Und Gegenwart*, ed. Marian Füssel, Frank Rexroth, and Inga Schürmann (Göttingen, 2019), 69–88; Eric H. Ash, 'By Any Other Name: Early Modern Expertise and the Problem of Anachronism', *History and Technology* 35, no. 1 (2019): 3–30.

on the sources of knowledge which chroniclers used, while I explored the changing ways in which they reasoned with old and new knowledge. By approaching the chronicles with the conceptual apparatus of the history of knowledge and anthropological theories about cultural evolution, this study explores a new way to study the circulation of, and engagement with, knowledge in the early modern period. In this introduction, I will first discuss in greater detail why the acceptance of change by non-experts is an important historiographical topic, and how scholars have so far addressed this. Secondly, I will explain why the study of a larger corpus of chronicles may offer a good way to improve existing views of this topic. Finally, I will outline how I have gone about this task and structured the results.

Historiography

Innovation in the Low Countries

In the history of innovation, the early modern Low Countries have an important role to play. For much of this period, the Low Countries were known as a highly urbanised and exceptionally literate hub for the production and consumption of new knowledge and technology.[7] They played an important role in the 'printing revolution' (which we now call the 'information revolution') and what we used to call the 'scientific revolution'.[8] The Dutch Republic is known as the home to an 'industrious revolution' in manufacturing, while the Southern provinces were also home to the 'early industrial revolution'.[9]

7 C. A. Davids, *The Rise and Decline of Dutch Technological Leadership: Technology, Economy and Culture in the Netherlands, 1350-1800*, History of Science and Medicine Library, Knowledge Infrastructure and Knowledge Economy (Leiden, 2008).

8 For the debate about the term scientific revolution, see: Lindy A. Orthia, 'What's Wrong with Talking About the Scientific Revolution? Applying Lessons from History of Science to Applied Fields of Science Studies', *Minerva* 54, no. 3 (September 2016): 353–73.

9 Jan de Vries, *The First Modern Economy: Success, Failure, and Perseverance of the Dutch Economy, 1500-1815* (Cambridge, 1997); Davids, *The Rise and Decline of Dutch Technological Leadership*; Klaas van Berkel, 'The Dutch Republic. Laboratory of the Scientific Revolution', *BMGN - Low Countries Historical Review* 125, no. 2–3 (1 January 2010): 81–105; Ann Coenen, *Carriers of Growth?: International Trade and Economic Development in the Austrian Netherlands* (Boston, 2015); Arthur der Weduwen and Andrew Pettegree, *The Bookshop of the World: Making and Trading Books in the Dutch Golden Age* (London, 2019); Jonathan I. Israel, *The Dutch Republic: Its Rise, Greatness, and Fall; 1477 - 1806* (Oxford, 1998); M. Prak, *Nederland en het poldermodel: sociaal-economische geschiedenis van Nederland, 1000-2000* (Amsterdam, 2013); Peter Scholliers, *Geschiedenis van de ongelijkheid* (Berchem, 2014); Peter Scholliers, *A History of Bread: Consumers, Bakers and Public Authorities since the 18th Century*, Food in Modern History (London, 2024); Erik Thoen, 'A "commercial Survival Economy" in Evolution: The Flemish Countryside and the Transition to Capitalism (Middle Ages - 19th Century)', in *Peasants into Farmers ? The Transformation of Rural Economy and Society in the Low Countries (Middle Ages-19th Century) in Light of the Brennerdebate*, vol. 4 (Brepols, 2001), 102–57; Christian Vandenbroeke, 'De proto-industriële en de industriële ontwikkeling van België in het kader van de internationale historiografie', *Revue belge de Philologie et d'Histoire* 63, no. 2 (1985): 310–23; Davids, *The Rise and Decline of Dutch Technological Leadership*.

Politically, the area was a conglomerate of many smaller polities that were first unified by the Habsburg dynasty in the 1530s. Until the late sixteenth century, it was the thriving commercial economies of Flanders and Brabant that were deemed the most important in the new state. Yet, as a result of the Dutch Revolt, and the subsequent political split between the Dutch Republic (the political predecessor of the Kingdom of the Netherlands) and the Habsburg Netherlands (roughly current-day Belgium), the centre of economic and political gravity moved North, especially to the province of Holland. The seventeenth-century Dutch Republic became a hotspot for the production and spread of new knowledge of all kinds as well as an economic and commercial powerhouse. Its growing colonial empire also turned it into an important global player that had a central role in the circulation of knowledge.[10] In the eighteenth century, the Dutch had to cede their primacy to other European powers, but they maintained an impressive knowledge infrastructure and capital base, as well as colonial possessions.[11] It was also known for its religious pluralism. While the Dutch Republic adopted Reformed Protestantism as its 'most favoured' religion, it developed de facto toleration of many dissenting Christians, and in some places also Jews.[12]

The Southern Netherlands, meanwhile, quickly recatholicised after the Spanish Habsburgs reconquered and 'reconciled' the rebellious provinces of the South.[13] Their economy revived in the early seventeenth century, but in the second half of the seventeenth century wars with the French and weakening of the Spanish influence, especially, brought about a grave crisis. It was only after the Austrian Habsburgs had taken over and consolidated their position that the eighteenth-century Habsburg Netherlands recovered from prolonged warfare and regained economic energy. The regime also began to improve the infrastructure and encourage economic development. The Southerners introduced a range of new reforms and technologies that were to turn it into an early hub for the industrial revolution. From the 1780s, all Low Countries experienced a prolonged period of crisis. Revolutions and a French takeover put a sudden end to the world of the Ancien Régime and transformed the political landscape. The Low Countries found themselves briefly reunited between 1815 and 1830 as the Kingdom of the Netherlands, before going their separate ways again.[14]

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10 Israel, *The Dutch Republic*, chaps 12, 14, 23–24.

11 David Onnekink and Gijs Rommelse, *The Dutch in the Early Modern World: A History of a Global Power* (New York, 2019).

12 Christine Kooi, *Reformation in the Low Countries, 1500-1620* (Cambridge, 2022).

13 A. C. Duke, *Reformation and Revolt in the Low Countries* (London, 1990); Kooi, *Reformation in the Low Countries, 1500-1620*.

14 Marnix Beyen, *Wereld geschiedenis van Vlaanderen* (Kalmthout, 2018); Paul Janssens and Arnout Balis, *België in de 17de eeuw: de Spaanse Nederlanden en het prinsbisdom Luik. Bd. I: Politiek*. (Ghent, 2006); Paul Janssens and Arnout Balis, *België in de 17de eeuw: de Spaanse Nederlanden en het prinsbisdom Luik Bd. II, Cultuur en leefwereld*. (Ghent, 2006); Gita Deneckere, *Een geschiedenis van België* (Ghent, 2022).

The early modern Low Countries are thus an interesting case study for various reasons. First, the literature tells us that they were a very important 'hub' in the creation and spread of knowledge in this period. Secondly, they evolved politically into states with quite different religious and political regimes. Third, they lend themselves to comparison.

Knowledge and Society

Throughout the twentieth century, intellectual and economic historians explained the 'modernisation' of the Western world, through the emergence and acceptance of new ideas, knowledge and technology during the Scientific and Industrial Revolutions.[15] Initially, historians, anthropologists, and sociologists perceived the acceptance of scientific or objective knowledge above all as an intellectual process, in which great thinkers had set the pace.[16] Since the 1970s, however, (social) historians of science have stressed the importance of cultural and local factors in understanding the emergence and acceptance of new knowledge, a turn that has been associated with Steven Shapin and Simon Schaffer's *Leviathan and the air pump* (1985).[17] At that time, philosophers of science, such as Thomas Kuhn (1970) and sociologists like Bruno Latour (1987), also stressed the importance of the specific contexts in which knowledge is shaped.[18] This contextualist approach, in which 'culture' plays a key role in studying the emergence and development of scientific knowledge and technology, was widely adopted in the 1990s.[19]

Simultaneously historians of science began to expand their understanding of what they regarded as knowledge.[20] The study of knowledge production and its circulation broadened from a small learned elite to a larger group of 'experts', such

15 Paul Hazard, *La crise de la conscience européenne (1680-1715)* (Paris, 1934); Margaret C. Jacob, *The First Knowledge Economy: Human Capital and the European Economy, 1750–1850* (West Nyack, 2014); McCloskey, *Bourgeois Equality*; Mokyr, *A Culture of Growth*.

16 Adi Ophir and Steven Shapin, 'The Place of Knowledge a Methodological Survey', *Science in Context* 4, no. 1 (1991): 3–5.

17 Steven Shapin, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, 1985); For earlier work on the role of culture in relation to knowledge, see: Arnold Thackray, 'Natural Knowledge in Cultural Context: The Manchester Mode', *The American Historical Review* 79, no. 3 (1974): 672–709; Jack Morrell, *Gentlemen of Science: Early Years of the British Association for the Advancement of Science* (Oxford, 1981); Ian Inkster and Jack Morrell, *Metropolis and Province: Science in British Culture, 1780-1850* (London, 1983).

18 Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago, 2012) Kuhn also emphasised the role of institutions; Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, 1987); Emile Durkheim, *Emile Durkheim: Selected Writings* (Cambridge, 1972), 88; Ophir and Shapin, 'The Place of Knowledge a Methodological Survey', 4.

19 For a volume with twenty-four essays that shows this, see: N. Jardine and James A. Secord, *Cultures of Natural History* (Cambridge, 1996).

20 Peter Burke, *What Is the History of Knowledge?*, What Is History (Cambridge, 2016); Martin Mulsow and Lorraine Daston, 'History of Knowledge', in *Debating New Approaches to History*, ed. Marek Tamm and Peter Burke (London, 2019), 159–79.

as apothecary-chemists, in which practical knowledge played a more important role.[21] For instance, Margaret C. Jacob (1997) drew inspiration from the history of science and technology, combined with cultural history, to explain the cultural origins of the Industrial Revolution in the eighteenth century. She examined the scientific culture of the seventeenth century, focussing not only on individual scientists like Isaac Newton, but also on more practical 'experts', such as practitioners, entrepreneurs, and engineers.[22] According to Eric Ash (2019), these experts 'control a body of specialized practical or productive knowledge, not readily available for everyone [...] and should be distinguishable from common practitioners or artisans.'[23]

The awareness that scientific renewal should be studied in the context of broader sets of ideas and practices has led to the emergence of a new field: history of knowledge. Philipp Sarasin (2020) argues that '"knowledge" in this understanding is virtually everything that can be thought, believed, spoken out, or what is hidden or merely implicit, "unknown," "tacit," or "forgotten".'[24] Martin Mulsow uses a similar definition, which I will also adopt. He defines knowledge as: 'reasonable convictions or beliefs.'[25] Even so, knowledge, according to Sarasin and Mulsow, is not exclusively bound to the realms of secular thinking. As Peter Burke had argued, knowledge must also encompass belief systems of people from all walks of life.[26] This means that the purview of history of knowledge ranges from knowledge acquired through everyday experience to the knowledge of artisans, craftspeople, and skilled workers, from administrative and entrepreneurial expertise to the knowledge of academic scholars and scientists.[27]

A key question in the history of knowledge is how new knowledge spreads. In 1991, Steven Shapin still found that how new knowledge came to be embedded in society was 'a great mystery'.[28] However, in the last few decades, historians of knowledge have made great strides in studying the circulation of knowledge, especially in colonial contexts and through migration. According to Simone Lässig, this has taught us that 'knowledge is created by the continuous interaction between heterogeneous actors, even if those

21 Ursula Klein, 'Apothecary's Shops, Laboratories, and Chemical Manufacture in Eighteenth-Century Germany', in *The Mindful Hand: Inquiry and Invention from the Late Renaissance to Early Industrialisation*, ed. Lissa Roberts, Simon Schaffer, and Peter Robert Dear, History of Science and Scholarship in the Netherlands 9 (Amsterdam, 2007), 247–76; Ursula Klein, 'Artisanal-Scientific Experts in Eighteenth-Century France and Germany', *Annals of Science* 69, no. 3 (1 July 2012): 303–6,

22 Margaret C. Jacob, *Scientific Culture and the Making of the Industrial West* (New York, 1997).

23 Ash, 'What Is an Early Modern Expert? And Why Does It Matter?', 75.

24 Philipp Sarasin, 'More Than Just Another Specialty: On the Prospects for the History of Knowledge', *Journal for the History of Knowledge* 1, no. 1 (15 July 2020): 2; Knowledge is defined among similar lines by: Lässig, 'The History of Knowledge', 40; Burke, *What Is the History of Knowledge?*

25 Martin Mulsow, *Knowledge Lost: A New View of Early Modern Intellectual History* (Princeton, 2022), 2.

26 Burke, *What Is the History of Knowledge?*; Sarasin, 'More Than Just Another Specialty', 2.

27 Lässig, 'The History of Knowledge', 43.

28 Ophir and Shapin, 'The Place of Knowledge a Methodological Survey', 3.

actors are rarely on equal standing.'[29] In an influential essay reviewing the field, she emphasises that the history of knowledge should also include knowledge of minorities and the masses who have left little written evidence. She argues that:

> The history of knowledge thus does not focus solely on the dominant knowledge culture at any given time but also considers diverse and often not equally powerful actors, media, and forms of knowledge. Knowledge is taken up, transformed, and combined with other knowledge. Traces often remain of where knowledge came from. The basic question behind the history of knowledge is thus not what exactly knowledge is and how it relates to other concepts but rather how, when, and why particular knowledge emerged or disappeared and how bodies of knowledge with different foundations stand in relation to one another.[30]

Although the new questions and proposed methodologies that have been raised in the past decades are promising, many have yet to be taken up, according to Lässig. Despite their self-declared ambitions to study knowledge across society, in practice historians of knowledge tend to study how knowledge is created, accepted and circulated among experts.[31] As a consequence, the role of non-experts in the creation, circulation, and acceptance of new knowledge remains poorly understood.[32]

Knowledge and 'Cultural Evolution'

Like historians of knowledge, economic historians of the early modern West have in recent decades also been thinking about knowledge in society. This is because they have come to believe that economic innovation and growth depend on cultural factors. In this view, cultural characteristics of a given society explain the production of the new knowledge and technologies that lead to economic innovation and success. One of the leading voices in this scholarship is Joel Mokyr, who argued that the origins of the Industrial Revolution should be explained primarily through cultural factors.[33] In his view, changing ideas, and a new openness to innovation, ultimately enabled the Industrial Revolution. For the emergence of new ideas, some preconditions have to be met, including the accumulation of 'useful knowledge' and 'some measure of

29 Lässig, 'The History of Knowledge', 43.
30 Ibid., 40.
31 Ibid., 54.
32 Martin Mulsow and Lorraine Daston, 'History of Knowledge', in *Debating New Approaches to History*, ed. Marek Tamm and Peter Burke (London, 2019), 174–75.
33 Joel Mokyr, *The Gifts of Athena: Historical Origins of the Knowledge Economy* (Princeton, 2002); Mokyr, *A Culture of Growth*.

[governmental] decentralization [...] coupled with openness and freedom of [...] ideas.'[34] According to Mokyr, such conditions came into being in northwest Europe beginning in the sixteenth century, but especially in the seventeenth century, which saw the Scientific Revolution. This cultural transformation enabled the proliferation of useful knowledge and the availability of this knowledge for a larger group of people in the eighteenth century, a period which he labels the 'Industrial Enlightenment'.[35]

Mokyr (2002) developed the concept of 'useful knowledge' to establish a direct link between the Scientific and Industrial Revolutions, and to explain why the latter started in Britain and not elsewhere.[36] He defined this concept as 'knowledge of natural phenomena that excludes the human mind and social institutions', in which a pivotal role is played by 'technology in its widest sense [which] is the manipulation of nature for human material gain'.[37] Mokyr divides 'useful' knowledge into two types: 'propositional' and 'prescriptive' knowledge. The former encompasses all knowledge about natural phenomena and regularities and can be applied to create the latter. This 'prescriptive' knowledge that Mokyr also calls 'technology', consists of techniques to manipulate nature, and knowledge that objectively describes how something works.[38]

During the 'Industrial Enlightenment', as he calls it, there emerged 'a set of social changes that transformed the two sets of useful knowledge and the relationship between them'.[39] Useful knowledge became increasingly 'tight' and more widely available at a low cost, a process in which the printing press played an important role. This 'tightness' of knowledge is a measure of its being commonly accepted. When knowledge is 'tight', it is accepted in a society as 'true' knowledge, which is, for example, demonstrated, tested, or verified. Moreover, 'tightness' determines the confidence that people have in knowledge and thus their willingness to act upon it, according to Mokyr.[40] In other words, 'more accurate' knowledge arose because the 'tightness' of knowledge could be tested using a 'scientific' method, which was then made available to the rest of the population in an accessible way and at a low cost.

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34 Mokyr, *The Gifts of Athena*, 282.

35 Industrial Enlightenment is defined as: 'the belief in social and human improvement through the accumulation and dissemination of useful knowledge.' Joel Mokyr, 'Cultural Entrepreneurs and the Origins of Modern Economic Growth', *Scandinavian Economic History Review* 61, no. 1 (March 2013): 8; Mokyr, *The Gifts of Athena*, chap. 2.

36 For more information on the Dutch case in this debate, see especially: Davids, *The Rise and Decline of Dutch Technological Leadership*; See also: C. A. Davids, *Religion, Technology, and the Great and Little Divergences China and Europe Compared, c. 700-1800* (Leiden, 2013).

37 Mokyr, *The Gifts of Athena*, 3; The term is borrowed from Simon Kuznets, who used it as the source or modern economic growth. Simon Kuznets, *Economic Growth and Structure: Selected Essays* (New York, 1965), 85–87.

38 Mokyr, *The Gifts of Athena*, 3–10; William J. Ashworth, 'The Ghost of Rostow: Science, Culture and the British Industrial Revolution', *History of Science* 46, no. 3 (2008): 256; Mokyr, *A Culture of Growth*, 184.

39 Davids, *Religion, Technology, and the Great and Little Divergences*, 214.

40 Mokyr, *The Gifts of Athena*, 6.

To examine how new knowledge was accepted among experts and picked up by society at large Mokyr used models from cultural-evolution theory, which, in his view, produced by 'far the most persuasive and rigorous literature on this topic.'[41] Mokyr refers especially to the work of the evolutionary anthropologists Robert Boyd and Peter J. Richerson (2005) who proposed a population-based theory of cultural change.[42] They argued that their theory does not necessarily aim for universal laws but rather provides concepts that offer a promising starting point to explain why some beliefs and attitudes spread and persist while others vanish. By studying the processes that bring about cultural change – changes in knowledge, beliefs, and practices at a population level – they argue that it is possible to explain cultural change.[43]

According to cultural-evolution theory, cultural transmission is both vertical and horizontal – we acquire culture, including (usually) our first language, from our parents, but many other aspects of our lives are shaped through our interactions with peers, as well as through schools, work places, churches, and media.[44] When we choose, as children or adults, to adopt or reject some innovation, we are talking mainly about horizontal transmission. This occurs when people are often exposed to alternative ideas or values and then choose among them, although the choice may not be conscious.[45]

This process is labelled as 'biased cultural transmission', which occurs when people preferentially adopt some cultural variants rather than others. Since the 1940s, thousands of case studies of the diffusion of innovations have been published, demonstrating a wide variety of biased transmission.[46] Because biased transmission results from the (not necessarily conscious) comparison of alternative variants, the resulting rate of cultural change depends on the frequency of a cultural trait in the population. Initially, innovations often spread slowly, as few people practise them; however, as innovation becomes more common, more people are exposed to it and can compare it with other behaviours, and the rate of adoption accelerates. This process, documented in many different cases, generates a characteristic S-shaped trajectory, and is used by Mokyr to explain cultural change.[47]

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41 Mokyr, 'Cultural Entrepreneurs and the Origins of Modern Economic Growth', 27; Mokyr, *The Gifts of Athena*; Mokyr, *A Culture of Growth*.

42 Peter J. Richerson and Robert Boyd, *Not by Genes Alone: How Culture Transformed Human Evolution* (Chicago, 2005); See also: Robert Boyd and Peter J. Richerson, *Culture and the Evolutionary Process* (Chicago, 1985).

43 Ibid., 68.

44 Mokyr, *A Culture of Growth*, 48; Richerson and Boyd, *Not by Genes Alone*, 69–71; Stephen Chrisomalis, *Reckonings: Numerals, Cognition, and History* (Cambridge, 2020), 92.

45 Richerson and Boyd, *Not by Genes Alone*, 69.

46 Bryce Ryan and Neal C. Gross, 'The Diffusion of Hybrid Seed Corn in Two Iowa Communities', *Rural Sociology* 8, no. 1 (1943): 15–24; Rogers, *Diffusion of Innovations* Rogers (1983) surveys this literature, counting 3,085 studies from 10 different disciplines as of that date.

47 Mokyr, *A Culture of Growth*, chap. 5.

The discovery and acceptance of new knowledge among those 'few' people, or 'experts' in Mokyr's case, is explained through *content* and *direct* biases from cultural-evolutionary theory.[48] Accepting new knowledge through *content* bias means that new knowledge was validated and tested, and thus became increasingly 'tight'. Learning through *direct* bias means that people inform themselves through 'experts' or influential figures to decide what is true and moral.[49] To demonstrate how this worked, Mokyr attributed great influence to 'cultural entrepreneurs' – agents who change the beliefs of others. An example of such an entrepreneur is Isaac Newton:[50]

> Newton's mathematical physics was recognized almost right away to be both innovative and correct. First through content bias (the best minds saw the logic of his work) and then through direct bias (his followers were themselves intellectuals of the highest standing), his work got the recognition it deserved in the market for ideas.[51]

However, according to Richerson and Boyd, at the population level, *content* and *direct* biases play only a minor role in explaining cultural change. They argue that most people are not in a position to make comparisons based on content and validation. Most people are more strongly influenced by the cultural variant – that is, the common occurrence of a cultural trait in their society, which is known as *frequency-dependent* bias.[52] When examining the acceptance of new ideas among 'experts' we often see metanotational comparisons, which involve people looking at the two systems and making explicit comparisons. However, such comparisons are rare among the population at large, because non-experts are unlikely to make such direct comparisons between various systems.[53] This makes scholars suspect that when they accept change it is not *content* and *direct* bias, but *frequency-dependent* bias that is at play.[54]

48 Ibid., chaps 5–8; Richerson and Boyd, *Not by Genes Alone*, 69, 120–23, 205.

49 Mokyr, *A Culture of Growth*, 48–49.

50 Cultural evolution theorists and Mokyr also use other biases to explain cultural change. Mokyr explains cultural change mainly through *content* and *direct* biases on the level of 'experts' and uses – like Richerson and Boyd – *frequency-dependent* bias to explain cultural change on the level of the population. According to them, *frequency-dependent* bias is also the most important, and the general process (e.g. *conformity* and *model-based* bias are forms of frequency dependence), through which they explain the acceptance of new knowledge and technology when coercion or trauma do not play a role. Ibid., chaps 7–8; Mokyr, 'Cultural Entrepreneurs and the Origins of Modern Economic Growth', 1.

51 Mokyr, *A Culture of Growth*, 101.

52 Richerson and Boyd, *Not by Genes Alone*, 205.

53 Chrisomalis, *Reckonings*, 92.

54 Richerson and Boyd, *Not by Genes Alone*, 69, 120–23, 205; Chrisomalis, *Reckonings*, 92.

This led Mokyr to conclude that:

> Cultural evolution and the growth of useful knowledge, whether codified or tacit, was shared by only a minute percentage of the population in only a few nations. The cultural changes affected first a few thousand, then a few tens of thousands of people in pre-Industrial Revolution Europe; democratic instincts notwithstanding, we must concede that what the large majority of workers and peasants knew or believed mattered little as long as there were enough of them to do what they were told by those who knew more.[55]

In other words, the actions of this intellectual minority eventually affected the rest of the population, not so much via a trickle-down process but by 'dragging' them along.[56] The economist Deirdre Nansen McCloskey, who also focussed on both early modern England and the Low Countries, sees this slightly differently. To be sure, she agrees with Mokyr that, 'not coal [...] but words and ideas caused the modern world.'[57] Contrary to Mokyr's top-down approach, however, she argued that 'new ideas came mostly from the bottom up, depending directly on a social environment of free enterprise.'[58] 'Bottom-up' in this case refers to merchants, entrepreneurs, innovative industrialists and farmers, bankers and so on, whom she labelled as 'bourgeois' agents.[59]

Whether cultural change depended on cultural entrepreneurs or bourgeois agents, remains, however, hard to assess if we do not know how they achieved the acceptance of new knowledge and technology among 'the rest of the population'. The example of master baker Rybens might suggest that Mokyr is right – Rybens and his contemporaries had to be 'dragged along'. Yet both students of innovation and anthropologists have shown that the trajectories of the acceptance of innovation among society at large are often not straightforward. Therefore, if we want to explain cultural change, we also need to understand the changes in knowledge, beliefs, and practices at a population level, that of the non-experts.[60] Moreover, Richerson and Boyd emphasise that analysing cultural

55 Mokyr, *A Culture of Growth*, 119, 282.

56 Ibid., 120.

57 Joel Mokyr, 'Culture, Elites and the Great Enrichment', in *Bourgeois Virtues and the Great Enrichment: The Ideas and Influence of Deirdre Nansen McCloskey*, ed. Warren Bruce Palmer, vol. IX, The Annual Proceedings of the Wealth and Well-Being of Nations 2016-2017 (Beloit, 2017), 14; Deirdre N. McCloskey, *The Bourgeois Virtues: Ethics for an Age of Commerce* (Chicago, 2006); Deirdre N. McCloskey, *Bourgeois Dignity: Why Economics Can't Explain the Modern World* (Chicago, 2010); McCloskey, *Bourgeois Equality*.

58 McCloskey, *The Bourgeois Virtues*; Deirdre Nansen McCloskey, 'How We Became Rich: From Liberal Ideas, Not Capital or Institutions or Exploitation', in *Bourgeois Virtues and the Great Enrichment: The Ideas and Influence of Deirdre Nansen McCloskey*, ed. Warren Bruce Palmer, vol. IX, The Annual Proceedings of the Wealth and Well-Being of Nations 2016-2017 (Beloit, 2017), 32.

59 McCloskey, *The Bourgeois Virtues*; McCloskey, *Bourgeois Equality*; Mokyr, 'Culture, Elites and the Great Enrichment', 39.

60 Richerson and Boyd, *Not by Genes Alone*, 68.

change on a fundamental level demands a comparative and long-term diachronic analysis.[61] While historians of knowledge see such work as desirable, they have yet to develop methods by which to do so.[62] The strength of the history of knowledge, as of cultural history in general, is that it is very adept at unpacking layers of meaning, and connections between various cultural phenomena. Yet it tends to do so in case studies where it is not certain how representative they are for society at large. Because of this they are also difficult to compare over time. Comparative research into the acceptance of various types of knowledge in a large number of case studies can provide a solution, according to Daston and Mulsow (2019), and allow us to see what was considered valuable knowledge at a particular time and how it developed. They feel this might be a way to guide the history of knowledge out of its 'cabinet of curiosities' condition.'[63] Yet so far no one has developed a practical approach to doing this, in part because it is not so easy to find sources that both offer a window onto the knowledge systems of non-experts ánd allow for comparison. This is where chronicles come in.

Local Chronicles in the History of Knowledge

The Early Modern Local Chronicle

In 2016 Pollmann published an article in which she suggested that local chronicles, written by the literate middle and upper-middle classes of early modern towns and villages, might be a promising genre to study the reception of new media and new knowledge among non-experts.[64] The key characteristic of chronicles is that they offer chronologically structured accounts of events. As such, they exist all over the world. European chroniclers followed biblical and classical models, referring to the two Old Testament books of Chronicles, and the Roman Annals. In medieval Europe chronicling was one of the main ways in which dynastic and ecclesiastical history was written, and from the later Middle Ages they were also written in cities, that used to document their origin, legal foundation and political structure as well as military feats.[65] Soon the practice was adopted by other local literate people in towns and villages, first in Italy and the German lands, and in the fifteenth century also in the Low Countries. There, the genre was to remain popular at least until the mid-nineteenth century.[66] Traditionally, chronicles have mostly been studied by medievalists, who approached the chronicle

61 Rogers, *Diffusion of Innovations*, 1–5; Richerson and Boyd, *Not by Genes Alone*, 70.
62 Lässig, 'The History of Knowledge', 54.
63 Mulsow and Daston, 'History of Knowledge', 2019, 181.
64 Judith Pollmann, 'Archiving the Present and Chronicling for the Future in Early Modern Europe', *Past & Present* 230, no. 11 (2016): 251.
65 Ibid., 235; Erika Kuijpers et al., 'Profiling Local Chroniclers', *Urban History*, no. Forthcoming (n.d.).
66 Pollmann, 'Archiving the Present', 236–40; Kuijpers et al., 'Profiling Local Chroniclers'.

as a historical genre. Yet in early modern local chronicles, it was not only the past, but increasingly also the lifetime of the author that became a central concern.

To capture this, Pollmann proposed a new definition:

> A chronicle is a text resulting from an act of literacy by someone who decides that he is well suited to keep a record of events in his surroundings, who believes that these events are worth recording, and that the best way to structure this information is to do so chronologically.[67]

Authors used chronicles to collect and 'archive' information that they deemed both memorable and useful. They were thus not only interested in writing a history of their locality but collected information on a wide range of topics that they considered useful for future reference. Of course, they made their own selection of what knowledge they considered useful, but in general chroniclers shared an interest in local politics and history, crime, prices, public space and natural or cultural events that they deemed remarkable.[68]

Early modern chronicles have long been neglected. The authors did not publish their work – it was a manuscript genre. In the nineteenth century there was a wave of interest among scholars, which resulted in the publication of many editions. However, most scholars found them a 'disappointing read'.[69] Their content can seem random or trivial. For many modern historians, they were too subjective to be considered reliable, while students of the self and emotions found they lacked the inward-looking qualities of 'diaries' or 'autobiographies' that privileged the feelings of the authors. In fact, they were outward-looking. 'Local chronicles' were designed to be useful to family members, neighbours, fellow citizens, and future generations. This means that chronicles were written about and usually for a wider community than the 'individualist self'.[70] As they remained in manuscript there was little need for (self-) censorship. At the same time, this also made them difficult to access for historians and easy to ignore. Chronicles are often poorly catalogued and scattered across local archives.[71]

As a consequence, they were mainly used by urban historians to fill the gaps left by institutional sources, and for information on local history. This means that they were seldom studied in a comparative way.[72] Pollmann noted that this began to change in the

67 Pollmann, 'Archiving the Present', 235.

68 Ibid., 241–49; Colleague Alie Lassche has researched which topics occur most frequently in chronicles and how this has changed over time. Alie Lassche, 'Information Dynamics in Low Countries' Chronicles (1500-1860). A Computational Approach' (Leiden, 2024), chap. 5.

69 Pollmann, 'Archiving the Present', 232.

70 Brodie Waddell, 'Writing History from Below: Chronicling and Record-Keeping in Early Modern England', *History Workshop Journal* 85 (1 April 2018): 241.

71 Pollmann, 'Archiving the Present', 236–37.

72 Ibid., 232; Kuijpers et al., 'Profiling Local Chroniclers'.

1990s when historians discovered that they could use the subjectivity of the genre as a lens to study various socio-cultural aspects from the middle and upper class of early modern society.[73] Scholars who compared a few chronicles from different periods also noticed that the type of information selected by the authors seemed to remain fairly similar. For that reason, Pollmann hypothesised that this manuscript genre remained stable enough for it to be used as a baseline for comparisons over time and space to study the reception of change.[74] Erika Kuijpers proposed that should be done by creating a large, digital collection of texts. In 2017 Pollmann and Kuijpers were awarded an NWO project grant to put that idea into practice in a pilot project in which I studied the changing ways in which chroniclers reasoned with old and new knowledge.

Collecting a Corpus of Chronicles

The Chronicling novelty team collected 204 Dutch chronicles from the Low Countries in 308 volumes (*Figure 1* & *2*). They were selected on various criteria, starting with Pollmann's modern definition of a chronicle. A search by title would not have been suitable. Although authors might use variants of the word 'chronicle' to describe local chronological records of this type, other descriptors were also frequently used. For example, there are chronological records of local events that authors themselves called 'journals', 'annals', 'memoirs', 'commentaries', 'histories' and 'diaries'. Many authors also used these terms interchangeably, which means that the collection does not consist only of texts that called themselves 'chronicles'.

At the same time, there were also 'chronicles' that were not included in the corpus. These were, for example, family chronicles and institutional chronicles. The first category lacks the focus on public affairs, while the latter were more often written for publication and by semi-professional historians. For our research questions, it was important that chronicles were written by non-experts on various topics that they wrote about in order to go beyond the reception of knowledge by experts.

We also collected metadata on the authors. This permitted us to get a sense of the social profile of the chroniclers and enabled us to divide them into five occupational categories (*Appendix 1*). Elsewhere, we have demonstrated that especially public servants, clerics, merchants and craftsmen maintained a chronicle, representing roughly 61 per cent of the authors. Yet, over time, this changed as an increasingly larger and more diverse group of people started to keep chronicles, including women and villagers, meaning that the level of education ranged from well-educated town secretaries to tax collectors, shoemakers, bakers and farmers with less, or a minimum level of, schooling.[75]

73 Pollmann, 'Archiving the Present', 233.
74 Ibid., 251–52.
75 Kuijpers et al., 'Profiling Local Chroniclers'.

Figure 1. Geographical distribution of chronicles.[76]

76 Map: *Nieuwe en nauwkeurige kaart der XVII Provincien van Nederland* (Amsterdam, c. 1738).

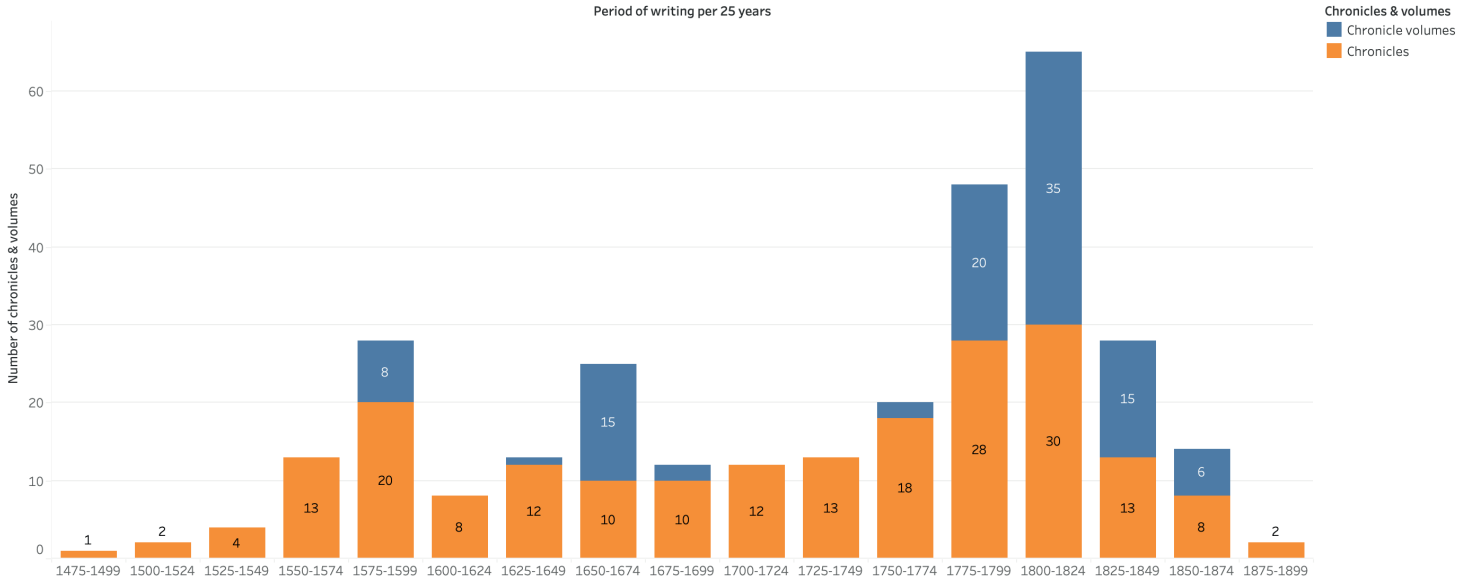

Figure 2. Distribution of chronicles and volumes in periods of twenty-five years.

Another selection criterion was more pragmatic in nature and was made on the basis of language. The corpus covers only chronicles from the Dutch language area, including the Northern and Southern Netherlands, although French was also an important language in the Southern Low Countries (*Figure 3*).[77] The decision to do so was predominantly pragmatic since the corpus had to be machine searchable to make comparisons in both time and space. This was already a quite complex task for chronicles that were written in Dutch, due to the enormous variation in spelling.

We tried to achieve a balanced distribution of chronicles both spatially and over time. For our selection we visited 39 archives and libraries throughout Belgium and the Netherlands. There is some bias in our corpus nonetheless. Geographically, not all regions are equally covered. We have 133 chronicles from the Northern Netherlands and 74 from the Southern Netherlands. In the Northern Netherlands most chronicles are from the North-Western and Southern provinces, of which 76 per cent were written by townspeople. In the Southern Netherlands, 86 per cent of the chronicles were written in towns, 50 per cent in the three major cities of Antwerp, Brussels and Ghent (*Figure 4*).[78]

The data collection allows us to make comparisons between the 'Northern' and the 'Southern Netherlands' and their historically increasing political and religious differences.[79] Especially in the first chapter, it will become clear to what extent political differences had an impact on the way chroniclers wrote and gathered their information. In the subsequent chapters, the religious differences between the predominantly Reformed North and the Catholic South and the role of religion in the acceptance of new knowledge will be discussed (*Figure 5*).

With regard to time there is a bias in the sense that we see peaks in periods of war and social turmoil, especially in the second half of the sixteenth century and from 1750 to 1850, during the Dutch Revolt and the Age of Revolutions. (*Figure 2*) Although chronicles were also written in relatively stable periods, there was an increasing interest in chronicling during periods of crisis. These chronicles may have also stood the test of time better than others, probably because they were deemed more important by later generations.[80]

77 For an extensive overview of the number of authors, chronicles and volumes per province, see Appendix 2.

78 See also Appendix 2 for the distribution of chronicles per province.

79 Because the boundaries were frequently changing during our period, we have used the current-day situation to distinguish the Northern (Dutch) provinces from those in the Southern Netherlands (Belgium). This means that the parts of Brabant and current-day Limburg are classified as 'Northern', despite the fact that they were ruled by the Habsburgs for much of our period.

80 Kuijpers et al., 'Profiling Local Chroniclers'; See also Waddell, 'Writing History from Below', 242.

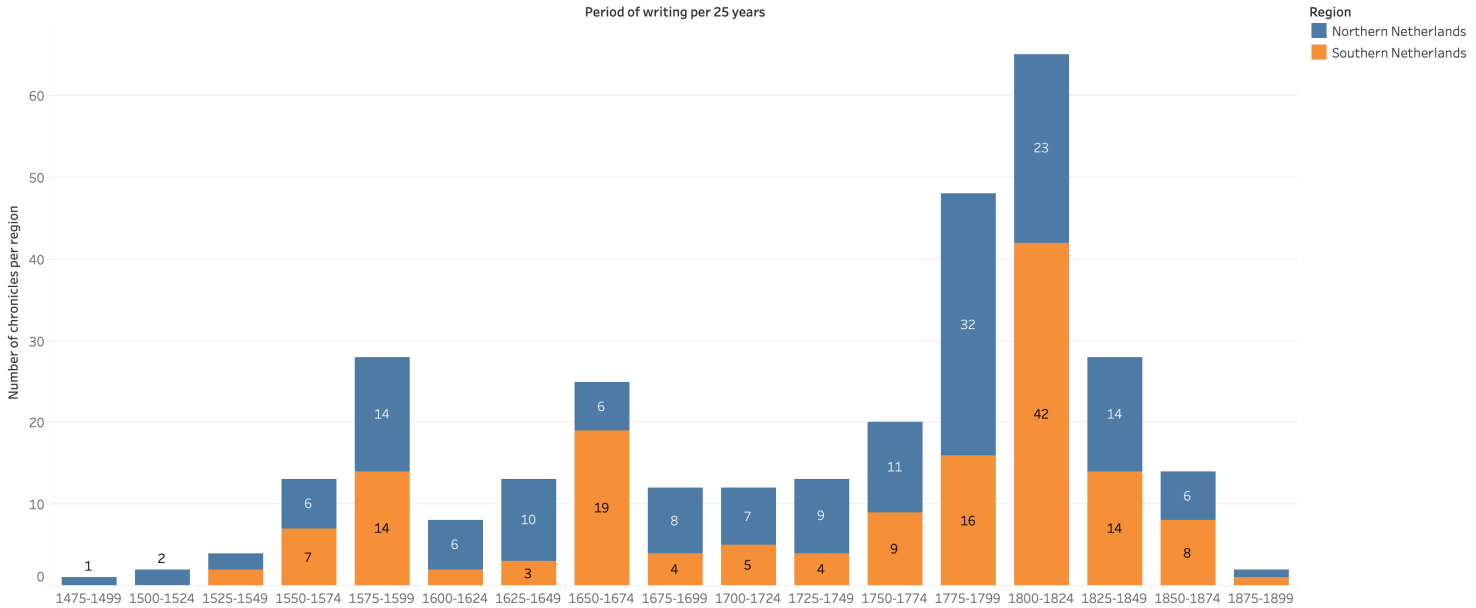

Figure 3. Distribution of chronicles from the Northern and Southern Netherlands in periods of twenty-five years.

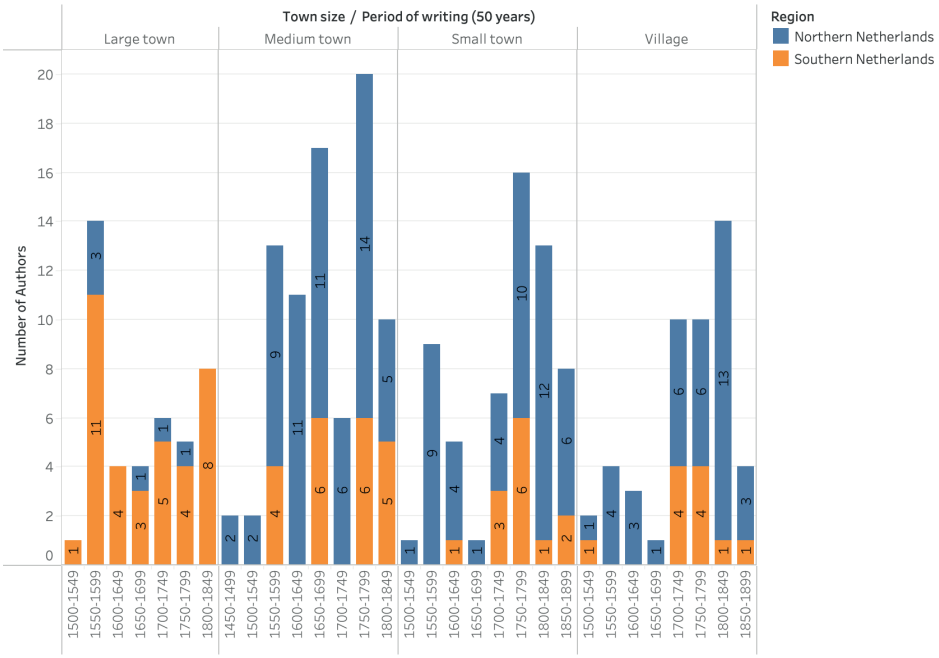

Figure 4. Distribution of chronicles according to town size, region and period of writing.[81]

81 Large town (>50,000), Medium town (10,000-50,000), Small town (<10,000), Village (no urban privileges).

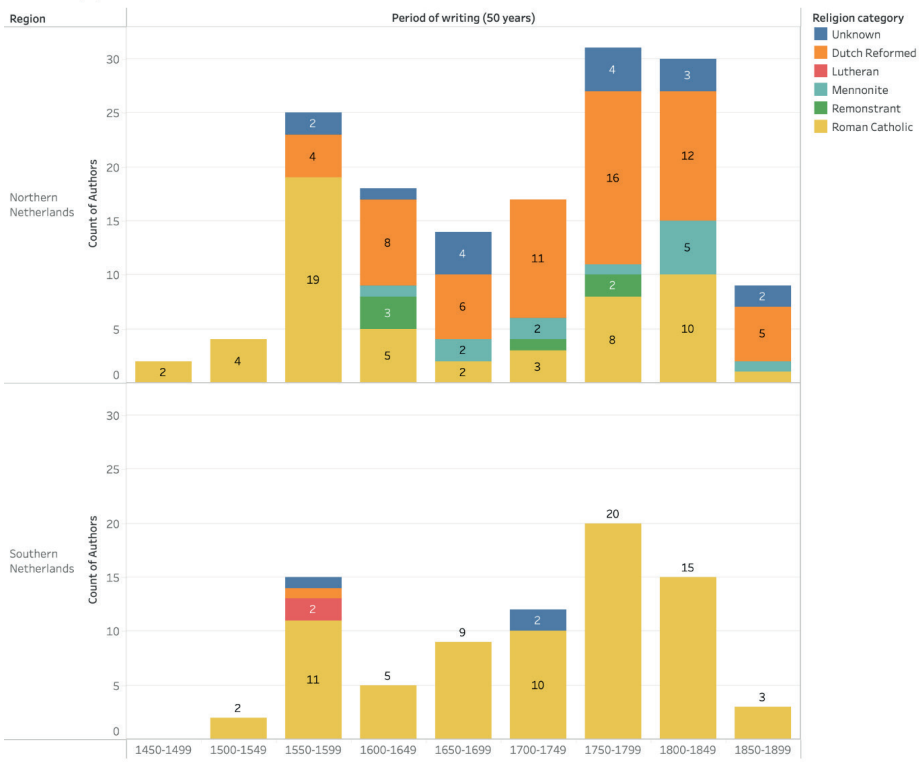

Figure 5. Denomination of the chroniclers in the Northern and Southern Netherlands per fifty years.[82]

Finally, we selected chronicles that covered events that the authors themselves had experienced and written about. Many chronicles were written in retrospect or contained historical sections starting with the birth of Christ or the founding of their village or city. To investigate how chroniclers experienced novelty or new ideas, how they reflected on them, and what information they collected to be able to do so, these contemporary parts of the chronicle are crucial. This is not to say that the historical sections in many chronicles were not relevant: they did play an important role as knowledge base and in the interpretation of events during the chronicler's lifetime. However, as presented in *Figure 6*, the historical components of chronicles largely faded or disappeared from chronicles from the eighteenth century onwards. Why this was the case is explained in *Chapter 3*.

Of the 204 chronicles, 98 had been edited and published or transcribed before. A significant portion of these were made digitally available (in cooperation with *Chronicling Novelty*) by the *DBNL* (*Digitale Bibliotheek voor de Nederlandse Letteren*).

82 See note 79.

The remaining 106 chronicles consisting of 177 volumes were photographed either by the archives or by ourselves.[83] The images were then checked and uploaded to *Transkribus*.[84]

In collaboration with the citizen-science platform *VeleHanden*, the images were made digitally accessible for transcription by a community of volunteers. Using Transkribus' *HTR* (*Handwritten Text Recognition*) software, every chronicle was transcribed, corrected, and, when necessary, checked again. Once a chronicle had undergone this process, it was made available in *VeleHanden* for enrichment through annotations.[85] This step was particularly crucial for applying computational methods to the corpus, which was especially relevant for the fourth and final chapter of this dissertation.

The process of digitising, transcribing, and annotating lasted from 2019 to 2023, which had an impact on the number of chronicles that I could use for my analyses. At the time of writing my first chapters, I was not able to use the entire corpus, which means that depending on the moment of writing I used between 71 and 92 per cent of the full corpus. At the beginning of each chapter, there is a paragraph with information about which part of the corpus I used.[86]

83 We used the Scantent developed by READCOOP to take images of the manuscripts. https://readcoop.eu/scantent/

84 A platform that was developed within the Horizon 2020 'READ' EU project, and further developed since 1 July 2019 by READ-COOP SCE.

85 For more information on the digitisation process, see: Theo Dekker, Erika Kuijpers, and Carolina Lenarduzzi, 'Van Crowdsourcing Naar Echte Burgerwetenschap. Investeer in de Kwaliteit van Samenwerking', ed. Hilde Greefs, Dossier: Burgerwetenschap in stadsgeschiedenis. Reflecties vanuit de historische praktijk, 18 (December 2023): 105–17; For a detailed report on the annotation of the corpus, see: Theo Dekker et al., 'The Kronieken Corpus: An Annotated Collection of Dutch/Flemish Chronicles from 1500-1850', in *Proceedings of the 8th Joint SIGHUM Workshop on Computational Linguistics for Cultural Heritage, Social Sciences, Humanities and Literature (LaTeCH-CLfL 2024)* (St. Julians, Malta: Association for Computational Linguistics, 2024), 243–52.

86 In the *Corpus Chronicle*s section of the bibliography, there is also an overview of the (volumes of the) chronicles that I used for each chapter.

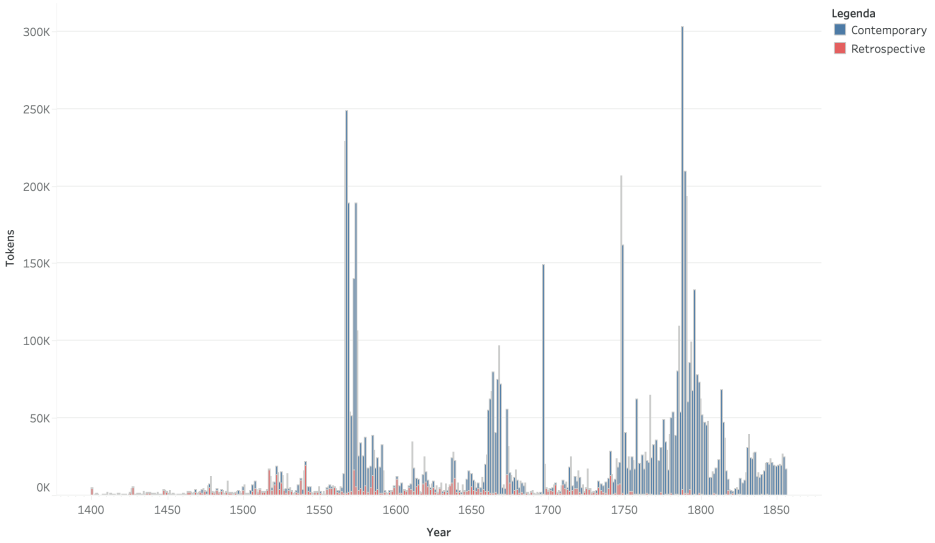

Figure 6. Retrospective and contemporary written words in the chronicles per year.[87]

Methods and Approach

To investigate how chroniclers collected information and how they engaged with it this study looks into topics that are covered by all of them because they were of daily concern in early modern communities: dearth, meteorological phenomena, epidemics, and the transition from Roman to Hindu-Arabic numerals, when written arithmetic became a highly desirable function, in early modern capitalist economies.[88] For each of these topics, I examined how chroniclers collected information, what selections they made, how they commented on them and how they used the data they assembled in their own chronicle to discover patterns. Many chronicles lack explicit argumentation or interpretation of the phenomena or events they describe. The very act of selecting information and the way it is ordered and inserted in a chronicle are therefore significant indicators for the way authors searched for patterns and tried to get grip on the events they experienced. According to Rens Bod (2022), writing down information to discover patterns is intrinsic to human nature, and, as it has its origins in people's survival strategy, this is inextricably linked to the production of knowledge and understanding of the world.[89] This means that especially in periods of dearth, epidemics, extreme weather conditions, we expect to find that chroniclers actively produced knowledge as part of their survival strategy.

87 For more information on the origins, composition of this figure, see: Kuijpers et al., 'Profiling Local Chroniclers'.

88 Chrisomalis, *Reckonings*, 25.

89 Rens Bod, *World of Patterns: A Global History of Knowledge* (Baltimore, 2022), 12, 19–20.

To study changes in the way chroniclers engaged with these phenomena over the period 1500-1850, I developed a combined method of close and distant reading.[90] For every chapter of this study I compiled lexica that accounted for all possible spelling variations of the relevant terms related to the topic in question.[91] Compiling such lexica was a necessary step since it was not until the nineteenth century that Dutch spelling was standardised; consequently, in the period under investigation there was a strong linguistic variation both regionally and over time. Spelling could also depend on the level of education of the chroniclers.[92] At the time of this research, it was not feasible to normalise spelling variation. Via closely reading relevant (related) fragments I found through searching the corpus digitally, I encountered new words and spelling variations, which were then added the lexicon. For the chronicles with no or only a few results, I scanned the entire text, to make sure that no word, spelling variation or fragment slipped through. Subsequently I used corpus analysis toolkits such as *Voyant* and *AntConc* to search for all relevant text fragments concerning the specific topic.[93] This made it possible to extract text fragments relevant to each chapter out of a corpus of more than twenty-two million words.

All the records concerning one of the topics were manually stored in a structured dataset, categorised and further annotated. This facilitated both qualitative and quantitative analysis. By categorising the fragments and linking them to a date, it became possible to create an overview of when and where entries on specific topics were recorded for the entire Low Countries between 1500 and 1850. This showed that certain crises identified as significant in the literature were sometimes mentioned only in passing by chroniclers, whereas other relatively unknown phenomena and events received more attention by contemporaries. Based on the way the authors structured and selected information, and in combination with their timing and reflections, it was possible to interpret why they considered certain pieces of information and events important enough to write down and what explanations they gave for their occurrence. How this can be done will be demonstrated in detail in *Chapter 1*.

The selection of information by chroniclers, the patterns they presumably searched for as well as the explanations they gave for phenomena were used to determine what chroniclers considered as knowledge and to study the transmission and acceptance of new knowledge over time. Some chroniclers regularly reflected on their own thoughts

90 Franco Moretti, *Distant Reading* (London, 2013).

91 See Appendix 2.

92 For more information on education and literacy in the Northern and Southern Netherlands see: Willem Frijhoff, Werkgroep 18e Eeuw, and Symposium Werkgroep 18e eeuw, *Onderwijs & opvoeding in de achttiende eeuw: verslag van het symposium, Doesburg 1982 = Enseignement & éducation dans Les Pays-Bas au dix-huitième siècle: textes du colloque, Doesburg 1982* (Amsterdam, 1983), chaps 1–3.

93 'Voyant Tools', accessed 27 February 2023, https://voyant-tools.org/; 'Laurence Anthony's AntConc', accessed 27 February 2023, https://www.laurenceanthony.net/software/antconc/.

and beliefs as well as those of others. Through these reflections it was possible to trace why they believed one thing and not another. By closely analysing these reflections in their historical context it also becomes possible to establish how they came to accept new knowledge or explanations. The theoretical concepts of *content* and *direct* bias as well as *frequency-dependent bias* are useful categories to analyse the chroniclers' engagement with new knowledge.[94] Did they base their judgements on the content of information, were they searching for validation and legitimation of this content, or did they rather trust the authority and knowledge of an expert? Or did they merely copy and assimilate the opinions and ideas that were circulating, and becoming more common, in their environment and in the media?[95] Additionally, this study will examine whether the process of acceptance depends on the type of innovation. For instance, was technological knowledge accepted under different conditions than new cultural beliefs?

Structure

To summarise, this dissertation examines *processes of cultural change in the Low Countries between 1500 and 1850 and how chronicles can help us to better understand these processes by offering us a window on the acceptance of new knowledge beyond expert circles*. It will do so by examining four topics that had a significant impact on people's daily lives and consequently encouraged chroniclers to collect information on these topics, to discover patterns and produce knowledge.[96] With the exception of political and religious events, these were the topics chroniclers wrote about the most, ensuring that as many chronicles as possible were used while making comparisons.[97]

The first chapter examines how and under which conditions chroniclers started to record prices and other relevant information. It aims to put my methodology into practice and to demonstrate that chronicles are more than just collections of 'trivial' data, or 'memorable' events. Many chroniclers also collected information for future use. They used this information to discover patterns, to arrive at new insights based on these patterns and to draw conclusions from them. Through the practice of collecting prices and related information I will show how chroniclers reasoned with their collection of information and how they produced knowledge as they sought to explain and anticipate periods of dearth.

In the second chapter, the conditions under which new knowledge and technology were accepted are explored through various meteorological phenomena. In the sixteenth and seventeenth centuries, extraordinary meteorological phenomena were often

94 Richerson and Boyd, *Not by Genes Alone*, 6, 68–98.

95 Ibid., 205; Mokyr, *A Culture of Growth*, chap. 5.

96 Bod, *World of Patterns*, 12, 19–20.

97 Because not every chronicler wrote about every subject, I have used a selection of the corpus for each chapter. At the beginning of each chapter, there is a paragraph with information about which part of the corpus I used to study cultural change. In the section *Chronicles Corpus* in the *Bibliography* there is an overview of the volumes I used for each of the four chapters.

interpreted as signs from God. Recent scholarship has illustrated that this changed in the eighteenth century when the role of God receded into the background. *Chapter 2*, however, argues that chronicles show that this observation applied only under specific conditions and only for some meteorological phenomena. For others traditional interpretations persisted well into the nineteenth century. That chroniclers explained meteorological phenomena both through natural processes and divine intervention illustrates that they could operate at two different cultural levels at the same time.[98] In this chapter I will also discuss the acceptance of the lightning rod and explain why it took almost a century after its invention before these devices were installed on a large scale.

Building further on the findings of *Chapter 2* the next chapter focusses on how chroniclers used multiple explanations side by side to explain epidemics. Unlike the case of some meteorological phenomena, the acceptance of new knowledge on epidemics did not lead to the disappearance of traditional explanations. Religious and several types of natural explanations were used not only alongside each other, but also in combination. Furthermore, *Chapter 3* analyses why the corpuscular theory of disease was not accepted among most non-experts around 1700, but became generally accepted only more than a century later.

The final chapter addresses the use of Roman and Hindu-Arabic numerals, and the replacement of the former by the latter. It discusses the different motives non-experts may have had for accepting an innovation such as a new numeral system. The second half of this chapter delves into the role that a new technology can play in the discovery of new patterns and the emergence of new explanations. It will do so by examining chroniclers' growing interest in collecting quantitative data. Using the lists and tables, which they frequently included in their texts from the 1750s onwards, chroniclers tried to detect such new patterns, for example to better understand epidemics. Again, this did not mean that religious interpretations disappeared. Through these newly discovered patterns chroniclers tried to gain new insight into God's intentions.

The final chapter cuts through the previous chapters, so to speak, focussing on the processes underlying the acceptance of new knowledge, and thus cultural change. This sets the stage for the conclusion that answers the questions raised in the *Introduction*. It will argue that by taking non-experts into account, we can see that the acceptance of new knowledge, and hence the conditions for cultural change, runs along different paths than we have previously thought. Studying the daily lives of chroniclers enables us to discover how non-experts had a stake in the philosophies and technologies of knowledge.

98 See also: Theo Dekker, 'Coping with Epidemics in Early Modern Chronicles, The Low Countries, 1500-1850', in *Dealing with Disasters from Early Modern to Modern Times: Cultural Responses to Catastrophes*, ed. Hanneke van Asperen and Lotte Jensen, Disaster Studies (Amsterdam, 2023), 229–47.

Chapter 1

Reasoning with Prices in Periods of Dearth

Lords, open your warehouses with your grain, or in five days Brussels is lost.[1]

– Chronicler Willem Boonen (1547-1618), Leuven.

1 'Gij heeren doet op[en] u solders met uwen coren, Oft in v daeghen es Bruessel verloren.' This poem was written on pieces of paper and distributed throughout Brussels during the dearth of 1556. Willem Boonen, *Geschiedenis van Leuven, Geschreven in de Jaren 1593 En 1594*, ed. Gérard Edouard van Even (Leuven, 1880), 94.

Introduction

In 1822, Sebastiaan van Beringen, supervisor of the mills in the town of Roermond noted that some people argued that population growth would soon outstrip food supplies – apparently someone in his vicinity had read the work or heard about the theories initially developed by Thomas Malthus (1766-1834). He wrote:

> There are certain people who believe that in the future it will be impossible for grains to return to decent prices, due to the increase of population. It seems to me that I must include an entry here, to show that our God today is the same one who fed five thousand people with five loaves and two fishes over 1800 years ago. In the year 1816, one loaf of bread cost 50 stivers, now it costs 10 stivers, and all grains accordingly. A *malder* [164.4 litres] of potatoes cost 24 guilders and now 3 guilders. Yet, in the month of April only 30 stivers. Butter costs only 6 stivers per pound, and the vegetables are so cheap that plenty are given away for nothing. Therefore, it is not a good thing that know-alls talk too much about matters that concern no one but the wise omnipotence of God.[2]

This passage not only shows that Van Beringen was sceptical of what certain people said, but also explains why he did not believe it. Probably due to his profession, Van Beringen collected information about food prices for years and observed a pattern of declining food prices since the period of dearth from 1816 until 1817.[3] So far, a rising population had not led to scarcity and high prices, according to Van Beringen. Moreover, he knew from Scripture that there are examples of God providing His people with food during times of scarcity. Based on empirical evidence and religious knowledge Van Beringen concluded that the theory of 'certain people' could not be correct.[4]

In this example, we can see explicitly how a chronicler reasoned based on the information he collected. How common was this? To many readers of chronicles, it may not seem self-evident that we can use chronicles to discover how authors reasoned.

2 'Er syn lieden, die meenden, dat het in de toekomst onmogelyk soude syn, dat de graenen weder aen civiele prysen souden komen, uyt reden van de menigte van menschen die jaerlyks bykomen. My dunkt ik moet hier eene aenmerking maken, om aen te toonen, dat onze God van heden dezelfde is, die met vyf brooden en twee visschen vyfduyzend menschen gespysd heeft over 1800 jaer. In het jaer 1816 kostte één brood 50 stuivers, nu kost hetzelve 10 stuivers, en alle graenen nae rato. Een malder aerdappelen kostte 24 gulden en nu 3 gulden, jae in den maend April maer 30 stuiver. De boter kost maer 6 stuiver het pond, en de groentens syn soo goed koop, dat er genoeg worden om niet gegeven. Het is dus niet goed, dat de wysneuzige menschen te veel praten van saeken, die niemand aengaen dan de wyse almogentheyd van God.' Sebastiaan van Beringen, 'Kronijke der Stad Roermond beginnende met de komst van keizer Joseph II en eindigende met de troonsbeklimming van Leopold I, koning der Belgen (1781-1831)', ed. J. Habets, *Publications de la société historique et archéologique dans le Limbourg* 2 (1865): 42.

3 There was a period of dearth in the Low Countries between 1816 and 1817, see Jan de Vries, *The Price of Bread: Regulating the Market in the Dutch Republic* (Cambridge, 2019), 471.

4 Van Beringen referred to the example in: Matthew 14:13-21, Mark 6:30-44, Luke 9:10-17, and John 6:1-14.

Chronicles have traditionally been read as historical texts, and it is new to approach them as collections of information that could help the author to think about the present and the future.[5] Moreover, chronicles are in general not very discursive, and the topics chroniclers selected for recording often seem selected rather randomly. Most authors refrained from explaining in detail why they thought the information they offered was relevant and to whom, and connections between items are often unclear. Our first task is thus to show how and why chronicles can be used to explore patterns of thought.

This chapter will do so by analysing how authors wrote about the prices of goods, especially grains. Various historians have noted that prices, especially prices of goods, often appear in the diaries and chronicles of early modern people, but they have been at a loss to explain why they were recorded or what contemporaries did with them.[6] When we read chronicles, we encounter entries on prices for a wide variety of goods and services, including taxes, soldiers' expenses, food prices, and wages, at first sight noted at random.[7] As a result, some scholars have dismissed such entries as 'side issues'.[8]

In this chapter, I will show that at least some prices were recorded consistently. Having investigated when chroniclers noted prices, and which prices, I observed that most authors recorded food prices, especially grain prices. They did not do this every year, but did so in a consistent manner during periods when food prices increased significantly and were extremely high. These moments of price recording often coincided with entries on periods of political uncertainty or unusual natural conditions like extremely cold winters.[9]

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5 Pollmann, 'Archiving the Present', 249–52.

6 Thomas Fuchs, *Geschichtsbewusstsein Und Geschichtsschreibung Zwischen Reformation Und Aufklärung Städtechroniken, Kirchenbücher Und Historische Befragungen in Hessen, 1500 Bis 1800* (Marburg, 2006), 41; Ayesha Mukherjee, 'Introduction: A Cultural History of Famine', in *A Cultural History of Famine: Food Security and the Environment in India and Britain*, ed. Ayesha Mukherjee, Routledge Environmental Humanities (Abingdon, 2019), 1–18; Ayesha Mukherjee, 'Famine Chorography. Peter Mundy and the Gujarat Famine, 1630-32', in *A Cultural History of Famine: Food Security and the Environment in India and Britain*, Routledge Environmental Humanities (Abingdon, 2019), 73–93; Brodie Waddell, 'Writing History from Below: Chronicling and Record-Keeping in Early Modern England', *History Workshop Journal* 85 (1 April 2018): 249, 251; Francesca Canadé Sautman, '"Il a Bien Sceu Jouer Des Haulx Bois, et Si n'estoit Ménétrier": A Sixteenth-Century Protest in the City of Sens against the Depletion of Wood Resources', ed. Briony Neilson, *French History and Culture: Papers from the 23rd George Rudé Seminar* 11 (2023): 22.

7 See for example: Tamme Gijsbers, 'Kroniek van Tamme Gijsbers', Universiteitsbibliotheek Leiden, LTK 2293; Hendrik Haexbergen, 'Memoriaal van de stadssecretaris Hendrik van Haexbergen, 1619-1623', Stadsarchief Deventer, 0691 Schepenen en Raad van de stad Deventer, periode Republiek (22600: 94-2); Jakob Bikker Raye, 'Notietie van het merkwaardigste meijn bekent dat in het jaar 1732 binnen Amsterdam is voorgevallen. 1733, 1734, 1735, 1736, 1737, 1738, 1739.', Stadsarchief Amsterdam, Bibliotheek 15030/3551; Luijt Hoogland, *Chronologische aanteekeningen, betrekkelijk de stad Enkhuizen, van 1732 tot 1807, uit het dagboek van Luijt Hoogland, gewoond hebbend en overleden te Enkhuizen*, ed. K.E. Koeman, Paludanus reeks 1 (Enkhuizen, 1980).

8 'Teuerungen' as 'Nebensächlighkeiten' in: Fuchs, *Geschichtsbewusstsein Und Geschichtsschreibung*, 41.

9 Jan Golinski, *British Weather and the Climate of Enlightenment* (Chicago, 2007), 83; Ayesha Mukherjee, *A Cultural History of Famine: Food Security and the Environment in India and Britain* (Abingdon, 2019), 24.

These periods of (unusually) high prices, which contemporaries called '*duurte*', or dearth, had a significant impact on early modern societies, and most generations encountered them at least once. Economic historians have argued that an unusual price increase in grain was the first indicator of dearth, since the natural price of grain was more volatile than wages, rents, the prices of manufactured goods, and capital goods.[10] Considering that bread grains accounted for 70 to 80 per cent of the total caloric intake of early modern Europeans, it is unsurprising that chroniclers more often recorded the price of grain than of other goods.[11]

Moreover, a significant part of income was spent on bread. In general, a journeyman spent roughly 25 per cent of his income on bread in the early modern period, having a sober diet of only buckwheat and rye.[12] Thus, an increase in the price of grain had considerable consequences for purchasing power.[13] In periods of dearth grain prices often doubled or tripled, making it one of the greatest threats to early modern societies.[14] To mitigate such price shocks, governments regulated the grain market. For example, they controlled bread prices, stockpiled grain, and restricted exports, particularly during periods of crisis. The Northern Netherlands, in particular, were remarkably successful in this regard.[15]

The Low Countries were a major importer of grain. In the fifteenth century, especially the western part urbanised rapidly, and local grain production decreased, leaving them with no choice but to import grain.[16] In the late sixteenth century, the province of Holland for example had to import 75 per cent of its grains.[17] Especially, after the Fall of Antwerp

10 De Vries, *The Price of Bread*, 10.

11 Ibid., 288.

12 For a detailed overview on the price of various types of grain between 1550 and 1840, see: Ibid., 356–57.

13 For an extensive overwiew of grain prices in the early modern Northern Netherlands, see: De Vries, *The Price of Bread*; For an extensive overview of the prices of grain and other goods in the early modern Southern Netherlands, see: Charles Verlinden, Jan Craeybeckx, and Hilda Coppejans-Desmedt, *Dokumenten voor de geschiedenis van prijzen en lonen in Vlaanderen en Brabant = Documents pour l'histoire des prix et des salaires en Flandre et en Brabant I, XVe-XVIIIe eeuw* (Bruges, 1959); Charles Verlinden, Jan Craeybeckx, and Hilda Coppejans-Desmedt, *Dokumenten voor de geschiedenis van prijzen en lonen in Vlaanderen en Brabant = Documents pour l'histoire des prix et des salaires en Flandre et en Brabant II, XIVe-XIXe eeuw*, 136 (Bruges, 1965); Charles Verlinden, F. de Wever, and Etienne H. L. Scholliers, *Dokumenten voor de geschiedenis van prijzen en lonen in Vlaanderen en Brabant = Documents pour l'histoire des prix et des salaires en Flandre et en Brabant. III: XVIe-XIXe eeuw* (Bruges, 1972).

14 Daniel R. Curtis and Jessica Dijkman, 'The Escape from Famine in the Northern Netherlands: A Reconsideration Using the 1690s Harvest Failures and a Broader Northwest European Perspective', *The Seventeenth Century* 34, no. 2 (15 March 2019): 229–58.

15 Jessica Dijkman, 'Coping with Scarcity: A Comparison of Dearth Policies in Three Regions in Northwestern Europe in the Fifteenth and Sixteenth Centuries.', *TSEG - The Low Countries Journal of Social and Economic History* 14, no. 3 (2017): 6; For more information, see: De Vries, *The Price of Bread*, chaps 1–4.

16 De Vries, *The Price of Bread*, 40; Maarten Prak, 'Urbanization', in *The Cambridge Companion to the Dutch Golden Age*, ed. Helmer J. Helmers and Geert H. Janssen, Cambridge Companions to Culture (Cambridge, 2018), 15–31; Jan de Vries and Ad van der Woude, *Nederland 1500-1815: de eerste ronde van moderne economische groei* (Amsterdam, 1995), 73–75, 482–88.

17 Curtis and Dijkman, 'The Escape from Famine in the Northern Netherlands', 243.

and the closure of the Scheldt in 1585, Amsterdam consolidated its place as the granary of Western Europe with an interregional grain staple, redistributing grain from the Baltic, and North-western Germany, to the markets in the Netherlands and Western Europe.[18] From the 1730s onward, Amsterdam's role as the grain storehouse of Europe decreased. However, the import of Baltic grain continued to be significant, consisting of roughly 30 per cent of the total grain consumption in the Northern Netherlands.[19] Amsterdam's central position in the trade of grain, combined with strict government regulation, allowed supply-and-demand shocks in the North to be largely absorbed.[20]

The Southern Netherlands, which returned under Habsburg rule in 1585, were at war with the Dutch until 1648. Due to the closure of the river Scheldt by the Dutch Republic, they imported grain from the Baltic through the ports of Ostend and Dunkirk. After the Eighty Years' War the Southern Netherlands increasingly relied on Amsterdam for the import of Baltic grain via Antwerp.[21] In the eighteenth century, Amsterdam continued to play an important role in shipping grain to the Southern Netherlands, but large amounts were also imported from Spain, France and to a lesser extent England.[22] In the same period, grain production in Flanders and Brabant soared, with even grain surpluses between 1750 and 1775.[23] Consequently, they became less dependent on the import of grain than the Northern Netherlands.[24]

18 Milja van Tielhof, 'Grain Provision in Holland, ca. 1490–ca. 1570', in *Peasants into Farmers?*, vol. 4 (Turnhout, 2001), 213–16.

19 De Vries and Van der Woude, *Nederland 1500-1815*, 483–87; De Vries, *The Price of Bread*, 151–52; See also: Victoria N. Bateman, 'The Evolution of Markets in Early Modern Europe, 1350-1800: A Study of Wheat Prices', *The Economic History Review* 64, no. 2 (2011): 447–71.

20 De Vries, *The Price of Bread*, 49–92.

21 R. Baetens, 'De Zuidelijke Nederlanden En de Handel Op de Baltische Ruimte (17e Eeuw)', in *The Interactions of Amsterdam and Antwerp with the Baltic Region, 1400-1800: De Nederlanden En Het Ostzeegebied, 1400-1800*, ed. W.J. Wieringa et al., 16 (Leiden, 1983), 61–69; Etienne H. L. Scholliers, 'De Eerste Schade van de Scheiding. De Sociaal-Economische Conjunctuur 1558-1609', in *1585: Op Gescheiden Wegen ...: Handelingen van Het Colloquium over de Scheiding Der Nederlanden, Gehouden Op 22-23 November 1985, Te Brussel = 1585: Proceedings of the Colloquium on 'The Separation of the Low Countries' Held on 22-23 November 1985 in Brussels*, ed. Jan Craeybeckx, Frank Daelemans, and F.G. Scheelings, Colloquia Europalia, VI (Leuven, 1988), 44; De Vries, *The Price of Bread*, chap. 6; Van Tielhof, 'Grain Provision in Holland, ca. 1490–ca. 1570', 213–16; H. Houtman-De Smedt, 'De Zuidelijke Nederlanden En de Oostzee in de 18e Eeuw (Oostenrijke Periode)', in *The Interactions of Amsterdam and Antwerp with the Baltic Region, 1400-1800: De Nederlanden En Het Ostzeegebied, 1400-1800*, ed. W.J. Wieringa et al., 16 (Leiden, 1983), 105; See also: Erik Thoen, 'A "commercial Survival Economy" in Evolution : The Flemish Countryside and the Transition to Capitalism (Middle Ages - 19th Century)', in *Peasants into Farmers ? The Transformation of Rural Economy and Society in the Low Countries (Middle Ages-19th Century) in Light of the Brennerdebate*, vol. 4 (Brepols, 2001), 102–57.

22 Houtman-De Smedt, 'De Zuidelijke Nederlanden En de Oostzee in de 18e Eeuw (Oostenrijke Periode)', 105; See also: Peter Scholliers, *A History of Bread: Consumers, Bakers and Public Authorities since the 18th Century*, Food in Modern History (London, 2024).

23 Adriaan Verhulst, Chris Vandenbroeke, and Frank Daelemans, *Landbouwproduktiviteit in Vlaanderen en Brabant XIVe-XIXe eeuw = Productivité agricole en Flandre et en Brabant XIVe-XIXe siècle = Agricultural productivity in Flanders and Brabant XIVth-XIXth century* (Ghent, 1979), i.

24 Ibid.

Crisis periods	Crisis periods
1502-1503	1629-1631
1516-1517	1649-1653
1521-1522	1661-1663
1530-1531	1698-1700
1545-1546	1708-1710
1551-1554	1740-1741
1556-1557	1770-1773
1565-1566	1794-1796
1571-1575	1800-1817
1585-1587	1845-1847
1595-1597	

Table 1. Periods of dearth in the early modern period.[25]

In general, the efforts of the authorities to ensure food security were quite successful in the Low Countries. This 'escape from famine', however, could not prevent several major food crises from also impacting the price of other goods besides food in the Northern and Southern Netherlands.[26] On the basis of crises discussed in the historical literature, I compiled an overview of these periods which is presented in *Table 1*.[27] It is beyond the scope of this dissertation to discuss the causes and consequences of each period of dearth here, but generally, the impact of these crises was greater in the South than in the North(west). This was partly due to Amsterdam's position in the international grain trade, but other factors also played a prominent role.[28]

Corpus

For this Chapter, I made use of 187 chronicles from the period 1500-1850, using 125 chronicles from the Northern Netherlands and 62 from the Southern Netherlands.[29] These chronicles have been analysed by using a wordlist to find text fragments that concern food prices (*Appendix 3*). The search terms I used related to dearth, famine, food products such as grains and vegetables, currencies, and words related to 'increase'

25 De Vries, *The Price of Bread*, 463–71; Arjan van Dixhoorn, 'The Grain Issue of 1565-1566. Policy Making, Public Opinion, and the Common Good in the Habsburg Netherlands', in *De Bono Communi. The Discourse and Practice of the Common Good in the European City (13th-16th c.)*, vol. 22, Studies in European Urban History (1100-1800) (Brepols Publishers, 2010), 171–204; Curtis and Dijkman, 'The Escape from Famine in the Northern Netherlands'; Etienne H. L. Scholliers, *De levensstandaard in de XVe en XVIe eeuw te Antwerpen: loonarbeid en honger* (Antwerpen, 1960), 11.

26 Curtis and Dijkman, 'The Escape from Famine in the Northern Netherlands'.

27 Compiled from the following literature. See especially Appendix 2, 'crisis periods' in: De Vries, *The Price of Bread*; For the sixteenth century, see: Van Dixhoorn, 'The Grain Issue of 1565'.

28 De Vries and Van der Woude, *The First Modern Economy*, 198–200; Curtis and Dijkman, 'The Escape from Famine in the Northern Netherlands', 229–31, 250–51.

29 The full corpus consists of 204 chronicles: 132 from the Northern and 72 from the Southern Netherlands. Therefore, I used respectively 95% and 86% of the full corpus for this Chapter.

(of food prices). As a result, I found that 82 of the chronicles in the Northern Netherlands, and 55 of those in the Southern Netherlands contained entries on dearth. Although the absolute number of chronicles from the Southern Netherlands is much smaller, in the South, 89 per cent of the chronicles contain entries on dearth, in contrast to 64 per cent in the North.

That dearth played a much more prominent role in chronicles from the Southern Netherlands is also evident from the number of entries that were examined. Of the 516 entries, 296 were from the South, meaning they account for 57 per cent of all entries on dearth. The number of authors who wrote about dearth per year are presented in *Figure 7*. This shows that most periods of dearth were discussed by chroniclers from both the Southern and Northern Netherlands. These periods largely coincide with the known periods of dearth from the historical literature (*Table 1*). Drought and crop failures in 1556-57, the impact of the Dutch Revolt in 1560s, 1570s, and particularly the sieges in the South in the 1580s, with the Fall of Antwerp in 1585 led to dearth in the sixteenth century.[30]

In the seventeenth century, it is primarily authors from the Northern Netherlands who wrote about dearth, particularly in the years 1630, 1662, and 1698, when war, cold weather, and crop failures conspired to drive up prices. The difference may be explained with reference to the small number of chroniclers from the Southern Netherlands for this period (*Figure 3*). In the eighteenth century, the two extremely cold winters of 1709 and 1740 stand out, and the period from 1789 to 1817 is characterised by uprisings, regime changes, and again a cold winter. The last spike represents the potato disease between 1845 and 1847.[31]

30 Astrid Friis, 'The Two Crises in the Netherlands in 1557', *Scandinavian Economic History Review* 1, no. 2 (1 July 1953): 193–217; Van Dixhoorn, 'The Grain Issue of 1565'.

31 For an overview of the causes of these periods of dearth, see: De Vries, *The Price of Bread*, 463–72.

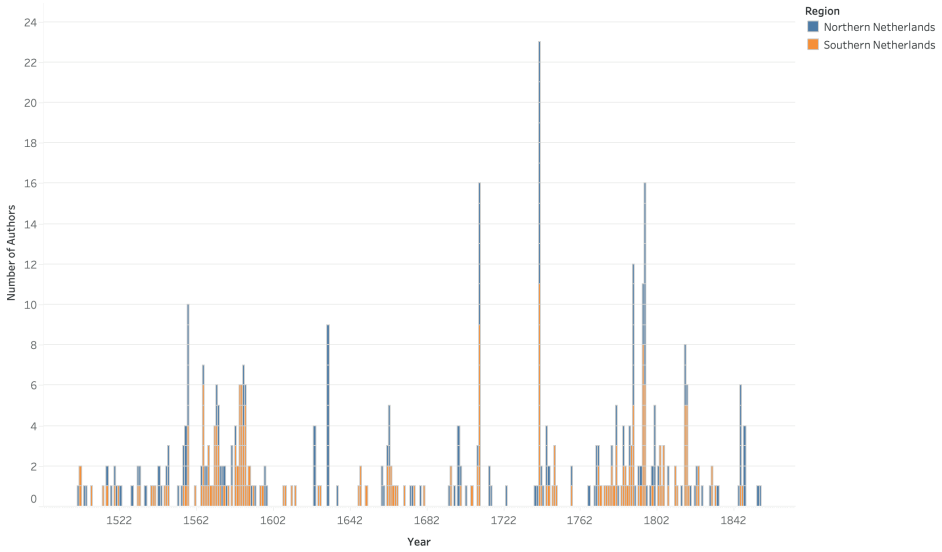

Figure 7. Number of chroniclers writing on dearth per year (1500-1850).

The fact that chroniclers in the Southern Netherlands wrote more often about dearth than did those in the Northern Netherlands can probably be explained by the fact that the impact was generally greater in that region. This can also be observed in the way chroniclers wrote about their experiences. In relatively short periods of dearth, authors recorded prices not systematically, but only to express the severity of the situation. When the impact was greater, we will see that authors start to keep track of grain prices on a weekly basis, combined with other information. However, there were also other reasons that motivated chroniclers to keep track of prices during periods of dearth.

The primary causes of dearth can be divided into three categories. First, natural phenomena such as epidemics and extreme weather conditions like drought or cold, led to crop failures or logistical problems. Second, war and political instability could complicate the transportation of food or result in sudden peaks in demand. Last, human behaviour could aggravate the effect of shortages. In periods of increasing prices and stimulated by rumours, people could start hoarding. Moreover, (grain) merchants often accumulated large grain reserves and started to speculate, thus driving up prices even further.[32]

32 Karl Gunnar Persson, *Grain Markets in Europe, 1500–1900: Integration and Deregulation*, Cambridge Studies in Modern Economic History (Cambridge, 1999), 76; Dijkman, 'Coping with Scarcity', 6.

The price of grain had a direct impact on other sectors of the economy, such as livestock farming and dairy production.[33] Consequently, the increase of grain prices also drove up the prices of other goods.[34] Moreover, rising prices also had social consequences, such as an increase in the number of beggars coming to the city.[35] Yet, high prices resulting from a crisis did not usually lead to protests. As students of the 'moral economy' have shown, it was suspicions about speculation or government indifference that provoked uprisings.[36]

The umbrella term 'moral economy', introduced by E.P. Thompson in 1971, includes views on honesty, justice, and fairness, and is used to describe the norms and expectations of the 'common folk' regarding the regulation of economic relations.[37] Economic historians studying this 'broadly shared set of beliefs' about the economy have noted how important the local was in the minds of early moderns.[38] Their first concern was that the local community should have both direct and primary access to locally produced food, which is also known as 'the first right of refusal'.[39] Second, grain in particular was too important to leave to market forces, meaning that the legitimacy of local authorities hinged on the public perception that they protected the common good.[40] It is therefore no wonder that during periods of dearth we find reflections on government actions and the behaviour of grain merchants in the chronicles, which chroniclers deemed useful to themselves and their readers.

In 2019, the literary scholar Ayesha Mukherjee argued that chronicles can make a significant contribution to cultural and socio-economic studies in understanding

33 See for example: Jan Kluit, 'Historische Jaerboeken der stad Briel, deel 1, 1e stuk, 1747-1751', Streekarchief Voorne-Putten, Rozenburg, 501, inv.no. 1; Jurriaan Spruijt, 'Het tweede deel off vervolg van de historie der stad Hoorn', Westfries Archief, Hoorn, 0656, Hervormde Gemeente Hoorn, inv.no. 590; Albert Pietersz. Louwen, 'Kronijk der stad Purmerende bevattende der selver opkomste en voortgang, in handschrift door Albert Pietersz. Louwen, 18e eeuw, deel 1', Noord Hollands Archief, Haarlem, 143. Collectie van A. Pietersz. Louwen, inv.no. 18; Albert Pietersz. Louwen, 'Kronijk der stad Purmerende bevattende der selver opkomste en voortgang, in handschrift door Albert Pietersz. Louwen, 18e eeuw, deel 3, tweede gedeelte', Noord Hollands Archief, Haarlem, 143. Collectie van A. Pietersz. Louwen, inv.no. 22; Anna Elisabeth Buma, 'Kroniek van belangrijke buitenlandse, landelijke, regionale en plaatselijke gebeurtenissen', Historisch Centrum Leeuwarden, 1759 Beucker Andreae, inv.no 374.

34 Scholliers, *De levensstandaard in de XVe en XVIe eeuw te Antwerpen*; Verlinden, Wever, and Scholliers, *Dokumenten voor de geschiedenis van prijzen en lonen in Vlaanderen en Brabant = Documents pour l'histoire des prix et des salaires en Flandre et en Brabant. III*; De Vries, *The Price of Bread*.

35 See for example: Justus Billet, 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 3', Stadsarchief Gent, Bibliotheek 1LF2 en lGDl, 529 (C. Handschriften), fol. 140 verso-141 verso; 'bedelaars' in: Cornelis Kartensz. Dekker, 'Aantekeningen in chronologische volgorde, bijgehouden tot 1813; geslachtsregister van de nakomelingen van Karte Cornelisz. Dekker (1813)', Gemeentearchief Zaanstad, Zaandam, bibl. 8G18 (16153), unpaginated.

36 Gregory Hanlon, *Early Modern Italy, 1550-1800: Three Seasons in European History* (Basingstoke, 2000), 101.

37 E. P. Thompson, 'The Moral Economy of the English Crowd in the Eighteenth Century', *Past & Present*, no. 50 (1971): 76–136; Van Dixhoorn, 'The Grain Issue of 1565', 202; De Vries, *The Price of Bread*, 19.

38 De Vries, *The Price of Bread*, 19.

39 Ibid.

40 Ibid.

how high prices were experienced in the early modern period. Because they are chronologically structured, they provide insight into the availability and distribution of food during periods of dearth.[41] But I argue that chronicles can also play a role in exploring patterns of thought. When the entries of chroniclers about dearth are examined, it is possible to see how they attempted to map out the causes and consequences of dearth. Systematically gathering prices and linking them to various factors went beyond the mere collection of information. It also resulted in the production of knowledge for future use.

In what follows, we will examine how and when a selection of chroniclers wrote about high prices. This discussion will focus primarily on the social profiles of the authors and the extent to which the explanation of high prices changed between 1500 and 1850. As will become apparent, I will argue that the point of writing about dearth was not just to record it for posterity. Rather, the recording of prices also served the purpose of acquiring understanding of what happened. Data were gathered to find patterns that might help to anticipate what was to come.

Collecting and Reasoning with Prices

Reading an Early Modern Chronicle

To show how chroniclers used their chronicle to collect information and started to reason with it, this chapter will take a closer look at some of the many authors who recorded high prices. The first of these is the chaplain Christiaan Munters (c. 1505-55) from Kuringen (near Hasselt), who maintained a chronicle from 1530 until 1545 in which he covered mainly events from the region Hasselt, Maastricht and Liège, but also wrote about international developments. Having kept a chronicle for eight years, in 1538 Munters started recording grain prices along with various other events. At first glance, it is not immediately clear why he started noting these prices, and how he used them. Yet when we see how the various prices are placed in sequence, a pattern unfolds that provides insight into the role that grain prices played in early modern chronicles. To make this visible, I have transcribed six pages from Munters's chronicle, in which I have highlighted the entries where he recorded or reflected on grain prices.[42]

41 Mukherjee, 'Introduction: A Cultural History of Famine'; Mukherjee, 'Famine Chorography'.

42 For the original transcription see Appendix 4. Christiaan Munters, *Dagboek van gebeurtenissen opgetekend door Christiaan Munters, 1529-1545*, ed. Jozef Grauwels (Assen, 1972), 95–98.

fol. 80 [recto]
20th September, a Friday during the Ember Days: one of my gracious lords servant had a kidney stone removed by a master from Liège in Jan Beckers' house in Kuringen. I held the [kidney] stone in my hand; it was as big as a small bean, and the boy died from this. I had administered the sacraments to him.

22nd September:
On the day of the fair Hasselt day, the little house of Bethlehem in Hasselt was robbed by two or three thieves. One of them was captured.

24th September:
At the new market in Hasselt the corn cost 11 st[ivers].

25th September:
In Hasselt, a man from Bree suddenly died after falling from his bed. He was found in the morning lying on his head and he was dead; he had gone to sleep drunk.

fol. 80 verso
27th September:
Corn cost 12 st[ivers] in Hasselt.

29th September:
My lord of Liège shot three times with a longbow in the mountains of Kuringen and then went to dine at Lenarts of Herkenrode.

1st October:
On a Tuesday, my lord of Bueren left Kuringen with Lady Mari to visit the King of France with 1500 horses.

Sint-Truiden
7th October, a Monday: Our most gracious Bishop of Liège, Sir Cornelis van Sevenbergen, was received by [the representatives of the city] Sint-Truiden, and during my lord's entrance, my lord scattered money, as it is an imperial city.[43] Additionally, those from Sint-Truiden presented my lord with a cask of wine of four *aams*, each *aam* costing twenty Brabant guilders.

Borgloon and Tongeren
9th October, on Saint Dionysius' Day: [the representatives of the city] Borgloon and Tongeren received my lord of Liège. Those from Tongeren had made seven hills at the market [square], namely Mount Zion, Mount Tabor, Mount Calvary, and those of Tongeren praised my lord greatly.

fol. 81 [recto]
Huy

10th October:
[The representatives of Huy] received our gracious lord.
The King of France showed great hospitality and affection to Lady Mari, my lord of Bueren, and my lord of Esselsteyn, receiving them with great love

43 Cornelis van Bergen or Corneille of Berghes was Prince-Bishop of Liège from 1538 to 1544. We read in the entries below about the Joyous Entry [*Blijde inkomst*] into several cities of the new prince-bishop.

and triumph. This visit cost the King of France 430,000 ducats daily, and it lasted 25 days.

13th October:
On a Sunday, someone was stabbed in Zuylre.

22nd October:
Corn cost 13 st[ivers] and 1 ort in Hasselt.

fol. 81 verso
12th November:
Corn cost 14 st[ivers] and 1 ort in Hasselt.
On the aforementioned day, the stadtholder of Diepenbeek stabbed a man who had the bastard daughter of the lord of Gavere, and he was the principal stadtholder; both were on horseback.

Item. This week in Diepenbeek, a servant died who had been beaten so hard by his mother that he died of it, and his sister helped him. This happened because of a pig, the servant deceived his mother and sister in his death.

This week near Antwerp, someone from Borgloon fell dead from his horse.

In Hesbaye [Haspengouw], during this sowing time, there were so many mice that the men of the corn had to carry water in wagons to the fields to drown the mice, and the mice had eaten so much of the grain from the fields that nothing was left.

fol. 82 [recto]
Maaseik
17th November, a Sunday: [the representatives of Maaseik], received our gracious lord and those from Maaseik were greatly honoured by my lord's grace.

On the aforementioned day, someone was stabbed in Tongeren.

fol. 82 verso
Bree
8th December, the feast of the Immaculate Conception of the Blessed Virgin Mary, which was a Sunday, [the representatives of] Bree received our most gracious lord.

The eastern grain
In this month of December, a lot of eastern grain arrived in the land of Liège, which the people were very pleased about, as the grain from the land of Liège was very difficult to obtain due to the period of dearth

These six pages from Munters's chronicle cover the period from 20 September to December 1538. The information he recorded is characteristic for a sixteenth-century chronicle, consisting of a combination of political and local news.[44] It ranges from the removal of kidney stones, a burglary in Hasselt during the fair, the death of a drunken man who fell out of his bed, the Joyous Entry of the Prince-Bishop of Liège and a visit from the lord of Bueren to King Francis I of France (1494-1547). In addition to these 'notable' and 'memorable' events, Munters also recorded four grain prices from the market in Hasselt. Twice in September with an increase of 9 per cent, after which the price of grain presumably remained stable until the next entry on 22 October. Compared to a month earlier, the price rose again by more than one stiver, followed by a new increase three weeks later. What caused this 30 per cent price increase in one and a half months becomes clear on 12 November.

On that day, news reached Munters from Hesbaye (Haspengouw) that a mouse infestation had left little locally grown grain available. Farmers flooded their fields to drown the mice, bringing grain production to a halt.[45] This meant that farmers lost their winter grain that was sown in the late summer and autumn and could be harvested around the start of the next summer period. This could lead to dearth in the following year, and price increases in 1538.[46] To compensate for the lost harvest, grain had to be imported. Yet, the arrival of grain by ship through the river Maas took some time in the early modern period, which meant that in the meantime prices increased. Relieved, Munters wrote that the market recovered in December when a significant amount of eastern grain arrived in the land of Liège.[47] After this entry, Munters stopped recording grain prices.

Judging by the structure and content of Munters's chronicle, he recorded entries sometimes daily and often weekly without drawing conclusions immediately. This suggests that this chronicle was written at the time itself, and not in retrospect. Moreover, the grain prices were not recorded at random. Although Munters did not reflect on the prices he wrote down, it is noteworthy that he recorded prices only when they increased significantly. Initially Munters may not have known what caused the significant price increase, because he did not reflect on it until 12 November. Yet once having noted the price increases, he may have been looking for information that could help him understand why they happened, but his chronicle does not give any indications in this respect.

44 For the dominant topics in early modern chronicles see: Lassche, 'Information Dynamics', chap. 5.
45 Munters, *Dagboek van gebeurtenissen*, 98.
46 Grain prices in Flanders were higher in 1538 than in the preceding and following years. For more information see: Scholliers, *De levensstandaard in de XVe en XVIe eeuw te Antwerpen*, 8, 240.
47 Munters, *Dagboek van gebeurtenissen*, 98.

In order to judge how common the reasoning behind Munters's observations was we need to look at chroniclers who reflected more extensively on this process. This will give us a better understanding of how chroniclers collected prices and information and how they reasoned with it. It will become clear that the example in Munters's chronicle is relatively straightforward. He explained the high grain prices on the basis of a single cause: the mouse infestation. In most cases, we see chroniclers reason with more variables, but the pattern of collecting prices and information, subsequently drawing conclusions from them, is similar.

'The Talk of the Town': The Price of Grain

In a chronicle written two centuries later we can see more clearly what shaped a chronicler's thinking. The Reformed minister's wife and farmer Aleida Leurink (1682-1755) from the village of Losser (near Enschede) maintained a chronicle from 1698 until 1754.[48] Especially in periods of uncertainty, she kept notes on a daily basis, as during one of the coldest winters of the eighteenth century.[49] In the autumn of 1739, she began to systematically note prices of goods, which coincided with a period of dearth until 1741. How Leurink did this and which patterns she subsequently observed will be discussed using the following entries from her chronicle.

On 11 October 1739, Leurink wrote that she heard from an acquaintance that his servant reported that a measure of rye cost 26 stivers at the market in Oldenzaal (8 kilometers away) and that the servant expected that it would increase up to 30 stivers. Another acquaintance, called Roterman, to whom she spoke, said that a farmer from Enschede offered him 27 stivers a measure in his home, and that the price of rye in Munster had already reached 30 stivers. A few days later, on 16 October, two other people visited her house in the evening with the news that the price of rye in Oldenzaal and Deventer (66 kilometers away) was, respectively, 26 and 24 stivers.[50]

From the literature we know that in the early eighteenth century the average price of a unit of rye was around 15 stivers. This could fluctuate, but it did not often exceed 20 stivers.[51] This explains why Leurink started collecting information on grain prices more frequently and in a systematic way when it crossed the 20 stivers' mark. It is evident from the recorded conversations in Leurink's chronicle that the rising grain prices

48 Aleida Leurink, *Tot Losser gekomen. Het notitieboek van Aleida Leurink 1698-1754*, ed. Maria Leonie Hansen (Epe, 2009).

49 De Vries, *The Price of Bread*, 468–69.

50 Leurink, *Tot Losser gekomen*, 48.

51 For more information on the price of rye west and east part of the Netherlands from 1550 to 1854, see: De Vries, *The Price of Bread*, 346; For literature on on rye and wheat prices in the entire Low Countries from 1400 to 1800, see: R.W. Unger, 'Integration of Baltic and Low Countries Grain Markets, 1400-1800', in *The Interactions of Amsterdam and Antwerp with the Baltic Region, 1400-1800: De Nederlanden En Het Ostzeegebied, 1400-1800*, ed. W.J. Wieringa et al., 16 (Leiden, 1983), 3.

became the talk of the town.[52] Through a social network of family members, villagers, and acquaintances, the grain prices of neighbouring towns were shared and compared with each other. This happened at the kitchen table and through other channels. On 5 March 1740, for example, Leurink wrote that: 'Verbekke was here with a letter from her sister. Rye cost 33 st[ivers] in Deventer.'[53] A few days later, Leurink recorded that the price of one *last* [3010 litres] of rye in Amsterdam cost 113 gold guilders. This was information that she derived from the newspaper of an acquaintance, printed on 29 February 1740.[54]

News about price developments in the Netherlands spread quickly, reaching even small villages like Losser. Leurink recorded these developments in combination with other information that she considered important. In March 1740, she wrote:

> [...] the high water and long period of rain this spring are causing the earth to be sodden with water and also it is cold. Have had little sunshine, so that the rye grows thinly in the fields. Ditto [on the same day], the yield of straw had decreased by a third compared to previous years, and many carrots did not sprout.[55]

Yields of other vegetables and turnips were also low, which meant that people were forced to slaughter their livestock because they could no longer feed their already malnourished cattle, according to Leurink.[56]

For Leurink, these observations were all indicators that prices would continue to rise in the spring. The cold led to disappointing harvests and higher prices of goods for both humans and animals. Moreover, due to the high prices and cold, there was low demand for manufactured products, which caused unemployment among a part of the population. On 31 May, the price of grain reached 58 stivers, leading Leurink to doubt whether one good harvest could compensate for it.[57] On 13 August 1740, around harvest time, Leurink wrote that she was 'sad for the poor who had no money to buy the expensive rye'.[58]

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52 Chroniclers often wrote that during periods of dearth, grain prices were the main topic of conversation. For example: 'Als er menssen byeen komen, dan was het eerste woord van den hongersnood en de duerte van het brood.' Lambertus Goofers, *Chroniek der stad Weert van 1784 tot 1802, geschreven door den ooggetuige Lambertus Goofers/bezorgd door Jos. Habets*, ed. Jos Habets, Overdruk uit Publications Limbourg 25 (1888) (Weert, 2004), 401.

53 '[...] Verbekke hier was met een brief van haer suster. rogge daer 33 st Deventer kost.' Leurink, *Tot Losser gekomen*, 51.

54 Ibid.

55 '[...] door al het hooge water en langdurigen regen dit voor jaer het aerdrijk altijd swemmet int water en koud daer bij was. weijnig sonneschijn gehad daer door de roggedunne op het land stond. dito wel 1/3 part minder stroo op was als de vorige jaren, veele wortlen bedden niet.' Ibid.

56 Ibid., 51–52, 57.

57 Ibid., 53.

58 '[...] bedroeft voor de arme menschen die geen gelt hebben om de duere rogge te konnen kopen.' Ibid.

In the following months, the situation only became more critical. She read in a newspaper that there was dearth in other countries as well. In combination with the price increase at various markets, she interpreted this as a bad omen. On 10 December, rye reached the price of 42 stivers in Oldenzaal, and, according to a letter from her daughter, five days later, it increased to 50 stivers in Enschede. This tripling of grain prices must have had significant consequences during the winter of 1740, but two months later good news arrived. At the end of February 1741, Leurink had heard that the new crops seemed to be doing well in several areas, and (the expectation of) large harvests of barley, oat, buckwheat, peas, and beans resulted in the price of rye dropping from 41 to 28 stivers a measure.[59] In the period that followed, grain prices returned to their 'normal' level, after which Leurink stopped recording prices in a frequent and systematic manner.

Although Leurink occasionally noted prices throughout her chronicle, they were systematically recorded only when they increased more than expected. In this period of systematic price recording, which lasted just over a year, Leurink noted an explicit link between cold weather, little sunshine, and an expected disappointing harvest. According to her, the cold led to a rise in food prices, and a decrease in employment opportunities. She monitored grain prices both locally and abroad, from which she concluded, among other things, that rising grain prices at the beginning of winter were a bad sign. Only after the reports indicated that the crops in various places were flourishing did the prices drop, after which the new harvests ensured that the prices stabilised.

Although Leurink was quicker than Munters to make explicit connections between the various factors that influenced dearth, we see similarities in the way both chroniclers structured their information and how they reasoned with it. In Leurink's chronicle we see more concretely that contemporaries talked about high prices and how they gathered information to explain, predict and likely anticipate fluctuating prices. Some of the variables they reasoned with were related to natural phenomena and supply and demand in the (international) grain trade that we know from the historical literature. Yet the chronicles offer striking evidence of how such variables became topics of conversation and of record-keeping.

Leurink and Munters, both villagers and without any professional knowledge of economic or political affairs, were writing as consumers. As such they represent the majority of chroniclers and presumably of others in their society, who equally would be eager to anticipate the future behaviour of food prices. Yet, some of our chroniclers were professionally involved with the grain trade, or involved in the political supervision of markets, the collecting of excises, or active in urban public roles concerned with the local economy. In the next section we will examine chroniclers who professionally dealt with (grain) prices on a daily basis, to compare them with the reasoning of chroniclers without expertise in this area.

59 Ibid., 57.

Chronicling Prices from the Perspective of 'Experts'

Weather and War: Predicting grain prices in 1580s Ypres

One of the chroniclers who regularly recorded periods of dearth from an expert point of view was the Catholic corn inspector Augustyn van Hernighem (c.1540-c.1617) from Ypres. Van Hernighem's chronicle covers the period 1562 to 1595, years marked by religious upheaval and the violence of the Dutch Revolt, and was divided into seven volumes. Van Hernighem recorded grain and butter prices almost exclusively in periods of dearth, and did so on a monthly and often a weekly basis. In years of dearth, these were the main topics he discussed in his chronicle.

Although the entire period covered by Van Hernighem was economically stressful, especially during the cold winters, I will here focus on the period of dearth in 1585-87. Ypres had been a Calvinist Republic from 1579 until April 1584 when Alexander Farnese, Duke of Parma (1545-82) reconquered the city after a long siege from August 1583 until April 1584. A year later, in August 1585 Antwerp also fell, and the river Scheldt was blocked by the rebel fleet, obstructing the grain trade from the port of Antwerp.[60]

In May 1585, Van Hernighem wrote that there had been no disease [pestilence] for a long time and that the land was cheap, however, 'grain was expensive. It cost 8 guilders per *raziere* [121 litre] and butter 8 g[uilders].'[61] At this point, grain prices had more than doubled since the previous year, and grain prices in 1586 and 1587 were to reach their highest point in four centuries.[62] Van Hernighem continued by describing that there was hardly any employment, both in the city of Ypres and the towns around it while, in addition, there was a huge tax burden. The high unemployment and the high prices of grain were the result of war and the various sieges that took place in Flanders. However, he could not explain why the price increased a month later. On 17 June 1585 he wrote: 'at this time, grain became very expensive, and nobody knew what caused it. The price was more than X gulden per *raziere* and everywhere there was little work and not a stiver to earn.'[63]

In the weeks that followed, an explanation emerged. Hernighem's entries on prices were now made in connection with military developments, with a particular focus on the city of Antwerp, which fell into the hands of Farnese on 17 August 1585. On that

60 For the impact of the Fall of Antwerp on grain prices in the Southern Netherlands, see: Scholliers, 'De Eerste Schade van de Scheiding', 42–46.

61 '[...] maer tcoorne was noch diere tgalt noch 8 guldens de raziere de bueter 8 g. [...]' Augustyn van Hernighem, 'Kroniek van Vlaanderen en Brabant. 4: 1584-1587', Universiteitsbibliotheek Gent, Boekentoren, BHSL. HS.3700, 60.

62 Scholliers, *De levensstandaard in de XVe en XVIe eeuw te Antwerpen*, 8; Scholliers, 'De Eerste Schade van de Scheiding', 44.

63 '[...] ende op desen tyt zoo diersde het coorne zeere niemaent en wijsts waer van zoo dat gaelt meer dan X guldens de raziere alzoo wast over al groote crancke neerynghe want over al zoo en wasser niet eenen stuver te winnen [...].' Van Hernighem, 'Kroniek van Vlaanderen en Brabant. 4: 1584-1587', 68.

day, grain prices skyrocketed after several reports came from Antwerp about which city would be besieged next.[64] Since the river Scheldt was blocked, more grain had to be imported via Ostend, Dunkirk, Calais, or Northern France. In the case of the latter, it had to be transported up the river Lys to Warneton; from there it was taken by road to Ypres, less than 15 kilometres away.[65]

Van Hernighem kept a close eye on both political developments and changes in the weather. As early as July bad weather had caused fears of even higher grain prices. Van Hernighem wrote: 'At this time, it was the poor summer that caused fear that the crops would not ripen well.'[66] These fears became reality. The bad weather further pushed up grain prices after six weeks of rain, and harvesting could take place only from early September. On the 14th, after two weeks of good weather that enabled farmers to harvest, Van Hernighem wrote: 'On this day, a Saturday, grain became a little cheaper, but not very much. As a result, people feared they would have to eat expensive grains for the whole year. Praise be to God.'[67]

In the entries from 1585, we can see how Van Hernighem reasoned with various variables. When the weather was cold and wet during the summer months, he also expressed his expectations for the future that the harvests would be disappointing. In addition, he observed other patterns and reflected on the consequences of high prices. Cold winters and sieges resulted in less work and trade, which in combination with high prices caused a highly precarious situation, especially for the poor.[68] These factors continued to play an important role in subsequent years, but a new variable was added in Van Hernighem's entries on the years 1586 and 1587.

After the disappointing harvests and the disrupted grain supply line via the Scheldt, new ways were needed to import grain and compensate for local shortages. On 26 May 1586 Van Hernighem wrote about a meeting of the city council concerning ways to supply the city and to purchase grain. Because grain from Lille and Artois could not be purchased in advance, the city council of Ypres sent a delegation to the latter city to import grain via the river Lys.[69] Consequently, Van Hernighem recorded in June how much the price of grain dropped when ships with grain arrived in Ypres, and four more in Calais from New Castle (England).[70]

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64 Ibid., 81–82.

65 J. E. C. Dijkman, 'Medieval Market Institutions: The Organisation of Commodity Markets in Holland, c. 1200 - c. 1450' (2010), 140–41; Baetens, 'De Zuidelijke Nederlanden En de Handel Op de Baltische Ruimte (17e Eeuw)', 61.

66 'Op desen tyt zoo wast zoo wack een zoomare datmen vreesde dat de vrucht niet wel rypen [...].' Van Hernighem, 'Kroniek van Vlaanderen en Brabant. 4: 1584-1587', 73.

67 'Op desen dach zaterdach zynde zoo sloucht coorne wat af maer niet zeere veele zoo datmen vreesde dat men zoude diere coorne eten het gansche Jaer god betert.' Ibid., 87.

68 Ibid., 120.

69 Ibid., 136.

70 Ibid., 146.

As Ypres became more dependent on the supply of grain via the North Sea, this also meant that the weather became an even more important factor. In this period, Van Hernighem also began noting wind directions and drew conclusions from them. On 18 November 1586, he wrote that 'many ships with grain would arrive from the Eastland [Baltic] in Dunkirk and Calais, as the wind had been easterly for a long time.'[71]

Eleven days later, on 29 November, the grain price dropped because several ships had arrived at Calais. Concurrently, Van Hernighem wrote that the weather became extraordinarily cold, causing the waterways to freeze and preventing ships from sailing. It led to great fear that the frosts would persist, which in turn would cause prices to rise again.[72] This was exactly what happened. The price of grain had been 17 guilders per *raziere* after the Fall of Antwerp, and it increased to 22 guilders in January 1587. At that time, the expected ships with grain had reached Bruges, but the frost prevented them from reaching Ypres, according to Van Hernighem.[73]

As grains became more expensive, Van Hernighem also began to record the price of legumes such as broad beans (*Vicia faba*), which were being eaten more frequently.[74] Through better weather, the arrival of grain ships, and a good harvest in 1587, the prices dropped and stabilised, after which Van Hernighem stopped keeping track of prices for several months.

Looking back on the period of high prices in the first half of 1587, he made a comparison with the period of dearth in 1556. Although the cold winter of 1586 to 1587 limited the supply of grain, there were no acute shortages as in 1556. In that year there had been really no grain for sale and even then, the prices were not as high as in 1586-87.[75] Van Hernighem interpreted the plague of dearth in 1586-87, as a 'deserved' punishment from God because 'the hearts of people were so hardened'.[76] The wars and their consequences were widely seen as a punishment from God as observed by other historians.[77] Yet, Van Hernighem also singled out the traders who profited from high grain prices instead of caring for fellow humans. These were the people who refused to atone, and let others suffer.

71 '[...] veele schepen mit Coorne uut oostlant tot duunckercke ende Cales arryveeren zoude want de wint hadde Langhe oost ghestaen.' Ibid., 189.

72 Ibid., 190.

73 Ibid., 199.

74 'parde boonen' or 'paerde boonen'. Van Hernighem, 'Kroniek van Vlaanderen en Brabant. 4: 1584-1587'.

75 The dearth in the period of 1556-57 was severe, but the dearth of 1586-87 was more extreme. Therefore, the comparison made by Van Hernighem here is not accurate. Scholliers, 'De Eerste Schade van de Scheiding', 44; Scholliers, *De levensstandaard in de XVe en XVIe eeuw te Antwerpen*, 12.

76 '[...] de herten van menschen zoo verhart waeren [...].' Van Hernighem, 'Kroniek van Vlaanderen en Brabant. 4: 1584-1587', 217.

77 Judith Pollmann, *Catholic Identity and the Revolt of the Netherlands, 1520-1635* (Oxford, 2011), 57–59, 92, 153–58.

Van Hernighem's chronicle gives us clear insight into the way he selected and used information to anticipate a period of dearth. The increasing grain prices in 1585 were the first indicator, even though he did not yet know the exact cause. By following his price recordings, we can chart Van Hernighem's line of thought and see that he closely followed the military developments in Flanders, as well as the meteorological conditions that would have a direct impact on the grain harvests. When grain import over sea became an important factor, wind directions and information from coastal areas were collected to stay informed about when ships arrived, and grain prices would fall. This information, in relation to fluctuating grain prices, enabled Van Hernighem to examine which factors influenced price developments.

The high level of detail in which he described how the various factors interacted can be explained by his knowledge of the market as a corn inspector. This allowed him to express expectations about future grain prices that usually came true. That Van Hernighem thought about dearth in this way, and tried to explain it based on how different factors influenced each other, is perhaps not very surprising. However, it is significant that he used his chronicle to systematically note prices during periods of dearth. This practice was therefore not limited to 'non-experts' but conducted by chroniclers regardless of their professional and socio-economic background. It provides insight into how they thought, and the patterns they identified in such situations.

From Patterns to Principles: Price Fluctuations in Ghent from 1661-68

An expert chronicler who is even more explicit in the way he used his chronicle to collect prices of grain and other information and consequently used it to reason with it is the seventeenth-century official Justus Billet from Ghent, whom we will now look at in more detail. The Catholic chronicler Justus Billet (1593-1682) held various remunerated positions in Ghent's city government, including those of alderman and treasurer, but during his role as 'police officer', he was charged with overseeing public works and reporting events in public space. This resulted in a ‘chronicle’ of twelve volumes entitled *Polytye boeck* for the period 1658 until 1668 in which events in Ghent were recorded on a weekly and sometimes even daily basis.[78] The period of dearth from 1661 until 1663 was covered in great detail by Billet, after which he continued to record grain prices on a weekly basis until 1668.

78 In addition to these twelve volumes, he also wrote another chronicle consisting of six volumes which he started around 1630.

His entries started on 9 September 1661, and as winter neared, grain prices became the most important topic in eleven of the twelve volumes of his chronicle.[79] In the first instance, Billet, like Van Hernighem, did not record, and perhaps did not know what caused the price increase. He only heard a rumour from the people working in the fields that there was a low supply, and that grain prices started to increase.[80] What followed were records of the weekly prices of rye, wheat, buckwheat, and oat, which were set at the market every Friday. Even when he was not able to go to market himself, Billet asked someone to go for him. He did so until 1668.[81] The result is presented in *Appendix 5* and his records of the price of rye are visualised in *Figure 8*.[82]

I have chosen to present Billet's records of the price of rye because he recorded rye prices almost every week, and because rye provided the most caloric intake among the population. The graph shows how extreme the price increase was at the end of 1661 and how relatively stable the prices were from 1664 onwards. According to various historians, the price increase in 1661 was the result of a total prohibition on grain export, due to crop failures in Danzig (Gdańsk).[83] Yet, in Billet's chronicle, we can read what contemporaries believed to be the cause of the price increase. A combination of natural factors played an important role, but according to Billet, the dearth was ultimately 'man-made'.[84] How did he arrive at this conclusion?

79 This statement concerns the contemporary parts of his chronicle. The twelve volumes of Billet's chronicle mostly cover a historical section and a contemporary section.

80 'Den jxen September 1661 soo was de graen-marct niet zeer abondant, want met het wercken van het Landtvock In het veldt, ende dat den roup vanden opslach begonst te loopen onder het volck, soo golt, ende wierdt vercocht.' Justus Billet, 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 2', Stadsarchief Gent, Bibliotheek 1LF2 en lGDl, 529 (C. Handschriften), fol. 134 verso.

81 'Vrijdagh den 22en desember 1662, alzoo Ick niet wel te passe en was ende geincommodeert van een Cortse soo en conde ick mijn ordinnaire Functie niet doen ofte Continueren in mijn debvoiren maer evenwel vut Curieusheidt ende om te weten wat datter passeerde op den Coorenaert inden prijsvande graenen soo sondt ick mijn volck daerwaerts om hun t'informeeren wat daer inde quantiteijt prijs, ende qualiteijt al passeerde, die mij raporterden dat de marct Cleine was ende datter Luttel graenen.' Billet, 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 3', fol. 66 verso.

82 Due to a missing volume of Billet chronicle, there is no data for the period between September 1661 and January 1662.

83 De Vries, *The Price of Bread*, 464.

84 '[...] een ghemaeckte dierte was.' Billet, 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 2', fol. 134 verso.

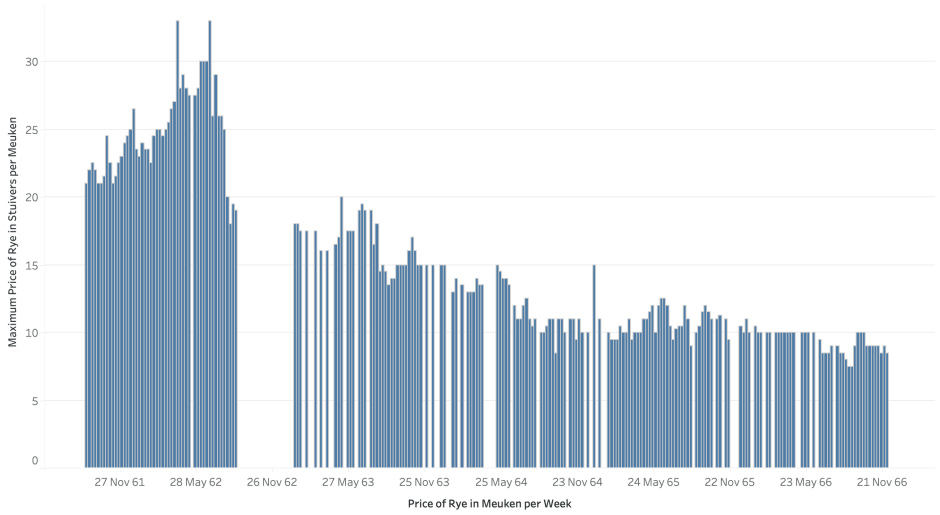

Figure 8. The weekly price of rye in stivers per meuken as recorded by Justus Billet from 1661-66.[85]

Studying *Figure 8*, it seems that at the time Billet started recording prices, in the late summer of 1661, the price of rye was already twice as high as normal at that time. Normally, the price of rye fluctuated between 7,5 and 12 stivers per *meuken* [2.2 litres] as was to be again the case from 1664 to 1666.[86]

In the first couple of weeks when Billet recorded grain prices, he only noted the increase without any reflections. On 29 October 1661, however, he reflected on the current price of rye. It had increased by three stivers compared to the previous week, which was 'a significant increase for the poor'.[87] Fortunately, on 11 November 1661, there was an unexpected and abundant supply of grain on the market, which made the price drop. Consequently, chaos arose on the streets of Ghent as people massively bought up grain and started hoarding. Billet wrote, 'the great multitude of wagons [...] could not move forward, nor backward until the market closed. It gave hope that the dearth might become less'.[88]

In the following weeks, prices started to increase again. This lasted until 7 January 1662, when Billet described how it rained all day and there was a large supply of grain on the market. He wrote 'Initially, the grains remained standing until two o'clock, as

85 Billet, 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 2-12.

86 A meuken was approximately 2,2 litres, see: Eline Van Onacker, 'Social Vulnerability, Social Structures and Household Grain Shortages in Sixteenth-Century Inland Flanders', *Continuity and Change* 34, no. 01 (May 2019): 105; See also: Verlinden, Craeybeckx, and Coppejans-Desmedt, *Dokumenten voor de geschiedenis van prijzen en lonen in Vlaanderen en Brabant* (1965).

87 '[...] voor de Aerme menschen een groote rijsinghe is.' Billet, 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 2', fol. 135 verso.

88 '[...] de groote menichte van waeghens [...] noch vooren noch achter en conden rijden, tot dat de marcten alf waeren gedaen; dat hope gaf van verminderijnghe van Dierte.' Ibid.

the bakers were not very eager to buy. This led to a subsequent drop in prices, both for wheat and rye, by about two or three stivers per *meuken*'.[89] Such weekly observations for a period of six months resulted in an overview of 'signs' that could explain the increase or decrease of grain prices.

In April 1662, he noted down a list of six '*juditien ende presagien van meerder dierte*', or 'signs' that could predict dearth.[90] First, when the price of grain in rural markets increased. Second, when the price of peas and legumes rose – the cheaper food products consumed by those unemployed. Third, when there were no expectations that grain from Douai [located at the river Scarpe] would be transported to Ghent during periods of dearth in France. Fourth, when unexpected dearth occurred in the Dutch Republic, England, or Portugal, as Baltic grain would then be sold and unloaded in Amsterdam at a high price. Fifth, when clergy from monasteries came to the markets to purchase grain. According to Billet, they visited the market only when their own supplies were depleted. Finally, when there was an increase in poverty in other regions, evident from an influx of beggars and vagabonds in churches and on the streets.[91]

The following month, in May, Billet also provided a list of 'precise signs that forebode a decrease in grain prices', see *Figure 9*.[92] First, the weather was favourable for rye growth. Second, there was 'a lack of interest from citizens and bakers in buying grain', which referred to the entry from 7 January 1662 that we discussed above. Third, when grain merchants themselves requested to market grain. Fourth, when clergy refrained from visiting the market. Fifth, when granaries were fully stocked. Finally, when the revenue from the harvest was higher than expected.[93]

89 'Int eerste de graenen bleven staene tot ontrent den twee uren, alsoo de Backers niet seer hongerichen waeren, ende niet veel en cochten waer uijt den afslacht volghdeghe soo op de Tarwe als op den Rogghe, ende dat wel van twee stuivers ofte drij stuijvers op het meuken [...].' Ibid., fol. 96 recto.

90 Billet, 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 3', fol. 140 verso-141 verso.

91 Ibid., fol. 140 verso-141 verso.

92 'Presaise teeckenen van afslach der Graenen.' Ibid., 145 recto.

93 Ibid., fol. 145 recto.

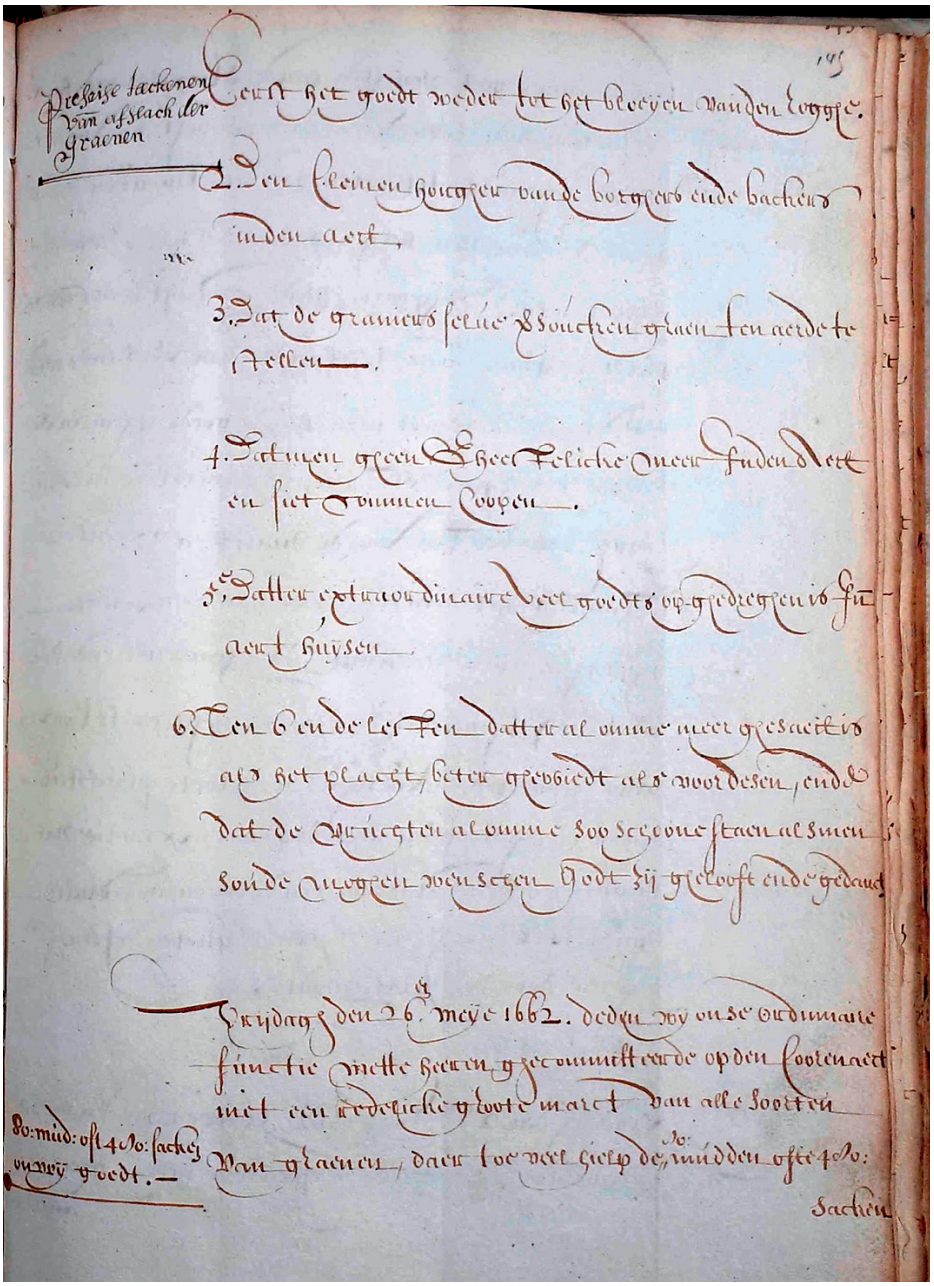

Figure 9. 'Presaise teeckenen van afslach der Graenen'.[94]

94 Ibid.

Billet used these signs as a guideline to make predictions. From May onwards, the grain prices continued to climb, but on 7 July 1662, the prices took a downturn. The day before, Billet recorded that the local authorities had purchased an additional hundred bags of rye beyond the initial order of twelve hundred bags for the poor, out of concern about potential unrest at the market. The next day, the market was overflowing with various types of grain. Although the new rye harvest was still too moist to grind, the price of the previous harvest fell by 24 per cent. The price of wheat saw only a slight decrease because the new harvest of buckwheat and oats was not yet available. Regardless, Billet was already looking ahead, asserting that the 'considerable shift and significant decline [of the price of rye] would hopefully lead to a more pronounced price reduction during the next market for the following reasons'.[95] First, a substantial amount of grain was unsold and returned to the granaries. Second, there was an abundance of crops in the fields and the farmers maintained that it was the most fruitful yield in years. Third, the weather was ideal for harvest: warm and dry. Fourth, fewer impoverished farmers than usual made their way to the city. Fifth, the 'stingy' [*gierighe*] farmers who kept their grain in storage to inflate the price were now bringing their old rye to the market to make space for the incoming harvest. The sixth, and most significant change, was the abundant harvest in the eastern, western, and southern regions of Europe, which reduced the price of grain in Amsterdam.[96] As a result, 'God has been merciful for all countries, and provided his blessing for unbelievers and Christians alike.'[97]

On 7 July, Billet could not have known that his expectations would be fulfilled, but indeed the prices plunged even further a month later, on 11 August 1662. This was largely due to the abundant new harvest of wheat and rye, as he had predicted a month earlier. Billet's analytical skills did not go unnoticed. Six months later, on 21 February 1663, Billet was summoned by the 'college of aldermen' [*college van schepenen van de keuren*]. Pensionary Vande Vijvere 'asked me [Billet], what I believed was the cause of the scarcity and dearth of fresh sea fish in Ghent, and what could be done to remedy it.'[98] Billet answered that 'dearth was caused by scarcity, and scarcity was caused by a low catch due to the long and cold period of frost. Dearth was common, also in Holland and

95 '[...] dese Considerable veranderijnghe ende merckelicken afslach die wij hoopen toecommenden martdagh noch meerder sal wesen, om de naervolgende redenen.' Ibid., fol. 150 recto.

96 Ibid., fol. 150 recto-verso.

97 '[... om te Concludeeren] Godt over alle landen seer liberael heeft gheweest, ende zijnen seghen soowel aen d'ongeloovige als ande Cristen heeft gegeven.' Ibid., fol. 151 recto.

98 '[...] die deden vraeghen [door den heer Pensionnaris vande Vijvere], om wat reden ofte Cause dat ick Jugierde, dat den vesschen zeevis al hier binnen Ghendt soo schaers ende diere was, ende wat men saude connen oft moghen doen, om daer in te remedieren.' Justus Billet, 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 4', Stadsarchief Gent, Bibliotheek 1LF2 en lGDl, 529 (C. Handschriften), fol. 4 recto.

Zeeland, similar to the situation in Antwerp and Brussels.'[99] Furthermore, dearth was caused by the large stocks that were accumulated by the monasteries, and there were many around Ghent. But the main reason was that the fishing vessels were frozen in, and therefore could not set sail, according to Billet.[100] After the magistrate heard what Billet had to say, he was invited to a gathering the next day to elaborate on the causes and consequences of the matter.[101]

After an extended deliberation, it turned out that the local authorities 'could not provide any clear reasons why the fresh sea fish remained so expensive.'[102] They believed that the long period of frost resulted in a low supply of fresh fish and consequently the price of pickled fish increased. While a limited supply caused prices to rise, the magistrates wanted to know why the supply was so limited and which factors influenced this. Yet, this case was too difficult to solve during this gathering, so they extended their inquiry. Two days later Billet presented his 'points and reasons of knowledge/science' (*poincten ende reden van wetenschap*), based on 'exact and careful research' (*exact ende neeirstigh ondersoeck*).[103] Billet's 'exact and careful research' was grounded in the insights of '*geexperimenteerde persoonen*' or 'experts' – individuals with knowledge of sea trade and the fishing of cod and salmon.[104] To dissect the complex 'knot' of events that interacted in causing dearth, Billet again assembled a list of factors contributing to the scarcity of fish.

First, this winter had seen more storms compared to the previous one. In addition, the long and severe frost had made it impossible for the fishing boats to set sail and the ice was too thick for the use of fishing nets. Second, in England, King Charles II (1630-85) had enforced a prohibition on meat during the fasting period, that resulted in an increased demand for fish. Third, the fish catches off the coasts of Nieuwpoort, Oostende, and Blankenberge were disappointing. The previous year's catches had been exceptional, but this year the fish must have been deep in the sea because of the cold. Fourth, there was a shortage of herbs and vegetables, which led to an increase in demand for fish and therefore the price rose. The final reason was inflation. All food products had become more expensive, especially due to disruptions of supply lines caused by the frozen waters.[105] However, not everyone experienced these consequences to the same degree. In Zeeland, Billet wrote, they actually benefited from the scarcity. They were

99 'Ick gaf voor Antwoorde dat ick meende dat de dierte procedeerde uijtte schaersheit, Ende de schaersheit uitte cleine vanck door het quaet caut weder ende lange vorst, waer door de dierte generael was, Jae selve in hollandt ende zeelandt, ende dat om ghelijcke reden tot Antwerpen, ende Bruissel.' Ibid.

100 Ibid., fol. 4 verso.

101 Ibid., fol. 4 verso-5 recto.

102 '[...] zoo en vonden wij gheen Notable ofte merckelicke reden waerom den selven verschen zeevisch soo diere was ende bleef.' Ibid., fol. 5 recto.

103 'Poincten ende reden van wetenschap [...] exact ende neeirstigh ondersoeck.' Ibid., fol. 7 recto.

104 Ibid.

105 Ibid., fol. 7 verso-9 verso.

able to sell all their supplies at high prices, which ran 'contrary to the common saying that: mussels make the fish turn off' (suggesting that a greater supply typically lowers the prices of similar goods).[106]

Billet had used his chronicle to investigate the causes for price developments. The lessons he learnt by keeping track of grain prices on a weekly basis, combined with a keen eye for other factors that influenced the rise and fall of prices, enabled him to explain price fluctuations of other commodities as well. Every chronicler understood that price fluctuations were caused by the relationship between supply and demand, but Billet went much further in analysing the factors that influenced them. The weather always played a role, but in his time international relations and human actions had a more crucial role, as large cities like Ghent were dependent on the international market for their food supply.

'*Opkoopers*' and '*Opknopers*': Dearth is 'Man-Made'

Non-Experts Chasing Rumours and Immoral Merchants

In the eyes of chroniclers who were not professionally involved in the grain trade, human agency often played an even greater role in explaining dearth. These 'non-expert' chroniclers primarily focussed on the actions of authorities and grain traders, and the 'moral economy' of the grain trade.[107] These chroniclers had less (access to) knowledge about the (international) grain trade, which led to the collection of different information, but they too used their chronicle to draw connections between price movements and other events. Especially in times of political instability and crises such as war, conspiracy theories, speculation, and the search for scapegoats played a significant role.[108] How this group of chroniclers tried to explain dearth and to what extent they included the role of weather and international factors will be discussed by making a comparison between especially sixteenth- and nineteenth-century chroniclers because one might expect the differences to be the most significant between the beginning and the end of the corpus.

The Antwerp painter and Lutheran Godevaert van Haecht (1546-99), drew a clear relationship between food prices in tandem with the behaviour of grain merchants and measures taken by the authorities in the early phase of the Dutch Revolt. Van Haecht began recording prices in the winter of 1564, which was exceptionally cold and followed by a period of dearth.[109] In 1565, the price of rye increased by 55 per cent compared to

106 '[...] oock contraria het gemeen Spreeckwoordt, dat seght de mosselen doen den visslichten.' Ibid., fol. 9 verso.
107 Thompson, 'The Moral Economy of the English Crowd in the Eighteenth Century'.
108 Raymond De Roover, 'The Concept of the Just Price: Theory and Economic Policy', *The Journal of Economic History* 18, no. 4 (1958): 418–34; Persson, *Grain Markets in Europe, 1500–1900*, 68; Van Dixhoorn, 'The Grain Issue of 1565', 176; De Vries, *The Price of Bread*, 9.
109 Godevaert van Haecht, *De kroniek van Godevaert van Haecht over de troebelen van 1565 tot 1574 te Antwerpen en elders*, Uitgaven van het Genootschap voor Antwerpsche Geschiedenis 2 (Antwerpen, 1929), 4.

the year 1564.[110] No one knew at the time that the dearth would continue until 1566, making the situation increasingly dire.

In January 1565, Van Haecht wrote that due to the cold, animals, trees, and people froze to death. In fact, it was so extreme, according to him, that a woman in desperation had bitten off two fingers of a man, allegedly while she was stealing peat.[111] After the winter, the prospects did not get much better. Van Haecht wrote several months before the grain could be harvested, in May 1565, that grain was running short in Antwerp and prices were high, 'the talk was, that there was no more grain in Amsterdam, which is the staple market for grain.'[112] As a result, 'the rumour was that it [grain] would become very expensive.'[113]

Van Haecht, who also closely followed the situation in other cities based on what he 'heard', noted that the situation in Brussels was even worse. A riot broke out in that city because there was no more grain to distribute. This news arrived during the same period when the King of Denmark, Frederick II (1534-88), had closed the Sound to all foreign shipping during the war with Sweden.[114] However, a rumour circulated in Antwerp that Amsterdam traders had paid Frederick II to close the Sound, thereby pushing up prices in a period of dearth.[115]

There were doubts whether the grain supply in Amsterdam had really run out. After all, it was the staple market for grain. Van Haecht described how a merchant from Douai devised a scheme to verify whether there was a grain shortage that justified the high grain prices. This merchant proclaimed: 'give me three or four ships with grain, and I will let the price drop [in Amsterdam].'[116] The merchant sailed to Amsterdam, and offered his grain for sale, for a 'small price'.[117] The Amsterdam grain merchants were surprised, according to Van Haecht. The man from Douai said that he could offer much more for this low price, but the Amsterdam merchants did not want to buy. They wanted to sell at a high price. Van Haecht concluded that the merchant from Douai had shown that there was no scarcity but plenty of grain in the Amsterdam warehouses. A price correction followed after which merchants from Antwerp were able to buy grain at a 'reasonable price' (*redelycken prys*).[118]

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110 The prices were comparable to the dearth year of 1556-57, and less than in 1530–31 and 1545–46. For more information see: Scholliers, *De levensstandaard in de XVe en XVIe eeuw te Antwerpen*, 8, 11.

111 'Daer was tot Antwerpen een vrou die om torf te hebben eenen man 2 vingeren afbete.' Van Haecht, *De kroniek van Godevaert van Haecht*, 5.

112 'En den roep was, dat tot Amsterdam geen coren en was, welck den stapel van het coren is.' Ibid., 7.

113 '[...] en den roep was al, dat het noch seer dier sou worden.' Ibid.

114 Paul Douglas Lockhart, *Denmark, 1513–1660: The Rise and Decline of a Renaissance Monarchy* (Oxford, 2007), 110.

115 Van Haecht, *De kroniek van Godevaert van Haecht*, 8.

116 '[...] 'Vult my 3 oft vier scepen met coren, ick sal't doen afslaen'.' Ibid., 7.

117 '[...] die hy kleyn stelde.' Ibid.

118 Ibid., 7.

The concept of a 'reasonable', or 'just price', is well known in the historical literature.[119] A high price can be acceptable as long as it is justified by factors beyond human action.[120] However, according to chroniclers, merchants often tended to abuse the situation. Van Haecht noted that his contemporaries drew the conclusion that: 'Amsterdam merchants, more than the cold winter, were the true cause of this dearth that emerged everywhere, for they had been buying it [grain] up in all places, here domestically.'[121] The Amsterdam staple was crucial for Antwerp when grain supply from Artois and Picardy fell short.[122] Yet, it was not solely traders from the Holland who were blamed: anyone trying to take advantage of the high prices was publicly scrutinised.

Three months later, in August 1565 prices rose again, both in France and in Antwerp. Van Haecht, who also monitored developments in France, described that the French blamed merchants for stockpiling excessive amounts of grain. In Antwerp this was no different since, 'every merchant wanted to trade in grain, when it became scarce', according to Van Haecht.[123] Because there was also a shortage of flour, due to the lack of wind that slowed down the milling, the Antwerp government took measures. The storage of grain was forbidden, and all houses were inspected for grain. People could keep only a necessary amount of grain and the rest had to be sold at the market.[124] Such government interventions in which grain stocks were inspected, and the price of bread was fixed were common in the early modern period.[125] Chroniclers were well aware of them, but local authorities did not always enforce these measures, causing chroniclers to watch transgressions closely.

In 1565 Antwerp, houses were inspected, and people had to hand over excess grain, however, two days later something unexpected happened which confirmed to Van Haecht that grain traders were acting immorally and causing dearth. In the grain loft of Pauwels van Dale, Lord of Lillo – a rich and famous merchant-banker – a floor collapsed under the weight of grain that was stored there. Immediately, a crowd gathered at his house and smashed his windows. Angry citizens (especially women) asked for justice by bringing with them ordinances published by the authorities that included regulations to prevent abusive practices by merchants. They shouted that it was unfair that dogs had to

119 De Roover, 'The Concept of the Just Price'; Thompson, 'The Moral Economy of the English Crowd in the Eighteenth Century'; Theodore M. 1953- Porter, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (Princeton, 1995); Hanlon, *Early Modern Italy, 1550-1800*; Van Dixhoorn, 'The Grain Issue of 1565'; De Vries, *The Price of Bread*.

120 Hanlon, *Early Modern Italy, 1550-1800*, 101.

121 'Ende hier na hoorde men vuel hoe die van Amsterdam, die meest met coren omgaen, oorsaeck waeren van de dierte, die overal was geresen, meer dan den couden winter; want sy't in alle plaetsen hadden geweest opcocpen, hier binnenslandts.' Van Haecht, *De kroniek van Godevaert van Haecht*, 7.

122 Van Tielhof, 'Grain Provision in Holland, ca. 1490–ca. 1570', 213–16.

123 '[...] elck coopman wilde nou scier met coren handelen nou sy sagen dat de dierte daer in quam.' Van Haecht, *De kroniek van Godevaert van Haecht*, 11.

124 Ibid., 11.

125 De Vries, *The Price of Bread*, chaps 1, 3–4.

be killed at times of dearth while merchants stockpiled grain. According to these women, 'those [grain merchants] whose grain fell on to their neck should be beaten to death.'[126]

This event, described both by Van Haecht and another anonymous chronicler from Antwerp, demonstrates that the riot at Van Dale's house was in the first instance directed at speculators and at the lack of enforcement by the local authorities, and not at the high grain prices as such.[127] Yet although measures were introduced, their enforcement left much to be desired, according to Van Haecht. This applied not only to grain inspections, but also to the fixed prices of bread. On 2 October, the local authorities of Antwerp ordered all bakers to bake bread of seven pounds for two stivers, but most of them only baked bread weighing five pounds. After offering bribes to the authorities, they were not punished.[128]

Meanwhile, the price of grain continued to increase. In November Van Haecht wrote that he was astonished that so many people died. Many people ate corrupted bread, while in Amsterdam all grain warehouses were bulging.[129] However, this grain was not brought to the market by the Amsterdam traders unless they received a high price for it, equivalent to the dearth year of 1557.[130] According to Van Haecht, however, the high prices in 1557 had been more justified, due to the dry summer and cold winter. In 1565, wheat reached the price of 6 guilders on 10 November, and after much commotion the magistrates took action. They ordered local officials again to make an inventory of the amount of grain that was stored in Antwerp, and at the same time, prices dropped in the neighbouring cities of Tienen and Diest.[131]

Except for a few local incidents in November, peace largely returned in December.[132] The prices had been dropping in Antwerp since mid-December, after magistrates of many cities and towns, including Antwerp, attempted to purchase grain in Amsterdam and abroad, in England and Spain. As a result, on 22 December, the city of Antwerp sold grain below the market price of 3 guilders and 2 stivers for 'bad' Baltic grain, and 3 guilders and 6 to 8 stivers for grain from Brabant.[133] After that remark, Van Haecht lost much of his interest in recording prices. The price of grain remained stable until 1572, and Van Haecht's interest shifted to rumours about the introduction of the Spanish Inquisition.[134]

126 '[...] dese [corenbyters] sou men dootslaen, die het coren op den hals valt.' Van Haecht, *De kroniek van Godevaert van Haecht*, 12.

127 Ibid., 11–12; F.G.V., *Antwerpsch chronykje, in het welk zeer veele en elders te vergeefsch gezogte geschiedenissen sedert den jare 1500 tot het jaar 1574 zoo in die toen ... vermaarde koopstad als de andere steden van Nederland*, ed. Frans van Mieris and Gerard van Loon (Leiden, 1743), 65–66.

128 Van Haecht, *De kroniek van Godevaert van Haecht*, 12–13.

129 Ibid., 13.

130 Ibid.; The price for rye was comparable in the two periods. See: Scholliers, *De levensstandaard in de XVe en XVIe eeuw te Antwerpen*, 8.

131 Van Haecht, *De kroniek van Godevaert van Haecht*, 14.

132 Ibid., 13–16.

133 Ibid., 17.

134 Scholliers, *De levensstandaard in de XVe en XVIe eeuw te Antwerpen*, 8.

Most of the criticism of the actions of the authorities comes from chronicles from the Southern Netherlands, regardless of the period. In the late seventeenth-century chronicle of the Catholic official Jacques Inbona (?-1714), we see how critics expressed their views to the city council of Bruges. He wrote: 'On 23 February 1675 between ten and eleven in the morning a letter was posted at the town hall, and no one knew from whom it was.'[135] In the letter, which was directed to the city government, the author complained that the local authorities were not enforcing the restrictions that they had implemented. Because the grain was so expensive, there was a restriction on the distillation of grain. The letter revealed several locations where distillation still took place and where large amounts of grain were stored. According to Inbona and others, 'this was no surprise since the gentlemen of the magistrate were bribed.'[136] The magistrate did eventually inspect the locations mentioned in the letter, but, according to Inbona, they 'found nothing because they did not look at the place where it was hidden.'[137]

In the eighteenth century, we find numerous complaints that penalties for illegal grain trading were not enforced, leading contemporaries to take matters into their own hands. In an anonymous chronicle from Kortrijk, where the cold winter and high prices of 1740 were described, we read that the court at Brussels took measures and prohibited the export of grain from the Southern Netherlands on pain of death. Yet, enforcement of the rules was not so strict, as the chronicler wrote that a grain merchant was caught exporting grain to France and locked up in jail. After showing remorse for his actions, he was freed after paying for all expenses and a fine of 500 guilders.[138]

To judge by such examples, it is not surprising that contemporaries took action when the authorities failed to do so. The same chronicler from Kortrijk noted that contemporaries found out where traders stored their grain, after which they pressured them and the city government to sell the grain locally.[139] In Kortrijk tensions ran so high that on 25 April 1740 a group of citizens demolished the house of a merchant on the Brugstraat.[140] Other merchants were pulled out of their houses and brought to the town hall when the citizens heard that they were selling grain to Holland. The citizens demanded that the merchants be imprisoned. The local authorities of Kortrijk succeeded

135 'Opden 23en februarij 1675 tusschen den thien ende elf uren inden dagh soo wierter voor het stadthuijs gheplackt eenen brief war sonder dater iemandt conde weeten van wien dat het was ghedaen.' Jacques Inbona and Pieter Ledoulx, 'Rare Geschriften Behelsende Het Gedenckweerdighste Dat 'er Is Voorgevallen Binnen de Stadt van Brugghe, 1645-1684 Door Jacques Inbona En Verdergezet Door Pieter Le Doulx Tot 1781 (Met Een Vervolgh Ofte Bijvoughsel)', Rijksarchief Kortrijk, Fonds Goethals-Vercruysse, ms. 175, 331.

136 '[...] dat het gheen wonder en was aenghesien de heeren vant magistraet hun met gelt lieten payen.' Ibid.

137 '[...] wiert niet ghevonden mits sij niet ende ginghen daer het lagh.' Ibid., 311.

138 Van de Putte, 'Chronycke van Cortryck', 105, Fonds Goethals-Vercruysse, ms. 215, Rijksarchief Kortrijk.

139 For more information on the 'immoral' actions of grain traders, such as hiding grain in pits from the authorities, see: Ibid., 105–6.

140 For an example in Brussels, see: Anoniem, 'De vermaerde ende wonderlycke Geschiedenissen der prinselycke Stadt van Brussel', Stadsarchief Brussel, ASB Archives historiques, Registre 3107, fol. 42 verso.

in calming both parties and ordered that the grain that was stored by the merchants had to be sold by auction.[141]

Despite the intervention of the authorities, grain prices initially hardly decreased, according to the chronicler. He closely followed government measures in Kortrijk, but also in other cities, by copying announcements, placards and ordinances regarding pricing into his chronicle.[142] In combination with recording grain prices, the chronicler tried to monitor the effect of the measures. These were demonstrated on 25 May 1740, when the authorities announced that no tolls needed to be paid to transport grain. As a result, the price of grain in Ghent and Kortrijk started to drop, after which grain prices came to play a less prominent role in his chronicle until 1744.[143]

In the Northern Netherlands, chroniclers wrote about, and probably also experienced, the extremely cold winter of 1740 differently. We have already seen at the beginning of this chapter that authors such as Leurink also systematically recorded high prices, but they did so though to a lesser extent than in the Southern Netherlands. In the Northern Netherlands, chroniclers wrote less about dearth, and there were also far fewer reflections on the actions of governments and grain merchants. In this period, they mainly wrote about the wet summer of 1739, and the extremely cold winter of 1740, resulting in the high prices that we have seen in the chronicle of Leurink.[144] In these chronicles the severity of the situation was primarily illustrated by a few high prices, and anecdotes about dire situations, such as livestock dying of hunger, or children having to steal bread from the baker because even their dog had already been eaten.[145]

141 Van de Putte, 'Chronycke van Cortryck', 106, 201–2.

142 See for example: Ibid., 201–10.

143 Ibid., 51–53.

144 Leurink, *Tot Losser gekomen;* Simon Jacobsz. Kraamer, 'Aantekeningen betreffende de geschiedenis van Zaandam', Gemeentearchief Zaanstad, Zaandam, Archief Doopsgezinde gemeente Zaandam-West Zaandam (KA-0012) L39, unpaginated; Kluit, 'Historische Jaerboeken der stad Briel, deel 1, 1e stuk, 1747-1751', 35–36; See also: Vincent Janszoon van der Vinne and Vincent Laurensz van der Vinne, 'Aantekeningen van aanmerkelijke gebeurtenissen te Haarlem waarbij gevoegt zijn, eenige door V.L. van der Vinne nagelaate', Noord Hollands Archief, Haarlem, Bibliotheek 3000-13249; Joachim Bontius de Waal, 'Oorspronck en opkomst der stede Alckmaar, beginnende anno DL uyt een seer oud manuscript berustende ter Liberije deser Stadt gecopieert ende vervolgt tot MDCCLX door Joachim Bontius de Waal', trans. Transcriptiewerkgroep Regionaal Archief Alkmaar, Regionaal Archief Alkmaar, Collectie Aanwinsten, inv.no. 41; Louwen, 'Kronijk der stad Purmerende bevattende der selver opkomste en voortgang, in handschrift door Albert Pietersz. Louwen, 18e eeuw, deel 1'; Cornelis Veen, 'Oostzaandammer kronijk behelzende alle het voornaamste en gedenkwaardigste voorgevallen aen de Zaan-Stroom, zedert den jaare 1740 tot 1794 incluys, beknoptelijk bij een gestelt, voor de liefhebbers der novelles', Universiteitsbibliotheek Leiden, Ltk 2183; Spruijt, 'Het tweede deel off vervolg van de historie der stad Hoorn'.

145 Simon Jacobsz. Kraamer, 'Aantekeningen betreffende de geschiedenis van Zaandam', Gemeentearchief Zaanstad, Zaandam, Archief Doopsgezinde gemeente Zaandam-West Zaandam (KA-0012) L39, unpaginated; Kluit, 'Historische Jaerboeken der stad Briel, deel 1, 1e stuk, 1747-1751', 35–36.

Dearth in the Kingdom of the Netherlands, 1816-17

Turning to the nineteenth century, we can see that explanations for dearth only slightly changed. This was partly the result of a new political regime. In 1815, the former Dutch Republic and the Southern Netherlands had come under the control of one ruler, the son of the former stadtholder William V, Prince of Orange (1748-1806), King William I (1772-1843). He was crowned king of the Netherlands in 1815, but despite this new unity there was a great discrepancy in the way Northern and Southern chroniclers perceived the period of dearth that they experienced soon after his coronation.

The dearth of 1816 and 1817 was accompanied by a wet summer, followed by a cold winter that doubled grain prices, resulting in at least 60 per cent of an unskilled worker's wages being spent on bread.[146] Of the twelve chroniclers who wrote about this period of dearth, the four chroniclers from the Northern Netherlands offered least detail.[147] They just noted that bad weather was the cause of the high prices, and had led to a dire situation among the poor. However, in the Southern Netherlands, there was extensive writing about this dearth. Not only about how the rain, cold, and poor harvests led to rising prices, but also about the actions of grain traders and authorities.[148]

In 1816, which became known as the 'year without a summer', the Catholic postman, and former wigmaker, Jean Baptiste Hous (1756-1830) from Leuven started to record the increase of grain prices with greater frequency. Moreover, from July he also recorded the price of potatoes, which had become part of the European diet since the second half of the eighteenth century.[149] Besides observations on the wet weather, Hous also wrote about the religious remedies that were being sought, such as processions to pray for better weather in the church of St. Jacob on 20 July.[150] On 22 July he praised God,

146 De Vries, *The Price of Bread*, 271, 471.

147 Olivier Groeneyk, *Kronijk van Zierikzee, ten vervolge op die van J. de Kanter Phil.z* (Zierikzee, 1820); Jan Baptist de Beer, 'Kroniekje van Tilburg over 1774-1854', Regionaal Archief Tilburg, 338 Collectie handschriften Tilburg, inv.no. 1; Van Beringen, 'Kronijke der Stad Roermond beginnende met de komst van keizer Joseph II en eindigende met de troonsbeklimming van Leopold I, koning der Belgen (1781-1831)'; Hendrik Godefridus van Moorsel, *Kronijk, of Aantekening der merkwaardige voorvallen binnen de gemeente Heeze en eenige omliggende dorpen en enkelde welken algemene belangstelling verdienen*, ed. Dominicus de Jong (Achel, 1953).

148 Jan Baptiste Filleul, 'Tydscronyck, deel 4', Rijksarchief Kortrijk, Stadsfonds, 935 inv.nr. 31; J.B. Lameere, *Aenteekeningen van merkweerdige geschiedenissen voorgevallen binnen Loven (en omliggende), 1784-1835*, ed. M Bols et al., Jubileumuitgave 1961-1986 Geschied- en oudheidkundige kring voor Leuven en omgeving (Leuven, 1986); Edouard Callion, 'Gentsche kronijke: 1525-1835', vol 4., Universiteitsbibliotheek Gent, Boekentoren, BIB.G.014248; J.B. Hous, *Leuvense kroniek (1780-1829)*, ed. J. Kempeneer (Heverlee, 1964); Bartolomeus Rantere, de, *Geschiedenis van Oudenaarde van 1701 tot 1786*, ed. Marc de Smet (Oudenaarde, 1985); Jan Karel Verbrugge, *Gedenkweerdige aenteeckeningen van Jan Karel Verbrugge*, ed. Albert Schouteet, Bronnen en bijdragen tot de Vlaamse geschiedvorsing 3 (Bruges, 1958); Jan Frans van der Straelen and Joannes-Baptista Van der Straelen, *De kronijk van Antwerpen*, ed. A. van Berendoncks, J Rylant, and R.J. Leenaerts, vol. 8, 8 vols (Antwerpen, 1929); Guillaume-François Tanghe, *Parochieboek van Iseghem, gevolgd door de levensbeschrijving des H. Hilonius* (Bruges, 1863).

149 De Vries, *The Price of Bread*, chap. 11.

150 Hous, *Leuvense kroniek*, 252.

because no rain fell between 19 and 21 July, and due to the favourable weather conditions the price of wheat dropped with 10 stivers.[151] Yet, the following month it continued raining and on 12 September Hous remarked that the harvested grains were still lying in the sodden fields, predicting that 'we are going to pay a high price for it, because from now on everything is expensive.'[152] He asked himself: 'what will it [the price] be in the winter?'[153] Hous wrote in September that in Leuven alone, 15.000 people were unemployed, partly because the lands could not be cultivated due to the rain.[154] Despite the large amounts of grain that were imported from Russia and Poland, at the end of January wheat still cost 7 guilders and 10 stivers per *halster* [c.30 litres] and therefore many people were eating legumes such as beans.[155]

As was the case with previous chroniclers, anomalous weather and rising grain prices triggered Hous to start tracking grain prices on a regular basis. Yet, in this case, prices remained high after the new harvest. Since imports of grain were also high and supply was thus plentiful, Hous concluded that the dearth was in the first instance caused by human factors. He wrote that 'there was grain enough', meaning that grain merchants drove up the price.[156] On 4 July he found evidence that supported this view. On that day, a [Russian] ship with grain arrived and a crowd 'with money', went there to buy a *halster*.[157] Three days later a group of farmers arrived in Leuven, to buy grain as well, which was, according to Hous: 'the world upside-down. Previously farmers brought grain to the city, now they came to buy it. There are now only two different types of people who have grain, the large tenants and the grain merchants.'[158] Two weeks later, on 21 July, again more than hundred farmers came to buy grain from the 'merchants [*opkoopers*] who are in fact executioners [*opknoopers*], because they tie a noose around the neck of the poor and the artisans.'[159]

The systematic recording of grain prices during periods of dearth, combined with notes on the weather, grain imports, and the actions of the authorities and grain merchants, enabled Hous to substantiate his criticism of the local government and to express his expectations for the future. For example, he advocated government intervention against

151 'Godt lof, het weder begint hem te stelle, den 19 en 20 en 21 en hebben wy geenen regen gehadt. den 22 julu is het coren 10 stuyvers par halster afgeslagen.' Ibid.

152 '[...] het graen dat gemeyt is ligt in het velt gelyck mist, ick geloof dat wy sullen de saus daer van betaelen want van nu af is alles even dier.' Ibid., 255.

153 '[...] wat sal het in den winter syn.' Ibid.

154 Ibid.

155 Ibid., 257.

156 '[...] daer is graen genoegh [...] in het landt maer het is de fout van de korenbyters (opkoopers).' Ibid., 259.

157 '[...] die geldt hadde.' Ibid., 261.

158 '[...] het is gelyck den verkeerden werelt, eertydts bragten de boeren het corennaar de stadt en nu komen sy het haelen; daer syn nu maer twee diffrentte menschen die graenhebben, dat syn de groote paghters en de opkoopers (korebyters).' Ibid.

159 '[...] opkoopers om beter te seggen opknoopers want sy doen de trop aen den hals van den armen en den ambaghtsman.' Ibid., 262.

these merchants by suggesting that grain trade should be controlled during periods of shortages. According to Hous, grain merchants were not concerned with the welfare of the population but with profit maximisation. This was confirmed again a year later, when Hous wrote that he was experiencing some sort of déjà vu. Again merchants travelled through the villages to buy large amounts of grain, and on 15 September 1817 he wrote 'if it is not prohibited, it [dearth] will be as bad as the previous year'.[160]

As before, dearth in combination with political unrest, or a lack of trust in the authorities, was a trigger for chroniclers to gather information and develop a better understanding of what they experienced. Not only in Leuven, but also in Bruges, Kortrijk, Ghent, and Oudenaarde, we see chroniclers registering anger about the immoral practice of profit maximisation during times of high prices and the lack of government intervention, which in turn led to uprisings.[161] The Catholic tailor Bartholomeus de Rantere (1775-1831) from Oudenaarde, described a riot on 10 July 1817. People took matters into their own hands just before the new harvest arrived. That day, there was very little grain available on the market, which, according to De Rantere, was visited by thousands of people. The farmers were asking a high price, 35 guilders per hectolitre, but that did not initially cause an uprising. It was only when grain merchants came to the market and tried to buy up the grain, thus ignoring or taking advantage of the shortages, that the riots broke out. One of those traders, Pieter Prevoost of Etichoven, had to flee for his life when an angry crowd came after him. He tried to hide in a smithy, where a smith put a hot poker against his face.[162]

Two days later, the price of rye dropped to 15 guilders per hectolitre due to the large supply offered by a merchant from Ghent. In the following days, the price dropped even further. De Rantere offered an explanation. He wrote: 'On the twenty-fourth of the same month, the Russian rye was priced at thirteen guilders, because with the new harvest approaching, the merchants feared they would no longer be able to sell their poor-quality grain.'[163] The pattern of large grain stocks being sold just before the arrival of the new harvest strengthened chroniclers in their belief that there was grain enough, and dearth was 'man-made'. A month later, in September the new harvest came, and the prices reached normal levels after which De Rantere stopped writing them down.[164]

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160 '[...] want dat daer geen verbodt tegen en komt dan sal het soo ergh syn als gepasseerden winter.' Ibid., 263.

161 Verbrugge, *Gedenkweerdige aenteeckeningen van Jan Karel Verbrugge*; Filleul, 'Tydscronyck, deel 4'; Callion, 'Gentsche kronijke: 1525-1835'; Bartolomeus de Rantere, *Het Dagboek van Bartolomeus de Rantere: Beschrijving van al Het Merkweerdigste Dat Er Voorgevallen Is in de Stad En Casselrije van Audenaerde Zedert Het Jaer Zeventhien Hondert Zevenentachentig Tot Het Jaer Achthien Hondert Vijfentwintig*, ed. Marc de Smet, 1973.

162 '[...] nam een gloeiende ijzer en stak het hem tegen de wange [...].' Rantere, *Het Dagboek van Bartolomeus de Rantere*, 212.

163 'Den vierentwintigsten dito wierd den Russischen rogge gesteld op derthien guldens want den nieuwen ougst op handen zijnde vreesden de koopmans van hun slegt graen niet meer te konnen verkoopen.' Ibid., 213.

164 Ibid., 213–14.

Both Hous and De Rantere explained the period of dearth from 1816 to 1817 mainly through a local lens. The Catholic chronicler Edouard Callion from Ghent, on the other hand, developed a political explanation. It was not the behaviour of local merchants, but a matter of 'political economy', [*staatshuishouding*] that was to blame. He was convinced that the policies of King William I caused dearth in the Southern Netherlands. According to Callion: 'he [William I] confirmed the old saying: small thieves are hanged, and big ones are allowed to walk.'[165] In January 1817 Callion copied an ordonnance which stated that the export of grain to other countries was prohibited. Violating the ordonnance resulted in a fine of thousand guilders.[166] Callion was upset and surprised that William I issued this ordinance, and remarked:

> Is it not unfair that a poor man who wants to earn five francs by carrying wheat to France runs the risk of thousand guilders and the forfeiture of his grain, while he [William I] permits major merchants from Holland to freely export shiploads of wheat on a daily basis?[167]

Callion was thus frustrated that people in the Southern Netherlands were not allowed to make money from the sale of their cultivated grain to France, while 'Holland' merchants were free to export grain from the Southern Netherlands. In the North merchants filled their pockets while people in the south were suffering from hunger.[168] The deputies of the Southern part of the kingdom wanted to propose a prohibition on the export of grain, but, according to Callion: 'several *Hollanders* [...] would vote against it, because the measure was not proposed by his majesty.'[169] Callion clearly believed that the interests of Southern Netherlands were endangered by the Northerners in the assembly. 'And these men are paid to represent the people', he remarked angrily. [170]

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165 '[...] hy bevestigde het oud spreekwoord. Kleyne dieven hangt men op, en groote laet men loopen.' Callion, 'Gentsche kronijke: 1525-1835', fol. 134 verso.

166 Ibid., fol. 134 recto.

167 '[...] is het geene onrechtveerdigheyd, dat hy eenen armen man, die, om eene prémie van vyf francs te winnen, zoo waegen van een guintal terwe in Vrankryk te draegen doet straffen met eene boete van duyzend guldensen met de verbeurte van die terwe, en dat hy de groote kooplieden van Holland dagelyks geheele schepen met terwe en andere eetwaeren vrylyk laet uyvoeren?' Ibid., fol. 134 verso.

168 Ibid., fol. 134 verso-135 recto.

169 '[...] verscheyde Hollanders zegden dat zy [...] voorgenomen hadden er tegen te stemmen, hier om alleen, om dat dien maetregel door Z M niet voorgesteld was!' Edouard Callion, 'Gentsche Kronijke: 1525-1835', vol. 4, Universiteitsbibliotheek Gent, Boekentoren, BIB.G.014248, fol. 135 recto; Under William I, the influence of the parliament was strongly reduced. Ministers and the opposition had little influence during this period. Prak, *Nederland en het poldermodel*, 192–94.

170 '[...] en zulke mannen wierden betaeld om het volk te verbeelden.' Callion, 'Gentsche kronijke: 1525-1835', fol. 135 recto.

As we have seen in other chroniclers, such commentary was combined with monitoring grain prices. Callion recorded price increases since the winter of 1816, which peaked around the New Year. At that time Callion wrote: 'on 11 January 1817 a hectolitre of wheat was sold at the market for 24 guilders and a bag of potatoes for 11 guilders! The next market the price of wheat increased to 29 and even 30 guilders.'[171] Callion continued by describing how people managed to obtain food, even by purchasing a measure of potato peels for 'six *oortjens* [1.5 stivers]'.[172] A week later, on 24 January, the market was less strained, and Callion hoped and even expected, that the prices would drop based on two indicators. He wrote:

> The white wheat in our market today has declined in price by more than three guilders per hectolitre; the red wheat even more, and rye by about the same amount. May we be so fortunate as to see such a reduction on the upcoming market day! We have the greatest hope for this, since the price of grains continues to fall in England, and the shortage in France is beginning to be mitigated by the large supplies in various ports.[173]

A week later, the prices stabilised as Callion predicted, after which he too stopped monitoring grain prices.[174]

Conclusion

Chronicles have often been seen as collections of 'trivial' data that were not recorded consistently. Yet, a comparison of entries on prices in a large number of chronicles offers a new perspective. This shows that the information that chroniclers recorded was remarkably consistent. Prices became a topic for chroniclers when they were extremely high, and when price rises were accompanied by political uncertainty, extreme weather, or epidemics. We have seen that chroniclers at first did not always explicitly reflect on the prices they recorded, but by focussing on the structure and the type of information, and the moment they started writing down prices, we saw a pattern emerge that recurred

171 'den 11 January 1817 op de merkt alhier, 24 guldens verkogt, het koorn 16 guld., en eenen zak pataten, 11 guldens! den volgenden merktdag is den prys der terwe tot 29 enzelfs tot 30 guldens geklommen!' Ibid., fol. 135 verso.

172 Ibid.

173 'Den 24. De witte tariwe is op onze merkt van heden meer als dry guldens par hectoliter in prys verminderd; de roode taewe noch iet meer en den rogge ook ontrent zoo veel. Mogten wy zoo gelukkig zyn van toekoomende merkt-dag, noch met zulke vermindering bekroond te zien! Wy hebben daer toe de grootste hope, doordien den prys der graenen in Engeland aen het daelen blyft en het ontbrekende in Vrankryk, door den grooten toevoer op verscheyde punten, begint vervold te worden.' Ibid., fol. 136 verso.

174 Ibid., fol. 137 verso.

in every chronicle discussed in this chapter. This pattern also shows that chroniclers used their records to reason with.

In the chronicles of 'experts', who were professionally involved in the grain trade, we have seen that they reasoned with a large number of variables. They were mapping natural, political, and human factors that influenced grain prices. Through their profession or public office, they had access to specific knowledge in the grain trade, and based on the information they collected in their chronicle, they could discover patterns and make predictions about the future.

This same process of pattern recognition, although often less sophisticated, was also visible among 'non-expert' chroniclers. Extreme cold, wet weather, and droughts caused grain prices to rise, but the increasing prices of vegetables and legumes were also indicators that prices would remain high, often until the new harvest. Therefore, chroniclers closely monitored price developments both domestically and abroad. For example, when prices fell in Amsterdam, England, or France, this often also resulted in lower grain prices in the Southern Netherlands.

Although a combination of different factors to explain dearth can be found in almost every chronicle, many chroniclers, especially those from the Southern Netherlands, also wrote that dearth was caused by human factors.[175] Extreme weather could push up prices, but it did not cause dearth or uprisings. According to them, dearth was 'man-made', caused by the combination of merchants exploiting the situation and (local) governments failing to intervene. This ranged from buying up large quantities of grain to drive up prices to creating the illusion of a grain shortage while selling large quantities just before the new harvest in periods of dearth. During these periods of fluctuating prices and political instability, chronicles thus served both as an instrument to explain and anticipate dearth and as a source of evidence enabling them to make moral judgments. By comparing periods of dearth, chroniclers could determine whether grain prices were justified depending on the circumstances. High prices during relatively stable periods were considered less justified than when an extremely cold winter froze the waterways and limited grain supply. This practice of collecting information, identifying patterns, and arriving at new insights and explanations was a core business for the chroniclers. Chroniclers not only wanted to record memorable events for their community and future generations. This chapter has

175 An example when the authorities caused dearth was with the introduction of assignats when the Southern Netherlands, then Austrian Netherlands, became part of the First French Republic. For some examples, see: G.A. Vervot, 'Register betreffende genealogische inlichtingen over de familie Vervot, wetenschappelijke verhandelingen, historische notities en een gelijktijdige kroniek van gebeurtenissen, geschreven, door G.A. Vervot, uit Steenvoorde, voor zijn kinderen. 1783-1808', Rijksarchief Brugge, Verzameling aanwinsten 1550-1980, inv.no. 121-1173, 481–503; Jan van Aarssen, 'De principaelste geschiedenissen voorgevallen binnen Antwerpen sedert 1794, 15 maert tot 16 maert 1796, beschreven door Jan van Aarssen, stoofmaker en koperslager op de Steenhoudersvest te Antwerpen', Felixarchief, Antwerpen, Pk. 123, fol. 9 recto; Anoniem, 'Chronyken der principaelste geschiedenissen, voorgevallen tenteyde der fransche republieq', Koninklijke Bibliotheek België, Brussels, Hs 5881, fol. 15 recto-17 verso.

demonstrated that they also collected information in order to understand what happened, thereby producing knowledge that they believed was useful.

In the example we discussed in this chapter, that of dearth, there was a great deal of continuity – dearth had very similar causes, and similar effects, in the sixteenth and in the nineteenth century, even if there were variations in the local impact, the political circumstances, and access to knowledge of the grain trade. Now that we have established that information was not collected randomly, it also becomes possible to investigate other types of knowledge, that we expect to have changed over time.

In the following chapters we will examine how chroniclers' explanations of other topics changed over time under the influence of new knowledge. Natural phenomena were increasingly explained by natural laws rather than with reference to divine interventions. New observations, experiments, and technological innovations made it possible to understand these phenomena in new ways. This 'new' knowledge also reached our chroniclers who, while observing natural phenomena, started to reason with the new information. What they did with it, which new patterns they discovered, and under what conditions they accepted new knowledge and explanations form the subject of the following two Chapters.

Chapter 2

A Differentiated Path Toward a New Understanding of Nature

Whoever also puts their faith in the planets and stars of the sky, as if they had power over the souls of people, is idolatrous

– Chronicler Philip van Campene (1516-67), Ghent.[1]

1 '[...] so wie ooc zijn gheloove stelt inde planeten ende sterren des luchts, als of die macht hadden jeghens de zielen der meynsschen, es een afgodisch.' Cornelis van Campene and Philip van Campene, *Dagboek van Cornelis en Philip van Campene: behelzende het verhaal der merkwaardigste gebeurtenissen, voorgevallen te Gent sedert het begin der godsdienstberoerten tot den 5en april 1571*, ed. Frans De Potter (Ghent, 1870), 359.

Introduction

We have seen that chronicles are not merely a collection of trivial data and memorable events. They were also an instrument with which contemporaries reasoned and tried to understand the events they experienced. Based on the information they collected, chroniclers discovered patterns by leafing back and forth in their chronicle, while making comparisons with previous events. In this chapter we will see that this happened most frequently with natural phenomena, the most prominent subject in the chronicles.[2] One of the explanations for this is that in the early modern period contemporaries were convinced that 'the landscape bore witness to the activities of God as its initial Creator and eternal curator'.[3] Besides the Bible, Nature was a book that revealed God's intentions and His plan for its human inhabitants.[4] Yet, these signs were no longer self-evident, since human reason had been clouded by the Fall. As a result, contemporaries searched for signs and patterns in order to explain the natural phenomena they experienced and to anticipate what was to come.[5]

How these signs and patterns were interpreted changed in the early modern period. Historians have argued that the Reformation and the 'Scientific Revolution' led to the accumulation of new knowledge and reshaped 'the theological and epistemological lens through which the landscape was interpreted.'[6] For scholars and experts, God would no longer actively intervene and withdrew as the creator who allowed the world to run its course according to His laws.[7] According to Mokyr, technology accelerated this process, since beliefs about the physical world, could be challenged using 'scientific' instruments.[8] This 'new' knowledge of explaining phenomena through natural processes, or laws, also reached our chroniclers. While observing natural phenomena they started to reason with it. In this chapter we will see how they did so, by discussing how they used this 'new' knowledge, which new patterns they discovered, and under what conditions they accepted new knowledge and explanations.

2 Lassche, 'Information Dynamics', chap. 5.

3 Alexandra Walsham, *The Reformation of the Landscape: Religion, Identity, and Memory in Early Modern Britain and Ireland* (Oxford, 2012), 327.

4 Eric Jorink, *Reading the Book of Nature in the Dutch Golden Age, 1575-1715* (Leiden, 2010); Walsham, *The Reformation of the Landscape*, chap. 5.

5 Jorink, *Reading the Book of Nature*, 44.

6 Walsham, *The Reformation of the Landscape*, 393; Eric Jorink, *Wetenschap En Wereldbeeld in de Gouden Eeuw* (Hilversum, 1999); Mokyr, *A Culture of Growth*.

7 E. J. Dijksterhuis, *De mechanisering van het wereldbeeld* (Amsterdam, 1950); Keith Thomas, *Religion and the Decline of Magic: Studies in Popular Beliefs in Sixteenth and Seventeenth Century England* (London, 1971); Tabitta van Nouhuys, *The Age of Two-Faced Janus: The Comets of 1577 and 1618 and the Decline of the Aristotelian World View in the Netherlands* (Leiden, 1998); Mokyr, *A Culture of Growth*, 231; Jan Willem Buisman, *Onweer: Een Kleine Cultuurgeschiedenis 1752-1830* (Nijmegen, 2019), 84.

8 Mokyr, *A Culture of Growth*, 55.

In his *Reading the Book of Nature* (2010) Eric Jorink argued that: 'Nature is not primarily the field of natural philosophers and engineers, but the starting point for religious meditation. Nature is a book and as such, just like the Bible, the object of exegesis.'[9] Jorink demonstrated how clerics combined the Bible with classical and modern works on nature to explain aberrations in nature.[10] During the weekly sermons, contemporaries came into contact with these ideas, but whether they engaged with them, and to what extent they made comparisons between their own observations, the Bible, and the Book of Nature has so far been difficult to research.[11]

To gain insight into how popular beliefs changed under the influence of new knowledge in early modern England, Alexandra Walsham studied sermons and pamphlets.[12] Like Jorink, and as observed by earlier scholars, she observed an inverse relationship between divine and natural explanations. However, both Jorink and Walsham stressed that this did not fundamentally undermine the assumption that God was at work in the world.[13] Walsham argued that the idea of an 'active' God was not 'intrinsically challenged by the rise of scientific empiricism and the gradual transfiguration of natural philosophy.'[14] Until the nineteenth century, 'strange aberrations in nature continued to be regarded as prodigious and admonitory and [...] calamitous happenings that wrought environmental havoc were interpreted as telling evidence of divine danger.'[15]

What changed, however, was that anxiety was gradually supplanted by an attitude of admiration and wonder. Yet, a significant part of the population was still inclined to interpret various natural phenomena as divine warnings of further punishments.[16] As a result, Walsham concluded that early modern people fostered a tendency to interpret natural phenomena symbolically rather than sacramentally.[17] Walsham called attention to the fact that the frontiers between 'natural', 'preternatural' and 'supernatural' were constantly redefined as early moderns 'questioned the precise mechanisms by which

9 Jorink, *Reading the Book of Nature*, 21; Similar observations have been made by: Vladimir Janković, *Reading the Skies: A Cultural History of English Weather, 1650-1820* (Chicago, 2001); Golinski, *British Weather*.

10 Jorink, *Reading the Book of Nature*, chap. 6.

11 Eric Jorink, 'Tekenen van Gods gramschap: Wonderbaarlijke natuurverschijnselen in de Republiek in de 16e en 17e eeuw', *Groniek*, 127 (1995): 177–88.

12 Alexandra Walsham, *Providence in Early Modern England* (Oxford, 1999); Walsham, *The Reformation of the Landscape*.

13 Walsham, *Providence in Early Modern England*; Walsham, *The Reformation of the Landscape*, chap. 5; Jorink, *Reading the Book of Nature*, 398.

14 Walsham, *The Reformation of the Landscape*, 328.

15 Ibid., 327.

16 Ibid., 328, 368, 393.

17 Ibid., 328, 566; The same observation for the Netherlands has also been made by Jan Willem Buisman, see: Buisman, *Onweer*.

Providence worked.'[18] This applied to both Protestants and Catholics, as Walsham and Willem Frijhoff have shown for England and the Netherlands, respectively.[19] Yet, how the religious and natural explanations continued to coexist, and how these 'frontiers' changed under the influence of new knowledge, is subject to debate.

In this debate, much depends on the sources that historians used to study how early moderns interpreted natural phenomena. Tabitta van Nouhuys (1998) argued that 'experts', such as university professors, emphasised natural explanations, in contrast to printed sources such as pamphlets, which were also written by 'non-experts'.[20] Walsham demonstrated that in sermons and (popular) pamphlets providential explanations were dominant, which according to Marieke van Egeraat (2023) was also the case in the Netherlands.[21] Yet, in her study of disasters in sixteenth-century chronicles, Van Egeraat noted that this preference is absent from chronicles. In fact, they offered much more diverse explanations for meteorological phenomena, which she used to study how chroniclers combined different types of explanations.[22]

By examining if and when these explanations changed in the chronicles beyond the sixteenth century, I will offer a new perspective on what prompted non-experts to adopt new knowledge and under what conditions. Two different explanations for the acceptance of knowledge are compared: on the one hand, *content* bias, in which case chroniclers accepted new knowledge on substantive grounds as did the 'experts' described by Mokyr; on the other hand, *direct* and *frequency-dependent* biases. In the former, they followed the opinion of 'experts'. In the latter, the majority of people in their immediate surroundings.

Corpus

In this chapter, I focus on knowledge about natural phenomena and, more specifically, 'meteorological' phenomena. Today meteorology is understood as the science of the atmosphere, but from Aristotle until the modern period meteorology concerned itself with all the phenomena of the sublunary sphere.[23] This means that not only wind, rain

18 Walsham, *The Reformation of the Landscape*, 327.

19 Willem Frijhoff, 'Signs and Wonders in Seventeenth-Century Holland. An Interpretive Community', in *Embodied Belief: Ten Essays on Religious Culture in Dutch History*, ed. Willem Frijhoff, Studies in Dutch Religious History (Hilversum, 2002), 137–52; Walsham, *Providence in Early Modern England*; Walsham, *The Reformation of the Landscape*.

20 Nouhuys, *The Age of Two-Faced Janus*, 555.

21 Walsham, *Providence in Early Modern England*; Marieke Van Egeraat, '"Zoo Zij Ghesindt Waeren": Het Nieuws En Verklaringen van Rampen in de Zestiende-Eeuwse Nederlanden' (2023), 155–56.

22 Van Egeraat, '"Zoo Zij Ghesindt Waeren"', 155–56; In an earlier article, I have demonstrated how natural and divine explanations were related to each other in early modern chronicles. Dekker, 'Coping with Epidemics in Early Modern Chronicles'.

23 Anne Lawrence-Mathers, *Medieval Meteorology: Forecasting the Weather from Aristotle to the Almanac* (Cambridge, 2020).

and lightning play a role, but also comets, earthquakes, and signs in the sky such as cloud formations.

To investigate how the knowledge about such phenomena changed, I used a wordlist to find text fragments that concern meteorological phenomena in the same way as in *Chapter 1* (*Appendix 6*). I made use of 145 chronicles from the period 1500-1860, using 105 chronicles from the Northern Netherlands and 40 from the Southern Netherlands.[24] I found that 94 of the chronicles in the Northern Netherlands, and 39 of those in the Southern Netherlands contained entries on meteorological phenomena, of which I analysed 2930 fragments in close detail.[25]

The frequency in combination with these categories is presented in *Appendix 7*.[26] This exercise allowed me to investigate which meteorological phenomena were recorded, how frequently, and to what extent this changed over the centuries. Yet, the aim of this chapter is not to describe the development of knowledge of every meteorological phenomenon in the chronicles, but to investigate under which conditions new knowledge about meteorological phenomena was accepted. Therefore, this chapter limits itself to some of the most frequently recorded phenomena in the chronicles, and for which there was initially no 'modern' explanation among the chroniclers, which are presented in *Table 2* and *Figure 10*.

Meteorological Phenomena Period 1500-1860	Recorded in the Chronicles	Percentage of the Total
Lightning & Storms	696	27%
Cold Winter	539	21%
Comets	142	5%
Earthquakes	114	4%
Signs in the Sky	35	1%
Other phenomena	1085	42%
Total	2611	100%

Table 2. Most frequent meteorological phenomena in the chronicles, 1500-1860.

What immediately stands out from *Table 2* and *Figure 10* is the proportion of 'lightning & storms' and 'cold winters'. Together, they account for 48 per cent of all recorded meteorological phenomena in the chronicles between 1500 and 1860. Storms and lightning were particularly noted when they caused damage, usually in the form

24 The full corpus consists of 204 chronicles: 132 from the Northern and 72 from the Southern Netherlands. Therefore, I used respectively 80% and 56% of the full corpus for this Chapter.

25 This is respectively 90% and 98%.

26 I have divided the natural phenomena into as few preconceived categories as possible, and therefore stayed close to the terms used by the chroniclers.

of fire. For centuries chroniclers also wrote about lightning as if it were fire.[27] The understanding that lightning is a form of electricity is seen only in nineteenth-century chronicles, as we will discuss in combination with the introduction of the lightning rod in the last section.

The cold winters largely coincide with the periods of dearth from the previous chapter (*Figures 7* & *10*). According to the chroniclers, these winters were extremely cold compared to earlier periods. One of the explanations for why chroniclers so frequently recorded cold winters was obviously because they had such significant consequences for early modern societies. A cold winter could even be a reason or motivation to start a chronicle.[28] These 'extreme' winters were often interpreted by the chroniclers as 'preternatural'. This was a sign or punishment from God, which remained within the limits of His natural laws.[29]

Not only cold winters, but especially comets, earthquakes, and signs in the sky such as an army or a cross were interpreted as providential signs from God.[30] This last category, however, was limited to the early phase of the Dutch Revolt in the second half of the sixteenth century. In the seventeenth century signs in the sky largely disappeared from the chronicles. Comets and earthquakes, on the other hand, were recorded by chroniclers throughout the early modern period. This makes it possible to make long-term comparisons and see when and how the explanations for the two phenomena changed. Moreover, chroniclers also collected occurrences of comets and earthquakes from before their own time. Historical phenomena, and the context in which they occurred, were used to interpret the phenomena they experienced, based on the parallels they observed.

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27 In the last two decades, there has been increasing attention among historians to how amateur meteorologists and 'ordinary' people interpreted meteorological phenomena. For more information see: Janković, *Reading the Skies*; Golinski, *British Weather*; Buisman, *Onweer*; Sky Michael Johnston, 'Printing the Weather: Knowledge, Nature, and Popular Culture in Two Sixteenth-Century German Weather Books', *Renaissance Quarterly* 73, no. 2 (2020): 391–440.

28 See for example: Van Haecht, *De kroniek van Godevaert van Haecht*; Veen, 'Oostzaandammer kronijk'; Kluit, 'Historische Jaerboeken der stad Briel, deel 1, 1e stuk, 1747-1751'.

29 Lorraine Daston, 'Marvelous Facts and Miraculous Evidence in Early Modern Europe', *Critical Inquiry* 18, no. 1 (October 1991): 93–124; Jorink, *Reading the Book of Nature*, 8. The category of the 'supernatural' however, is barely mentioned in the chronicles, and remained largely limited to the Old Testament, where, for example, God stopped the motion of the sun and the moon, see for example: Joshua 10:12-13.

30 For changing views on comets, see: Sara Schechner, *Comets, Popular Culture, and the Birth of Modern Cosmology* (Princeton, 1997); Tofigh Heidarzadeh, *A History of Physical Theories of Comets, from Aristotle to Whipple* (Dordrecht, 2008); Eric Jorink, 'Van omnizueze tot glorieuze tekens. Veranderende opvattingen over kometen', in *Kometen, monsters en muilezels: het veranderende natuurbeeld en de natuurwetenschap in de zeventiende eeuw*, ed. Florike Egmond, Eric Jorink, and Rienk Vermij (Haarlem, 1999), 89–104; For earthquakes see: Rienk Vermij, *Thinking on Earthquakes in Early Modern Europe: Firm Beliefs on Shaky Ground* (Milton Park, 2021).

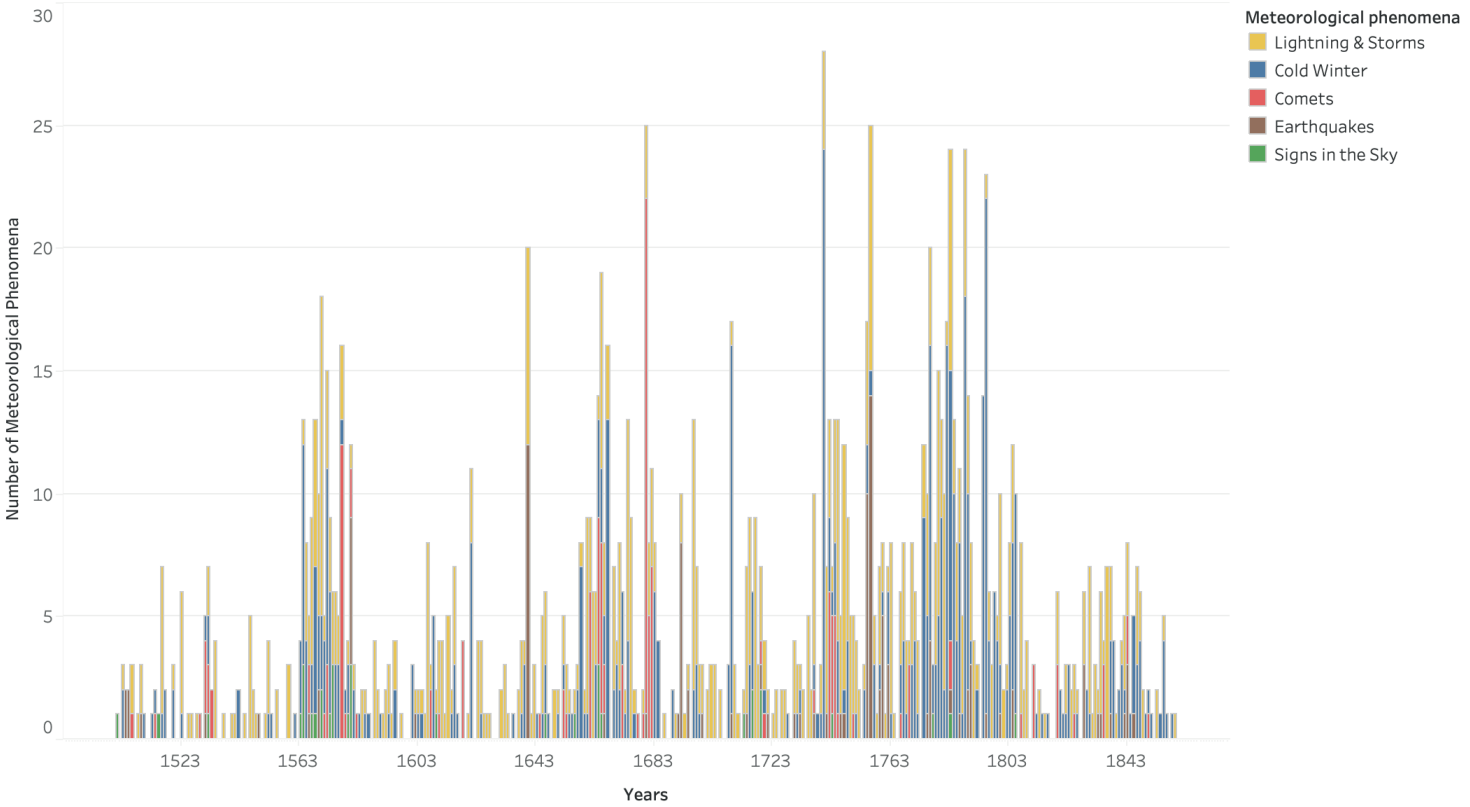

Figure 10. Number of meteorological phenomena per year, in the corpus (1500-1860)

First, we will discuss how chroniclers interpreted comets and other signs in the sky, and what patterns they observed. Subsequently, we will see that for some meteorological phenomena, the explanations hardly changed, making it possible not only to examine why contemporaries began to explain nature in new ways for other phenomena, but also why in some cases traditional explanations persisted well into the nineteenth century. This also emphasises the role of technology. Did the introduction of instruments, such as the thermometer and barometer, change the way chroniclers wrote about the weather, and what role did the lightning rod play in the acceptance of lightning as electrical discharge?

The Chronicle as a Compass

Deciphering Providential Signs

From antiquity, early modern scholars inherited roughly two different ways to explain the origin of comets. On the one hand, the 'natural explanation' as described in Aristotle's *Meteorology*, and further elaborated by Ptolemy. According to Aristotle, comets were sublunar meteors composed of hot, dry and windy exhalations, which could be used to forecast drought, earthquakes and prodigious rains, which were all symptoms of an abundant amount of hot, dry exhalations.[31] On the other hand, various Babylonian astronomers, and later Roman scholars, such as Seneca interpreted comets as signs from the gods. According to them, comets were a sign of impending doom, where the comet itself did not exert influence on Earth but was primarily seen as an instrument through which a supreme being communicated.[32] Both explanations coexisted in the early modern period, although there is debate among historians about what caused contemporaries to prefer one explanation over the other.[33] This project does not enable me to provide an answer to that specific question, but chronicles offer insight into the various explanations chroniclers gave and why.

31 Heidarzadeh, *A History of Physical Theories of Comets*, 1–28; Schechner, *Comets, Popular Culture, and the Birth of Modern Cosmology*, 17.

32 Ibid., 20–24; Nouhuys, *The Age of Two-Faced Janus*, 56, 390–91.

33 Schechner, *Comets, Popular Culture, and the Birth of Modern Cosmology*; Heidarzadeh, *A History of Physical Theories of Comets*, chaps 1–2; For more information on the development and relation on Christian and Aristotelian explanations, see: Anne Lawrence-Mathers, ed., 'Recreating Meteorology in the Early Middle Ages: Isidore and Bede', in *Medieval Meteorology: Forecasting the Weather from Aristotle to the Almanac* (Cambridge, 2019), 17–39.

Figure 11. Comet in the Months of February and March 1744, hand-coloured engraving, included in the chronicle of Albert Pietersz. Louwen.[34]

Comets were often interpreted by sixteenth-century chroniclers as harbingers of disaster, even if the specific implications remained nebulous. The Lutheran painter, Godevaert van Haecht (1546–99), recounted how Tycho's supernova in November 1572 was perceived in both Paris and his native Antwerp. It seemed 'as if God threatened them for their butchery [St. Bartholomew's Massacre] and in Antwerp a large star was seen for days, brighter and above all other stars'.[35] Five years later, the Catholic corn inspector from Ypres, Augustyn van Hernighem (c.1540-c.1617), reflected on the Great Comet of 1577, without clarifying the implications, except to suggest that they were negative.

34 Louwen, 'Kronijk der stad Purmerende [...] deel 1', 286.

35 '[...] alrecht of Godt haerder moorderye dreychde, ende ontrent Antwerpen werdt een groote sterre lange dagen gesien, seer claer lichtende boven allen andere sterren.' Van Haecht, *De kroniek van Godevaert van Haecht*, 225; For more information on this comet, see: Miguel A. Granada, 'Novelties in the Heavens between 1572 and 1604 and Kepler's Unified View of Nature', *Journal for the History of Astronomy* 40, no. 4 (1 November 2009): 393–402.

> On the 14th of November, a fearsome comet appeared in the evening, a star with a tail situated in the southeast, its tail stretching towards the southeast, which was dreadful in the eyes of many people and made its appearance for a good 5 or 6 weeks.[36]

This was the period when Calvinists were seizing control in several Flemish cities, a development that Van Hernighem's contemporaries seemingly associated with the comet's appearance.[37] In the chronicle of Prior Wouter Jacobsz. (c.1521–95), the same comet precipitated further trouble in Amsterdam. He wrote: 'in this month [November], a peculiar comet was seen in the sky, which also greatly distressed many people, fearing what more could arise on top of the heavy sorrow they had now endured for so long.'[38]

To sixteenth- and seventeenth-century chroniclers, the effects of comets were in general not preordained and neither did they necessarily signify something calamitous. Chroniclers saw them as a providential sign but were often reluctant to define of what. An anonymous chronicler from Maastricht and the Reformed official, Horatius Wigeri Vitringa (1632-99) from Leeuwarden both reflected on the comet of 1661. Besides providing details on the direction of the comet's tail and when it appeared, they respectively wrote: 'What this will bring forth, only time will tell' and 'the meaning is known to God Almighty.'[39]

Because the impact of a comet was not immediately visible, we see that around the time of their appearance both Catholic and Reformed chroniclers were reluctant to make explicit what they signified. Most authors, like the Catholic official and brewer from Haarlem, Willem Janszoon Verwer (c.1533-c.1580), simply recorded observations of comets as: 'At the beginning of November [1577], a comet was seen with a tail situated in

36 'Op den 14 van november zoo heeft huer vertoocht inden avent een vreeselycke commete een sterre mitte sterte zyttende int zuuteooste hueren stert streckende naer het zuut ooste twelcke was gruwelyck inde ooghe van veel menschen ende vertoochde haer wel 5 ofte 6 weken.' Augustyn van Hernighem, 'Beschrijving der stad Yper, deel 2', Rijksarchief Kortrijk, Fonds Goethals-Vercruysse, ms. 296, 62.

37 Anne-Laure Van Bruaene, 'Les républiques calvinistes (1577–1585)', in *Rebelles et subversifs de nos régions: des Gaulois jusqu'à nos jours*, ed. Anne Morelli (Charleroi, 2011), 82–97.

38 'In dese maent sach men eenen sonderlingen comeet sterre in den hemel, waerdoer oeck veel menschen seer bedrouft waeren, beducht wat haer boven soe swaeren verdriet, daer sij nu lange in geseten hadde, noch meerder soude opcoemen.' Wouter Jacobsz, *Dagboek van broeder Wouter Jacobsz (Gualtherus Jacobi Masius) prior van Stein: Amsterdam 1572-1578 en Montfoort 1578-1579. Deel 2*, ed. Isabelle Henriette van Eeghen, vol. 2 (Groningen, 1959), 685.

39 '[...] wat dit uytbrengen sal moet den tyd leeren.' Anoniem and Ludovicus Loyens, 'Manuscripta wegens de stad Maestricht de anno 998 usque anno 1742', 234, Handschriftencollectie GAM, 22.001A, inv.no. 197, Regionaal Historisch Centrum Limburg, Maastricht; 'De beduidinge is Godt Almachtich bekent.' Horatius Vitringa, 'Annotatien van Eenige aanmerckensweerdige dingen soo in als buiten de Provintie van Frieslandt in de tijt van twintig Jaren voorgevallen beginnende met den Jare 1657 en eindigende met den Jare 1676 incluis. Het eerste deel', Tresoar Leeuwarden, PB 1262, 258.

the South, radiating towards the East, and it remained until the New Year.'[40] Three years later, Verwer observed another comet in the same month, this time with a 'small tail'.[41]

As with the recording of prices, which we discussed in the previous chapter, recording such information was not trivial. Although the chroniclers did not reflect on every observation, when comparing numerous chronicles, a pattern unfolds. Why the moment of appearance and the physical properties of a comet were relevant to record can best be illustrated by the Catholic chroniclers L.F. Cattenbelt from Zwolle and Justus Billet from Ghent (1592-82). Both authors compiled lists of comets and other meteorological phenomena, tracing them from the birth of Christ to their own era. In Cattenbelt's list, comets were typically followed by other calamities such as earthquakes, war, or plague (*Figure 12*).[42] For example, 'In the year 700, 2 comets were seen [...] this was followed by a great pestilence.'[43] Similarly, in Billet's chronicle, various extraordinary signs were followed by extreme cold, earthquakes, and plagues in different regions of Italy. In 1231 for example, 'comets with long tails and the shape of a rod [...] foretold various punishments.'[44] He went on to note that in 1264 a comet was visible for three months, disappearing on the night that Pope Urban IV (c. 1195-1264) passed away.[45]

40 'In principio Novembris isser een commet ghesijen met een staert staende int Zuijden, straelende int Oost ende stont tot het nieuwe jaer toe.' Willem Janszoon Verwer, *Memoriaelbouck. Dagboek van gebeurtenissen te Haarlem van 1572-1581*, ed. J.J. Temminck (Haarlem, 1973), 197.

41 'Een cleijne commet met een cleijne staert gesien in November.' Ibid., 218.

42 L.F. Cattenbelt, 'Eenige gedenckwaerdige geschiedenissen raeckende meest het Landt van Overijssel ende deszelfs Steden? Kroniek van Overijssel en in het bijzonder Zwolle, geschreven door L.F. Cattenbelt, 1678 - 1681', Historisch Centrum Overijssel, Zwolle, 0263 Vereeniging tot Beoefening van Overijsselsch Regt en Geschiedenis, handschriftenverzameling, inv.no. 909, 161–62.

43 'Anno 700 wirden 2 Cometen gesien [...] hijer op volghde een groote peste.' Ibid., 161.

44 '[...] Cometen met langhe steerten in forme van Roeden [...] brocht sijn sonderlinghe straffe.' Justus Billet, 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 8', Stadsarchief Gent, Bibliotheek 1LF2 en lGDl, 529 (C. Handschriften), fol. 122 verso-123 recto.

45 Ibid., fol. 137 recto-138 recto.

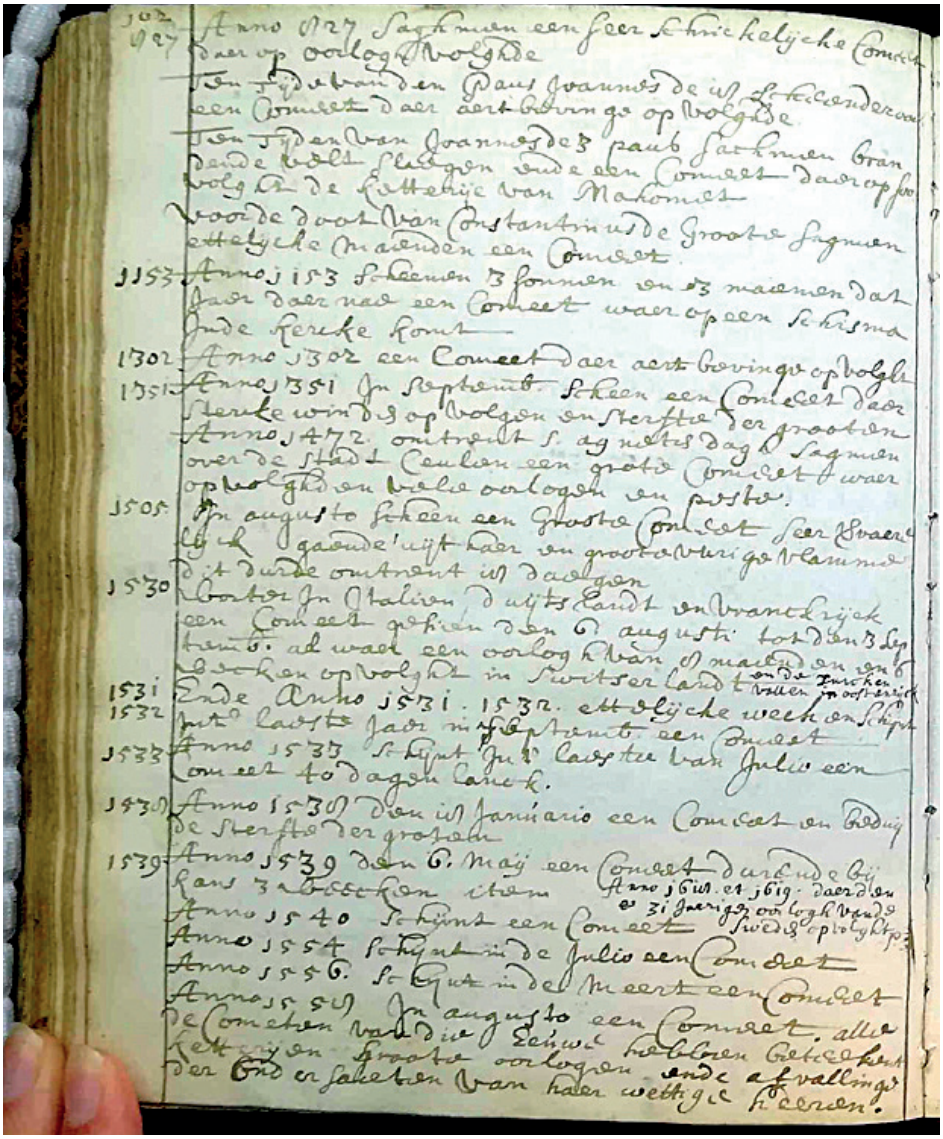

Figure 12. A list with comets from the years 827 until 1558 in the chronicle of L.F. Cattenbelt.[46]

The meaning of classical, medieval, and biblical examples was particularly related to epidemics, famines, and wars, and will therefore be discussed in *Chapter 3*. For now, it is important to note that chroniclers such as Billet and Cattenbelt used these examples to discern a pattern in God's judgment, as also appears from the preface of one of Billet's chronicles. He wrote:

46 (On the previous page also the years: 41, 55, 450, 454, 700), see: Cattenbelt, 'Eenige gedenckwaerdige geschiedenissen', 161–62.

> For it seems that the good God never wishes to punish humans for their free, unrestrained and reckless lives, without sending them signs and omens beforehand to warn them that the wrath He has against their manifold sins is ready, with the rod in hand, to chastise them. This may come in the form of war, pestilence, famine, or possibly even worse plagues, so that through these warnings we may turn to penance, atonement, and remorse, to reconcile ourselves with Him. For He is a merciful God who does not desire the death of the sinner, but rather that they should live and turn from their ways [Ezekiel 18:23].[47]

Comets were thus interpreted as a sign from God, and often as a harbinger of punishment if people did not change their sinful ways. Yet chronicles have more to offer. We can see how chroniclers were studying past instances and contemporary phenomena, and that their chronicle could act as a compass to anticipate the future. A comet was more than just a sign from God. It was a message that could be deciphered based on the physical characteristics of the phenomenon. So, while chroniclers did not precisely know what awaited them upon witnessing a comet, some believed they could assess the severity of the potential consequences. They did this based on the comet's length, duration, and position, characteristics that were often recorded by chroniclers. An example of how they reasoned with this information can be seen in Billet's chronicle:

47 'Want het schijnt dat den goeden Godt de menschen noeijt en wilt straffen om hun Liber ontbonden ende Roeckeloos leven, tensij dat hij hun altijt van ten vooren teeckenen ende voorboden sent om te waerschauwen dat de Gramschaep die hij heeft tegens haere menichvuldighe sonden gereet staet met de roede inde handt om hun te Castijden, met Oorloge peste ende dierentijde, ofte moghelijck noch met ergher plaeghen, Om dat wij door deselve waerschauwinge ons sauden begheven tot de penitentie Boete ende berauw, om ons daermede met hem te versonnen, want hij eenen bermhertigh Godt is die de doodt vanden sondaer niet en begeert maer dat hij leve ende hem bekeere [...] [Ezekiel 18:23].' Justus Billet, 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 11', Stadsarchief Gent, Bibliotheek 1LF2 en lGDl, 529 (C. Handschriften), Anden leser [unpaginated].

> On Wednesday the 7th of January 1665, here in Ghent, the comet, or star with the tail (which has been talked about for some days) was seen very clearly and distinctly in the evening between 9 and 10 o'clock. It stood about South to the East, stretching its tail (which was quite clear) towards the Northeast, in terms of the length and width of the same tail (as, after all, we can see) a good 10 or 12 feet long, and about one or one and a half foot wide. However, it did not compare in size and brightness to the star seen in the year 1618, which was more terrifying to behold. May God grant that if we are to be punished for our sins, the plagues may also be proportionately small, and not as great as we heard or saw in the year 1620 and 1621, when in the Kingdom of Bohemia, and surrounding lands of the German Empire, so much blood was spilled, and so much evil was committed, and the lives of so many thousands of people were taken.[48]

Billet compared the comets of 1618 and 1665. Based on an examination of the length and brightness of both comets, he speculated that the potential punishment might be less severe compared to the one of 1618. The latter was followed by the deaths of thousands in Bohemia and the German lands in the subsequent years as a result of the Thirty Years' War (1618-48).[49]

A similar pattern emerges with other meteorological phenomena. Chroniclers recorded various extraordinary meteorological observations in an attempt to decipher God's messages. For example, the nun Maria Luyten (c.1542-c.1570) from Weert linked the preternatural occurrences that she recorded with other events, when she wrote about an earthquake in February 1566 that was felt in several places.[50] During the same period, 'In the night between eleven and twelve o'clock, people saw a battle in the sky, a Cross of Burgundy, three coffins, and a red sword in the last two days of February.'[51]

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48 'Wonsdach den 7 Januarij 1665, soo wiert hier tot Ghendt. Des avondts tusschen 9 ende 10 uren seer claer, ende bescheedeli## ghesien de Comete, ofte sterre met den steerte (daermen van o## eenighe daeghen soo veel af ghesprocken heeft) sij stondt a## ontrent Zuijt ten Oosten streckende haeren steert (die tamelick claer was) naer den Nooroosten, weghens de lingde, ende breede van den selven steert (immers naer het ghesichte) wel 10 ofte 12 voeten lanck, ende ontrent eenen voet ofte eenen voet en alf breedt, maer en hadde even wel geen ghelijckenisse in grootheijt, ende viericheyt bij die sterre, diemen sagh in den Jaere 1618, die schrickelicker was om an te sien Godt geve moeten wij om onse sonden ghestraft sijn dat de plaeghen oock naer advenant cleijn mach wesen, ende niet soo groot ghelijck wij in den Jaere 1620 ende 1621 ghehoort ofte ghesien hebben, doen in t' Rijcke van Bohemen, ende omligghende landen van t' Duijtsche Rijcke soo veel bloets wiert ghestort ende soo veel quaets wiert bedreven, ende coste het leven an soo veel duijsende menschen.' Justus Billet, 'Den polytye boeck, … beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 7', Stadsarchief Gent, Bibliotheek 1LF2 en lGDl, 529 (C. Handschriften), fol. 7 recto-verso.

49 Geoff Mortimer, *The Origins of the Thirty Years War and the Revolt in Bohemia, 1618* (Houndmills, 2015).

50 See also: Susan Broomhall, 'Disorder in the Natural World: The Perspectives of the Sixteenth-Century Provincial Convent', in *Religion, the Supernatural, and Visual Culture in Early Modern Europe: An Album Amicorum for Charles Zika*, Studies in Medieval and Reformation Traditions (Leiden, 2015), 240–59.

51 '[…] des naghts tusschen elf en twelf uuren in de loght strijdtbaer volck, dat sich tegen malkander sette als ten strijde; item een Bourgoignons cruijs; item drij dootkisten en een root sweert; dat is gezien de twee

While Luyten did not specify what these signs meant, they did coincide with a period of dearth she had written about a month earlier.[52]

After recording these signs, she detailed the impact of the Great Iconoclasm that began in August of that same year. Moreover, she wrote that two comets had been observed: one in the east, visible for nine days, and, on the fifth day, a second appeared in the west, visible for seven days. Both were alarming to behold, and, according to Luyten, people believed the comets signified that war would erupt in France.[53] Whether Luyten believed this herself, or that she heard or read it somewhere else, we do not know. Some chroniclers recorded predictions when they circulated but refrained from making explicit predictions themselves. Yet, they did record signs and discerned patterns in retrospect, as we can see in Luyten's chronicle.

This can be illustrated with an event three years later. In 1570, Luyten commented on a preternatural event that she had observed three months earlier. Between one and four o'clock at night, on 4 August 1570, Luyten observed 'a miraculous sign, which was terrifying to see [...] I saw it with my own eyes, but it is impossible to describe or write how it was.'[54] What followed is a depiction of the event where white rays of light, clouds, and fog traversed the country like sea waves. She noted that 'at three o'clock it was as if the city was on fire and at exactly four o'clock it became light, and normal again.'[55] Although Luyten did not initially understand its significance, she subsequently made a connection with the All Saints' Flood on 2 November 1570. After detailing the disaster, she wrote that 'the signs which were seen in the sky in August had foretold this flood', demonstrating that she used her chronicle to construct patterns in hindsight.[56]

leste daegen van februari.' Maria Luyten, *Kronijk uit het klooster Maria-Wijngaard te Weert, 1442-1587*, ed. Jos. Habets, Ch. Creemers, and A. Nieuwenhuizen (Weert, 2004), 165.

52 Ibid., 164–65.

53 Ibid., 177–78; Also in 1607, contemporaries believed that a comet indicated war, though the 'opinion of some scholars', according to the Antwerp chronicler Guillame Baten. Guillame Baten, 'Oudheden 1510-1643', fol. 32 recto, Pk. 113, Felixarchief, Antwerpen.

54 '[...] soo wonderlijcke teeckenen, die schrickelijck waeren om aen te sien [...] Ick heb die met mijn eijgen oogen gesien; maer het waer mij onmogelijck te vertellen of te schrijven hoe het was.' Luyten, *Kronijk uit het klooster*, 213.

55 '[...] omtrent drij uuren, doen wiert die loght als een vier, iae, als eene stadt, die in vollen brandt staet, [...] Precies doen de clock vier uuren sloegh wiert het light en men sagh het niet meer.' Ibid., 213–14.

56 '[...] soo dat met reght de teeckenen, die in augusty gesien wierden in de loght, in deesen waeter vloet vermelt is.' Ibid., 216.

From Preternatural to Natural Explanations?

It is evident that chroniclers linked various meteorological signs to providential messages. However, they rarely correlated comets with their effects on nature, as was suggested in natural philosophical theories. On the basis of the works of Aristotle and Ptolemy, natural philosophers posited that comets could cause drought and wind.[57] This type of 'expert' knowledge was available, since chroniclers recorded that 'other' people believed that there was as relationship between a comet's appearance and a period of drought. The Catholic official and merchant, Jan de Pottre (1525-1601) wrote in 1580:

> And there has been seen a star with a tail or Comet for a long time, because of which people said it signified drought, and about eight days before Christmas a long-lasting rain began, such that it lasted a very long time and rained a lot afterwards.[58]

It is not clear from this fragment whether De Pottre also believed in the physical influence of comets on Earth, but certain 'people' did. However, there is little evidence that this perspective was embraced by chroniclers.

A chronicler who provided more clarity on the relationship between comets and meteorological phenomena on Earth is the Catholic lawyer and official in the Court of Flanders, Philip van Campene (c.1516-c.1567). He wrote that abnormal weather was not caused by comets or other signs in the sky, but by the behaviour of people themselves. Van Campene wrote that:

> This unpleasant weather occurs because of our sins, and particularly because of disbelief, as people put too much faith and trust in the common almanacs, in which some describe on the basis of the positions of the planets and stars the forthcoming changes in the weather. This practice came to us from the heathens who had such trust [in this type of knowledge], which the prophet Jeremiah strongly condemns. Furthermore, some put their faith in the gospel of the *Spinrocke*, who are also deceitful, for example when they say that it will rain for six weeks whenever it rained last on the birth of Saint John, and many similar things. Sometimes God allows these things to happen because of the great disbelief of people, and not because of the causes mentioned above.[59]

57 Nouhuys, *The Age of Two-Faced Janus*, 45, 57, 387; Vermij, *Thinking on Earthquakes*, 31.

58 '[...] Ende daer heeft oever langhe een sterre metten sterte oft Comet ghesien gheweest, daer om dat de lieden sayden dat de droegte bediet, ende ontrent viii daeghen voor kersmysse begost eenen lanckduerighe reghen, alsoe dat daer na zeer langhe duerde ende veel reghende.' Jan de Pottre, *Dagboek van Jan de Pottre, 1549-1602*, vol. 5, Maatschappij der Vlaamsche Bibliophilen 3 (Ghent, 1861), 106.

59 '[...] maer dit onbequaem weder ghebuert om onsen sonden wille, ende bijsonderlic van ongheloove, dat de meynsschen te zeer huerlieder gheloove ende betrauwen stellen upde ghemeene almanacken, inde welcke

Analysing this fragment in more detail, we can identify three distinct types of knowledge that Van Campene addresses, describing what he deems legitimate and illegitimate knowledge. First, there are the astrologers, or more specifically, practitioners of judicial astrology.[60] Van Campene views their practice of making prognostications based on the movements of heavenly bodies as 'pagan' knowledge, with reference to *Jeremiah* 10:2.[61] Second, there is the belief in the Gospel of the *Spinrocke*. This book, written as a satire about women's knowledge, predominantly contains what Van Campene deems 'deceitful' prognostications, dismissing them as 'old wives' tales.'[62] Van Campene concluded that God allowed 'unpleasant' weather to occur, but this was only to punish people for their 'disbelief'. According to Van Campene, the Book of Nature or Biblical events are the only reliable sources of knowledge to interpret meteorological phenomena.[63]

This latter form of knowledge, emphasising understanding both the Bible and nature in tandem, was especially significant. The convergence of these forms of knowledge is underlined by the chroniclers' conviction that a closer study of nature leads to a better understanding of God's actions. This notion is often associated with adherents of the Reformation, but the chroniclers in this section were all Catholic.[64] Moreover, Catholic chroniclers also described meteorological phenomena in a 'secular' way.

The Catholic Marcus van Vaernewijck (1518-69), a merchant and official from Ghent, reflected on an eclipse in April 1567. The citizens of Ghent used mirrors, buckets of water, and papers with holes to observe a solar eclipse where the sun assumed the shape of a 'waxing moon'.[65] Neither he, nor the Calvinists [*Geuzen*] considered the eclipse

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sommeghe bescriven uuter ghestaethede vande planeten ende sterren de toecommende veranderinghe vanden weere, dwelck ons es ghecommen vande heyndenssche, die zulck betrauwen hadden, dwelck den prophete Hieremias seer es mesprijsende. Ten andere, sommeghe stellen huerlieder gheloove up de evangelien vande spijnrocken, die ooc lueghenachtich zijn, als te zegghene dat VI weken reghenen zal, zo wanneer dat reghent up sint Jans gheboorte lestleden, ende vele dierghelijcken, dwelck somtijts God laet gheschieden omme de groote ongheloovichede vande meynsschen, ende nyet uut oorsake voorscreven.' Van Campene and Van Campene, *Dagboek van Cornelis en Philip van Campene*, 343.

60 Jeroen Salman, *Een Handdruk van de Tijd: De Almanak En Het Dagelijks Leven in de Nederlanden, 1500-1700* (Zwolle, 1997), 46; Jorink, *Reading the Book of Nature*, 121.

61 Thus saith the LORD, Learn not the way of the heathen, and be not dismayed at the signs of heaven; for the heathen are dismayed at them.

62 'Evangelien Vanden Spinrocke', accessed 4 August 2021, http://www.volkoomenoudeherbariaenmedisch.nl/evangelien%20vanden%20spinrocke.htm; Carine Grootenboer, 'Een revolutionair positief of een conservatief negatief vrouwbeeld in een laatmiddeleeuws volksboek', *Vooys*, 14, no. 2 (March 1996): 31–37; Herman Pleij, *Het Gilde van de blauwe schuit literatuur, volksfeest en burgermoraal in de late middeleeuwen, opnieuw ingeleid door de auteur* (Amsterdam, 2009), 180.

63 Van Campene and Van Campene, *Dagboek van Cornelis en Philip van Campene*, 343–44.

64 This supports the observations of: Frijhoff, 'Signs and Wonders in Seventeenth-Century Holland. An Interpretive Community'; Jorink, *Reading the Book of Nature*; Walsham, *The Reformation of the Landscape*; For earlier work on the differences between Catholics and Protestants in relation to nature, see: Thomas, *Religion and the Decline of Magic*.

65 Marcus van Vaernewyck, *Van die beroerlicke tijden in die Nederlanden en voornamelijk in Ghendt 1566-1568* (Leiden, 2007).

miraculous, but he noted that a Calvinist believed it was a sign that God's word had been obscured by the demolition of their (Calvinist) church. Van Vaernewijck, however, asserted he would argue 'that the eclipse is natural and how it could occur.'[66] He then explained that an eclipse occurs when the moon traverses in front of the sun, inducing the eclipse without affecting the luminance of other stars.[67] This knowledge, he asserted, was not inherently obvious. However, fear and astonishment could be replaced by an understanding of natural causes, on which he had elaborated in the 25th edition of the '*Leecken Philosopie*', called the '*Hemelsche Bouck*'.[68]

Although Van Vaernewijck did not discern any divine message in this solar eclipse, this did not imply that he attributed meteorological phenomena exclusively to 'natural' causes and mechanisms. As we will see in more detail in *Chapter 3,* for other phenomena that he could not (entirely) explain through natural factors, he resorted to preternatural and providential explanations. The same chronicler could thus explain some meteorological phenomena by citing natural processes in which God played a passive role, while other meteorological phenomena were believed to be sent by an active providential God, often harbouring concealed messages within them. The essence of this message was not unequivocally evident beforehand, but it did function as a first warning.[69] To gauge the intensity of the forthcoming judgement, chroniclers could compare their observations with prior instances, sometimes spanning millennia, serving as a comparative methodology to anticipate potential repercussions.[70] Under the influence of new knowledge, however, a growing number of natural phenomena were increasingly explained by natural processes.

New Knowledge makes the Extraordinary Ordinary

In the eighteenth century extraordinary celestial phenomena such as crosses and armies in the sky largely disappeared from chronicles. Chroniclers persisted in recording their observations of comets, eclipses, and auroras, but they rarely interpreted them as signs of divine providence. Admittedly, these interpretations did not vanish entirely. Some of them continue to resonate today.[71] Although the prevailing sentiment seemed to dismiss a causal relationship between the two, a handful of eighteenth-century chronicles still perceived a connection between comets and war. An anonymous chronicler from

66 '[...] dat den eclips natuerlic es, ende bij wat middel dat hij gheschien mach.' Ibid., 173.

67 Ibid., 173–74.

68 Until today no copies of this text have come to light. Ibid., 175.

69 Van Egeraat, '"Zoo Zij Ghesindt Waeren"', 44.

70 For other examples of reasoning by analogy in the early modern period, see: Judith Pollmann, *Memory in Early Modern Europe, 1500-1800* (Oxford, 2017), chap. 2.

71 Kees van den Brink, 'Tekenen der tijden in 2023: niet alleen aardbeving, overstroming en oorlog', *RD.nl*, 29 December 2023; Nuweira Youskine, 'Vingerwijzingen van God zijn nergens zo zichtbaar als in de natuur', *Trouw*, 15 August 2013.

Maastricht, for example, wrote in March 1742 that 'according to some a comet signified a bloody war.'[72] In Versenare, near Bruges, three years later, the sacristan J. Vermeersch wrote: 'Many old people who still have seen stars with tails concluded that Holland and England would be most harmed', referring to the Battle of Fontenoy (1745) during the War of the Austrian Succession (1740-48).[73]

Typically, when a new phenomenon was perceived, chroniclers would initially attempt to explain it through natural causes, rather than swiftly invoking divine intervention. Lieuwe Jans de Jong, a Mennonite farmer from Poppenhuizen (1798-1842), observed 'blood red clouds' on 18 February 1832. His preliminary hypothesis was that it could be a form of aurora borealis, but he also remarked that 'approximately at the same time, planet Mars passed behind the moon which probably made a contribution to the light.'[74]

That comets and other signs in the sky were no longer interpreted in providential terms was a result of the fact that these phenomena could increasingly be explained through natural processes. This can be observed in the chronicle of the Reformed teacher, official, and farmer Doeke Wijgers Hellema (1766-1856). This chronicler, residing in the small village of Wirdum in the province of Friesland, described the visibility of Halley's comet to the naked eye on 10 October 1835:

> The tailed star, or comet Halley, sinks so deep in the west that it is now invisible. It was at its most visible in the evening around 7 to 8 o'clock, high in the sky, shooting an amazingly long tail, sometimes visually ranging from 10 to more feet. My labourer once saw it at 5 o'clock in the morning in the northeast with such a terrifying tail that he was startled by it. During its appearance, people became so accustomed to this natural phenomenon that they hardly paid any attention to it.[75]

72 '[...] het geene door somige beteekent enen bloedigen oorlog.' Anoniem, 'Chronyk van Maestrigt, 1750-1800', Regionaal Historisch Centrum Limburg, Maastricht, 22.001A Handschriftencollectie GAM, inv.no. 653, 137.

73 '[...] Veele Oude Menschen die nog sterren met Steerten gesien Hadden, die Oordeelden dat hollandt, en Enghelandt Het erste Souden Wegh dragen.' J. Vermeersch, 'Kronijk van Antwerpen', Felixarchief, Antwerpen, Pk. 134, unpaginated.

74 'Ook op dit ogenblik of ongeveer deze tijd ging de planeet Mars achter de maan door, mogelijk was dit mede werkend.' Lieuwe Jans de Jong, *De dagboeken (1825-1855) van Lieuwe Jans de Jong, boer te Poppenhuizen onder Oldeboorn*, ed. L.J. de Jong (Aldeboarn, 1998), 108.

75 'De staartster of komeet Halleij, zakt zoo diep in het westen dat hij thans onzigtbaar wordt. Zij stond gedurende den tijd op het zigstbaarste 's avonds om 7 a 8 uur hoog aan het firmament schietende een verbazende lange staart, op het oog somtijds wel van 10 tot meerdere voeten, zoo zag mijn arbeider haar eenmaal 's morgens 5 uur in het N.Oosten met zulk een vervaarlijken staart, dat hij er van schrikte. Gedurende hare verschijning wierd men zoo gewoon aan dit natuurverschijnsel, dat men er naauwelijks meer op lette.' Doeke Wijgers Hellema, 'De Dagboeken van Doeke Wijgers Hellema, 1766-1856', ed. H. Algra, Tresoar Leeuwarden.

Instead of interpreting this comet as a sign of divine providence, it was now perceived as a 'natural' instead of a 'preternatural' phenomenon. What Hellema did not say, but what nevertheless may have played a role in this change of attitude is that the comet's arrival had not been unexpected. Contemporaries had devised more precise explanations for the origins of comets, meaning that *content* and *direct* biases played an important role. They could anticipate their appearance, thus chroniclers knew what to expect. The regularity of Halley's comet was discovered in 1705 and confirmed by its re-appearance in 1758. Therefore, its subsequent visibility in 1835 did not catch anyone off guard, especially as a comprehensive news bulletin in the local newspaper described its position even the day prior to Hellema's record.[76] In other words, comets did not appear 'unexpectedly' or as a result of sinful behaviour, but followed a pattern according to natural laws which He created and which could be observed by the chroniclers.

We see a similar example in the changing explanations for tides, and particularly spring tides. In the dissemination of new knowledge, new media such as newspapers played an important role. Both Hellema and De Jong copied an article from the *Leeuwarder Courant*, which explored the causes of the flood in February 1825 that ravaged parts of Germany and the Low Countries.[77] According to the German astronomer Heinrich Wilhelm Olbers (1758-1840), the inundation was initiated by a confluence of the sun's position, a full moon, and a north-westerly wind.[78] Six months later, Hellema reflected again on the role of celestial entities in relation to floods, referring to his notes from earlier that year, positing that the moon's position influences water levels.[79]

Although Isaac Newton (1642-1727) had called attention to the relationship between gravity and tides in the late seventeenth century, this example shows that Hellema was probably not previously familiar with the concept that (spring) tides are partly caused by the position of the moon. His reference to 'experts' [*deskundigen*] and the fact that he revisited it six months later show that he regarded it as a plausible explanation.[80] This means that for both comets and (spring) tides, new knowledge had become accessible and that it could be verified. This made it easy to accept a new explanation.

Why the Extraordinary Remained Extraordinary

From the eighteenth century onwards, meteorological phenomena like comets were thus less frequently explained in a providential way by chroniclers. In line with what Jorink and Walsham have previously argued, the focus shifted to the underlying 'natural'

76 'Leeuwarder Courant', 9 October 1835.

77 De Jong, *De dagboeken (1825-1855) van Lieuwe Jans de Jong, boer te Poppenhuizen onder Oldeboorn*, 6–7; Hellema, 'De Dagboeken van Doeke Wijgers Hellema, 1766-1856', 79–80; 'Leeuwarder Courant', 1 March 1825.

78 Ibidem.

79 Hellema, 'De Dagboeken van Doeke Wijgers Hellema, 1766-1856', 144.

80 Isaac Newton, *Philosophiae Naturalis Principia Mathematica* (London, 1687), vol. 3.

mechanisms according to which nature operated. However, this shift did not apply to abnormal weather or earthquakes. With regard to the former, it was commonly known that seasons were caused by Earth's position relative to the sun, but significant deviations in the seasons were harder to explain, even after the invention of instruments, such as the thermometer and the barometer, allowed for measuring and predicting them. For earthquakes, a wide variety of theories emerged that were heavily debated among scholars, but which were difficult to verify.[81]

Earthquakes

There were no breakthroughs in the knowledge of earthquakes in the early modern period. Although knowledge of meteorological phenomena proliferated rapidly during the eighteenth century, it was not until the nineteenth century that scholars determined that earthquakes occurred along fault lines. According to Rienk Vermij, 'In 1500, people had no idea what caused earthquakes and in 1800, this was not different.'[82] So how did this affect the chroniclers' view of them?

Earthquakes were one of the most frequently recorded meteorological phenomena, yet chroniclers seldom reflected on them. This can be partly explained by the fact that earthquakes were rare in the Low Countries.[83] Many chroniclers copied classical and medieval accounts of earthquakes, mainly across Europe, leading to epidemics, crop failures, and periods of dearth. We will discuss this further in *Chapter 3*. For the purpose of this chapter, it is important to note that in their own time, these causal relationships were rarely made.[84] In fact, only a few chroniclers reflected on the meaning of earthquakes, but when they did, they were often interpreted as portentous signals or warnings of God's displeasure, with specific details such as timing, location, and extent of damage being notably significant.[85]

This interpretation aligned with descriptions in the books of *Isaiah*, *Job*, and *Samuel*, where earthquakes are depicted as divine exhibitions of God's anger.[86] For example, the Catholic chronicler Jozef Jakob de Munck (1740-92) from Mechelen, who experienced the earthquake near Düren in 1756, noted that although it inflicted minimal damage in his hometown, a decree was promulgated by local authorities within five days, asserting that 'it is forbidden to organise masquerades and open dance schools on the

81 Vermij, *Thinking on Earthquakes*.

82 Ibid., 2.

83 Exceptions are the (minor) earthquakes on 18 September 1682 and 18 February 1756.

84 An exception is the nun Maria Luyten. See the years 1566 and 1569 in: Luyten, *Kronijk uit het klooster*.

85 See for example: Ibid.; Pieter Van Godewijck and W.M. van der Schouw, *Dese heerlicke stadt: een zeventiende eeuwse kroniek van Dordrecht* (Dordrecht, 2006); Jan Kluit, 'Historische Jaerboeken der stad Briel, deel 2, 1e stuk, 1757-1762', Streekarchief Voorne-Putten, Rozenburg, 501 Kluit, inv.no. 3; Louwen, 'Kronijk der stad Purmerende [...] deel 1'; M. F. Hendrizkszoon Pelckmans, 'Lovens chronycksken 1747-1807, deel 1', Stadsarchief Leuven, Oud Archief Ms 57; De Jong, *De dagboeken (1825-1855) van Lieuwe Jans de Jong*.

86 Isaiah 2:9, 5:25, 13:13, 24:18– 19, 29:6, and 64:1– 3. Job 9:6. 2 Samuel 22:8, Psalm 18:8.

next Shrove Tuesday due to the earthquake.'[87] Although De Munck does not reveal what he thought of it, it is known that dancing and revelries were often deemed licentious and sinful, prompting local authorities to curb such activities to appease God's wrath.[88] Additionally, the chaplain Hendrik Dominik van den Nieuwenhuysen (1724-80) also from Mechelen, wrote that after the earthquake days of prayer were declared throughout the diocese for the subsequent six weeks, culminating in a procession.[89]

Another chronicler who recorded the Düren earthquake, but who was unaffected by it directly, was the Reformed tax collector and official Jan Kluit (1722-1811) from Brielle. He wrote, 'due to God's mercifulness we have been spared, and therefore we perceive only our current disasters with anxiety and fear.'[90] Kluit wrote, among other things, about the cattle plague, which he also interpreted as divine retribution. Despite this, he was relieved that Brielle had been spared from the earthquake.

This was also true for the most devastating earthquake of the early modern period, which virtually flattened the city of Lisbon on All Saints' Day, 1 November 1755, and which was widely reported in the newspapers. Despite being one of the most widely documented events by the chroniclers in this corpus, only a few chroniclers reflected on the event.[91] Kluit wrote:

> On 1 November, the city of Lisbon and a large part of the kingdom of Portugal were turned upside down by a most terrifying earthquake, causing a huge number of people to be buried under the rubble. We therefore have double reason to thank God, that of this punishment we have only been touched by the tip of His finger.[92]

In contrast to comets, which caused no direct harm and could be partially predicted from the eighteenth century onwards, earthquakes were persistently interpreted as

87 '[...] by ordonnantie politiecq verboden de masquerades en danscholen in den aenstaenden vasten avond ter oorsaeke van de aertbevinge.' Jozef Jacob de Munck, 'Iaer-Boecken van Mechelen', Stadsarchief Mechelen, EE Kronieken en Jaarboeken XX 1, unpaginated, date: 23-02-1756.

88 Alessandro Arcangeli, 'Moral Views on Dance', in *Dance, Spectacle, and the Body Politick, 1250-1750*, ed. Jennifer Nevile (Bloomington, 2008), 282–94.

89 Hendrik Dominik van den Nieuwenhuysen, 'Deel 4 Kroniek van Mechelen Door Kapelaan Hendrik Dominik Van Den Nieuwenhuysen', Stadsarchief Mechelen, Varia 832/1, unpaginated, date: 16/17/18-01-1756.

90 '[...] zoo zijn wij door Godts goetheit van alle rampen dies aangaande bevrijt gebleven en dus sien wij alleen onse onheijlen voor het tegenwoordige sig met de schrik en vreese bepaalt.' Jan Kluit, 'Historische Jaerboeken der stad Briel, deel 1, 2e stuk, 1752-1756', Streekarchief Voorne-Putten, Rozenburg, 501, inv.no. 2, 1058–59.

91 See, Appendix 7.

92 '[...] de selven 1e November de stadt Lissabon en een groot gedeelte van het koningrijk Portugaal door eene alderverschrickelijkste aartbeving was ondersteboven gekeert, waardoor een ontsaggelijk getall menschen onder de puinhopen zijn gedolven geworden, zoo dat wij wel dubbelde reeden hebben on Godt te danken, dat wij van dese straffe als maar met den vinger zijn aangeroert geworden.' Kluit, 'Historische Jaerboeken der stad Briel, deel 1, 2e stuk, 1752-1756', 1035.

a form of divine retribution by chroniclers. This also applied to seasonal anomalies, especially severe winters.

Cold Winters

Winter weather is the meteorological phenomenon most frequently recorded by chroniclers, but when taking a closer look, we see that, as with periods of dearth, they especially noted when the winters were extremely cold. This can be explained by the fact that extremely cold winters occurred more frequently than comets and earthquakes, and moreover often had a major impact on society. We have seen in *Chapter 1* that chroniclers linked fluctuating grain prices to cold winters, and in the next chapter, we will see the influence of the weather on the spread of epidemics. But chroniclers also compared these winters with each other for a more fundamental reason. Often, contemporaries started keeping a chronicle during a cold winter, not only to record the disasters that followed but specifically to gain insight into divine providence.[93]

In the early modern period, it was generally accepted that seasons were caused by astronomical phenomena such as the position between the Earth and the Sun.[94] A deviation was often interpreted as a preternatural event, and thus a sign of divine intervention. Just as with comets, chroniclers recorded the various characteristics of the phenomenon, such as the duration and severity of the cold. Before the invention of the thermometer, this included the thickness of the ice or for how long seas, rivers, and lakes were frozen. On 18 December 1564, for example, Van Haecht described how a period of hard frost began, followed by a cold winter, with effects that had not been witnessed for a century. The river Scheldt froze over and sailors who could not reach the harbour in time froze to death. The cold winter had such an impact that it prompted Van Haecht to start a chronicle.[95]

93 Van Haecht, *De kroniek van Godevaert van Haecht*; Veen, 'Oostzaandammer kronijk'; Kluit, 'Historische Jaerboeken der stad Briel, deel 1, 2e stuk, 1752-1756'.

94 Anne Lawrence-Mathers, ed., 'Conclusion: The Afterlife of Medieval Meteorology', in *Medieval Meteorology: Forecasting the Weather from Aristotle to the Almanac* (Cambridge, 2019), 194.

95 Van Haecht, *De kroniek van Godevaert van Haecht*, 3–4.'

In the subsequent years, Van Haecht experienced several more cold winters, which he then compared with each other. For instance, four years later, in 1568, he wrote:

> Also, the winter of this current year of 1568 was very cold, very much like the year 1564, but because in Antwerp one could not cross the Scheldt on the ice before the city, this winter was not considered so cold, yet it was a swift cold. And it began on the 8th day of December, and on the 12th day people crossed all the frozen rivers; so that in Antwerp at the castle, in 2 or 3 nights, 10 Spaniards, who were sickly, died of cold as they are unaccustomed to such cold.[96]

Another four years later, in December 1572, Van Haecht wrote: 'This month and the previous month, it was as cold as never seen before Christmas, [...] and it was a great wonder that now the Scheldt did not freeze over before Antwerp like in the year 1564.'[97]

Such observations can be found in most chronicles in which comparisons were made between different years. From the eighteenth century onwards, temperature measurements were also included.[98] Although most eighteenth-century chroniclers

96 'Item den winter van dit teghenwoordich jaer van 1568 was seer cout en seer te gelycken by het jaer 1564, maer omdat men tot Antwerpen voer de stat niet over den Scelde ten ys en ginck, so en werdt desen winter so cout niet geacht, nochtans was 't een snelle coude. Ende beginde op den 8 dach Decembris ende op den 12 dach ginck men over alle stille riviren; also dat tot Antwerpen opt casteel in 2 of 3 nachten 10 Spaengiarden van coude sturven van die sieckachtig waeren, mits sy sulcken coude ongewoon syn.' Ibid., 62.'

97 'Dese maent en de voergaende maent was 't so grooten coude als oyt voor kerssmisse gesien was, [...] ende 't was groot wonder, dat nou het Scelt niet toe en bleef voer Antwerpen gelyck in 't jaer 1564.' Ibid., 225.'

98 Hoyte Roucoma, *Dronrijps Memoriael*, ed. K. Terpstra (Leeuwarden, 1986); Jacobus Barnaart junior, 'Dagverhaal van merkwaardige voorvallen aangetekend door Jacobus Barnaart Junior te Haarlem, 1747-49', Noord Hollands Archief, Haarlem, 18528 JS; Anoniem, 'Cronijk van Brabant en Vlaenderen. II.', Stadsarchief Brussel, ASB Archives historiques, Registre 2925; Bontius de Waal, 'Oorspronck en opkomst der stede Alckmaar'; Jan Kluit, 'Historische Jaerboeken der stad Briel, deel 2, 2e stuk, 1763-1767', Streekarchief Voorne-Putten, Rozenburg, 501, inv.no. 4; Bikker Raye, 'Notietie van het merkwaardigste'; Nieuwenhuysen, 'Deel 4 Kroniek van Mechelen Door Kapelaan Hendrik Dominik Van Den Nieuwenhuysen'; Anoniem, 'Opmerkingen van eenige zaeken in de stad Brussel voorgevallen', Stadsarchief Brussel, ASB Archives historiques, Registre 3106; Johannes Chrysostomus van Postel, *Het dagboek of De kroniek door Pastoor J(oannes) C(hrysostomus) van Postel.*, ed. Henri H.H. Uyttenbroeck, Bijdragen tot de geschiedenis van Venlo 3 (Venlo, 1912); Pelckmans, 'Lovens chronycksken 1747-1807, deel 1'; François Xavier van Quickenborne, 'Beschryvinge van het merkweerdigste dat voorgevallen is binnen en omtrent Gend, beginnende met 't jaer 1787', Universiteitsbibliotheek Gent, BIB.G.006074; Roelof Storm, 'Dagboeken van Roelof Storm' Historisch Centrum Leeuwarden; Symon Bakker, 'Kroniek van Broek in Waterland over de jaren 1282-1818, samengesteld door Symon Bakker, 19e eeuw', Noord Hollands Archief, Haarlem, 176 Losse Aanwinsten (verkregen tot 1984) van het Noord-Hollands Archief te Haarlem, 14.1.3.2, inv.no. 1534; Johannes in de Betouw, *Vervolg der Kronijk van Nijmegen, tot den jare 1818*, ed. C.J. van (Nijmegen) Goor en zoon (Nijmegen, 1818); Cornelis Pieter Sorgdrager, *Memorij: het dagboek van Cornelis Pieter Sorgdrager*, ed. W.J. Maas and P.B. Schuringa (Hollum, 1982); Anoniem and H. S., 'Vervolg op de kroniek van Hoorn van D. Velius, eerste deel tot 1794', trans. D.C.A. Abbing, Noord Hollands Archief, Haarlem, 176 Losse Aanwinsten (verkregen tot 1984) 1544; Jan Baptist de Beer, 'Kroniekje van Tilburg over 1774-1854', Regionaal Archief Tilburg, 338 Collectie handschriften Tilburg, inv.no. 1; De Jong, *De dagboeken (1825-1855) van Lieuwe Jans de Jong*; Jan Willem van Druijnen and Gerrit van Druijnen, *Leven aan de Waal, of Vervolg der Kronijk van Nijmegen 1819-1859*, ed. A Bosch, A.E.M. Janssen, and A.T.S. Wolters-Van

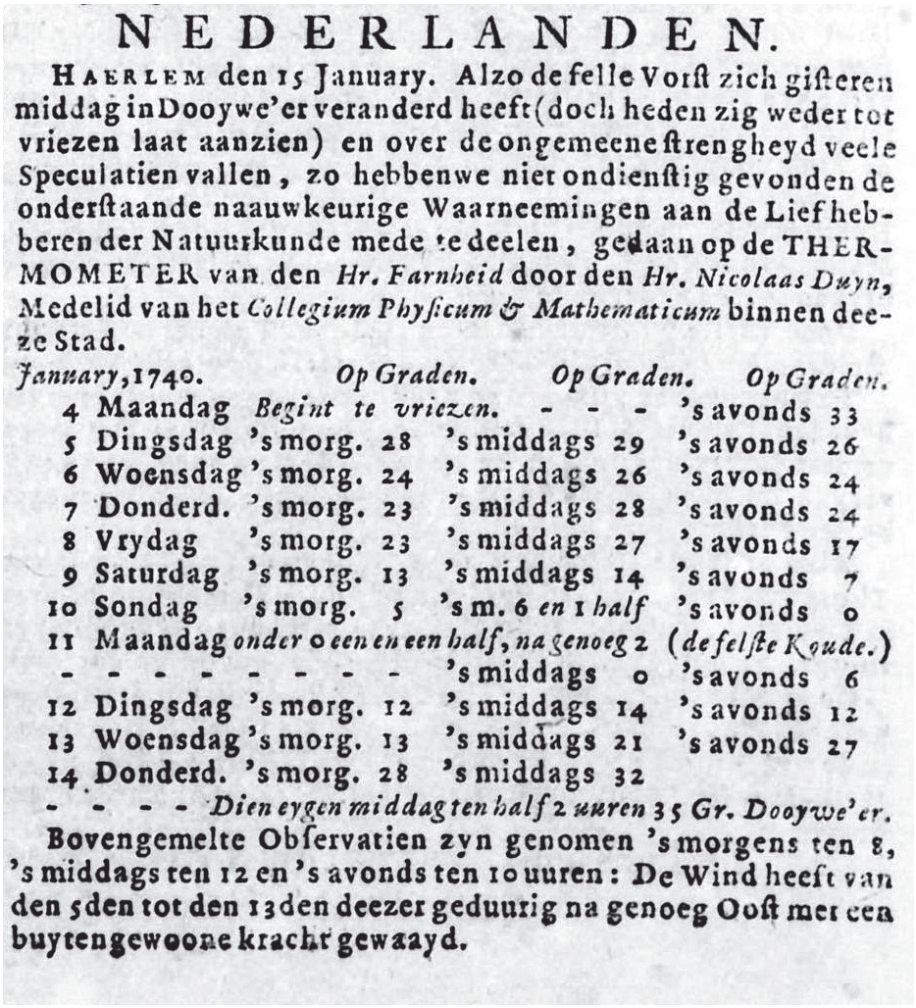
did not use the new instruments themselves, they copied the measurements from the newspaper and then used them for their own reasoning.[99] The Reformed chronicler and schoolmaster Hoyte Stoffels Roucoma (1661-1719) from the village of Dronrijp (Friesland) recorded in 1716 the first temperature measurements that I encountered in this corpus. He wrote that temperatures were measured using a '5-feet long thermometer, set at 90 degrees.'[100] The results were tabulated to facilitate comparisons between the temperatures in January of 1709 and 1716. Both winters had been etched in the collective memory as severe. Yet, these figures permitted a more nuanced comparison. Although Roucoma did not reveal his source, closer examination points to an Amsterdam newspaper that had used a table compiled by 'Professor of Mathematics' Balthasar Mentzer III (1651-1727).[101]

der Werff (Nijmegen, 2011); T.F. Haagsma, 'Kroniek van T.F. Haagsma 1840-1899', Historisch Centrum Leeuwarden, 3079 Thijmen Feddes Haagsma, waagmeester te Grouw, 1840-1899.

99 For an exception, see: Leurink, *Tot Losser gekomen*; For more information on what kind of people owned such instruments, see: Huib J. Zuidervaart, 'Cabinets for Experimental Philosophy in the Netherlands', in *Cabinets of Experimental Philosophy in Eighteenth-Century Europe* (Leiden, 2013), 11; For more information on the use and acceptance of 'weather' instruments, see: Golinski, *British Weather*.

100 'Vergelijking van de koude, sooals die is geweest in Januarij 1709 en nu van dit lopende jaar 1716, zeer naukeurig geobserveerd op een thermometer van 5 voeten lang, die op 90 graden is gesteldt.' Hoyte Roucoma, *Dronrijps Memoriael*, ed. K. Terpstra (Leeuwarden, 1985), 70.

101 'Amsterdamse Courant', 28 January 1716.



NEDERLANDEN.

HAERLEM den 15 January. Alzo de felle Vorſt zich giſteren middag in Dooywe'er veranderd heeft (doch heden zig weder tot vriezen laat aanzien) en over de ongemeene ſtrengheyd veele Speculatien vallen, zo hebbenwe niet ondienſtig gevonden de onderſtaande naauwkeurige Waarneemingen aan de Liefhebberen der Natuurkunde mede te deelen, gedaan op de THERMOMETER van den *Hr. Farnheid* door den *Hr. Nicolaas Duyn*, Medelid van het *Collegium Phyſicum & Mathematicum* binnen deeze Stad.

January, 1740.		*Op Graden.*		*Op Graden.*		*Op Graden.*
4	Maandag	*Begint te vriezen.*	- - -	's avonds	33	
5	Dingsdag	's morg. 28	's middags 29	's avonds	26	
6	Woensdag	's morg. 24	's middags 26	's avonds	24	
7	Donderd.	's morg. 23	's middags 28	's avonds	24	
8	Vrydag	's morg. 23	's middags 27	's avonds	17	
9	Saturdag	's morg. 13	's middags 14	's avonds	7	
10	Sondag	's morg. 5	's m. 6 *en* 1 *half*	's avonds	0	
11	Maandag	*onder* 0 *een en een half, na genoeg* 2				(*de felſte Koude.*)
-	- - - - - - - -		's middags 0	's avonds	6	
12	Dingsdag	's morg. 12	's middags 14	's avonds	12	
13	Woensdag	's morg. 13	's middags 21	's avonds	27	
14	Donderd.	's morg. 28	's middags 32			

- - - - *Dien eygen middag ten half 2 uuren 35 Gr. Dooywe'er.*

Bovengemelte Obſervatien zyn genomen 's morgens ten 8, 's middags ten 12 en 's avonds ten 10 uuren: De Wind heeft van den 5den tot den 13den deezer geduurig na genoeg Ooſt met een buytengewoone krachr gewaayd.

Figure 13. Temperature measurements copied by Joachim Bontius de Waal in his chronicle from the Oprechte Haerlemsche Courant, 16-01-1740.[102]

A similar comparison was made by the Catholic city archivist Joachim Bontius de Waal (1702–59) from Alkmaar. In 1740 he wrote that 'the cold [...] was so extraordinary fierce and vehemently that no elderly person could remember anything like it.'[103] De Waal continued by copying a list with 'the most accurate observations made by [the 'meteorologist'] Mr Nicolaas Duijn' (*Figure 13*).[104] A list of morning, afternoon, and

102 'Oprechte Haerlemsche Courant', 16 January 1740.

103 '[...] soo extraordinairie fel en vehement geweest als geen bejaerden menschen mogten gedencken.' Bontius de Waal, 'Oorspronck en opkomst der stede Alckmaar', 28.

104 '[...] de nauwkeurigste waerneeminge gedaen door den heer Nicolaas Duijn. Duijn was a member of the college of physics and mathematics in Haarlem.' Ibid.

evening temperatures for the dates from 4 to 14 January was published in the Haarlem newspaper.[105] However, in De Waal's chronicle only the lowest temperatures are included, and he himself made a comparison with the year 1709, since he wrote:

> On Monday, the 11th of January, at 8 o'clock in the morning, it was 1½ degrees below zero; at 12 o'clock in the afternoon, nearly 2 degrees; and at 10 o'clock in the evening, the most intense cold. This and the preceding day, the cold was found to be 8 degrees stronger than in the year 1709, with various canals here frozen to the bottom, so that not a single drop of water could be obtained from them.[106]

The emphasis on the temperature measurements that were the lowest and the comparison with the extremely cold winter of 1709 suggest that chroniclers wanted to know as accurately as possible which winter was the coldest. But for what purpose? In 1740 the Reformed tax collector and official Jan Kluit (1722-1811) from Brielle wrote in his chronicle:

> This most severe winter was, as has often happened under such circumstances, merely a harbinger of much worse disasters and mishaps. In itself, the cold was the first calamity, but from it sprang a second, which was that almost everywhere the grain was frozen, added to the utterly woeful and wet harvest of the year 1739. This caused not only the grain but also the feed for the animals in the fields to rot.[107]

The cold winter was the first of three disasters, from which a poor harvest followed. In combination with the War of the Austrian Succession (1740-48), this had heralded a period of 'great poverty' in Kluit's view.[108] According to Kluit, and the Reformed chronicler Cornelis Veen from Zaandam, the cold winter of 1740 was the first sign that other disasters would follow.[109] While war and dearth were primarily caused by

105 'Oprechte Haerlemsche Courant', 16 January 1740.

106 '[...] op maendag den 11 january 's morgens ten 8 uuren onder nul 1½ graed, 's middaegs ten 12 uure naegenoeg 2 graeden en 's avondts ten 10 uuren de felste koude, sijnde deesen en de voorgaende dag de koude 8 graeden stercker bevonden als in 't jaar 1709, sijnde alhier verscheyden gragten tot op de grondt toe bevrooren geweest, soodat daer geen droppel waeter uyt te bekomen was.' Bontius de Waal, 'Oorspronck en opkomst der stede Alckmaar', 28.

107 'Dese allerstrengste winter was, gelijk wel meer geschiet in zodanige gelegentheden, maar een voorbode van veel swaarder rampen en ongevallen. In sigselfs was wel de koude de eerste ramp, maar daaruit sproot een tweede, dewelke was dat door de felle vorst het koorn meest overal was uitgevroren, gevoegt bij de gants bedroefde en natten oegst van den jare 1739, waardoor niet alleen het koorn, maar ook het voeder der beesten op de landen was verrot.' Kluit, 'Historische Jaerboeken der stad Briel, deel 1, 1e stuk, 1747-1751', 27.

108 Ibid., 30–33.

109 Veen, 'Oostzaandammer kronijk', fol. 3 recto-4 recto.

human actions, this was not the case for extraordinary cold winters. The only possible explanation, according to the chroniclers, was divine intervention.[110] Recalling what people had said to each other in 1740, Kluit wrote: 'It seems as if our climate had changed. There were no cold winters or hot summers like in previous years. Yes, since 1729, there has been no [severe] winter.'[111] Kluit conveyed that many no longer believed God would punish as He had in the past, yet the cold winter of 1740 served as a 'little tip of His rightful wrath.'[112]

Kluit not only deduced the measure of God's wrath by comparing cold winters but also by studying the amount of rainfall in various years.[113] For example, a comparison between the years 1762 and 1766 showed that in the latter year, God was more favourably disposed towards his people. In that year he wrote: 'the all-blessing God still pours out His mercy over our Fatherland instead of calamities.'[114] This way of thinking in which inquiries into nature would lead to a fuller understanding of God's design of the world and his intentions for his creation remained dominant until the second half of the nineteenth century.

The Anabaptist Cornelis Kartensz. Dekker (1741-1816) compared the water level in 1791 with that of 1775 to illustrate that through 'God's goodness' the water receded in time so that it did not cause damage.[115] In the nineteenth century, the Reformed mayor Symon Bakker (1783-1836) from Broek in Waterland compared rainfall between the years 1816 and 1817, from January to August, concluding that 'God visits people with well-deserved punishments and judgements.'[116]

We do not see new explanations emerging in early modern chronicles for earthquakes and abnormal seasons.[117] Yet, chroniclers did make use of new knowledge as soon as it became available. For example temperature measurements and rainfall readings, which began to be published more frequently in newspapers and periodicals from the eighteenth century onwards. These measurements enabled chroniclers to make more accurate comparisons between meteorological phenomena, and to read nature

110 See for example: Ibid., fol. 5 recto-6 recto; Vermeersch, 'Kronijk van Antwerpen', unpaginated.

111 '[...] het schijnt alsoff ons climaat verandert was, men heeft geen koude winters off heete somers meer als in vorige jaren, ja men heeft immers sedert het jaar 1729 geen winters gehadt.' Kluit, 'Historische Jaerboeken der stad Briel, deel 1, 1e stuk, 1747-1751', 41–42.

112 '[...] een stipje van zijne regtmatige gramschap.' Ibid., 43.

113 See also: Louwen, 'Kronijk der stad Purmerende [...] deel 1', 366–72.

114 '[...] dat de Alzegenende God in plaats van onheijlen Zijne goedertierenheid over ons vaderland nog steets uitstort.' Kluit, 'Historische Jaerboeken der stad Briel, deel 2, 2e stuk, 1763-1767', 1412.

115 '[...] om half 12 begon het water weder te sakken en heeft door gods goedheyd geen schaden veroorsaakt.' Dekker, 'Aantekeningen in chronologische volgorde' unpaginated. Date: 01-02-1791.

116 '[...] Waarin God den Menschen Met Welverdiende Straffen en Oordeelen Bezoekt.' Bakker, 'Kroniek van Broek in Waterland', unpaginated.

117 Jorink, *Reading the Book of Nature*, 398.

as 'a sensitive barometer of moral disorder and a vehicle by which God habitually communicated with human beings.'[118]

Yet, while the notion of an active and punishing God remained important throughout the early modern period in relation to earthquakes and anomalous seasons, comets were no longer interpreted as a sign from God from the eighteenth century onwards. In other words, the explanation of meteorological phenomena based on natural processes did not occur simultaneously for each phenomenon. The transition was not linear for every meteorological phenomenon—from a God who actively intervened, to a God who operated at a distance. We can also see this in how chroniclers described lightning.

New Knowledge of Nature is New Knowledge of God

From the eighteenth century on, experts increasingly described lightning as a 'natural' process.[119] This is often attributed to the invention of the lightning rod around 1750. However, this invention did not immediately lead to a decline in providential explanations among non-experts. It was not until the mid-nineteenth century that such explanations for lightning diminished in favour of natural explanations. Why new explanations for the origin of lightning were found only around 1850, while these were available among experts a century earlier, is the question that will be answered in the last section.

A New Understanding of Electricity

Much like severe winters, storms and lightning were predominantly chronicled when they wrought damage to churches and dwellings or caused human deaths. They were perceived as divine signals, as articulated by Van Haecht in August 1570: 'The Supreme Lord sent great thunder with lightning and rain.'[120] In the eighteenth century, the descriptions of storms and lightning in the chronicles changed. Lightning was not only a sign of destruction, but it also had positive effects such as purifying the air. One of the first observations indicating that chroniclers began to view lightning in a new way can be found in the chronicle of the Reformed farmer and alderman from the village of Huizen, Lambert Rijckxz Lustigh (1656–1727). He wrote:

118 Walsham, *The Reformation of the Landscape*, 393.

119 Buisman, *Onweer*, chaps 3–4; For an example of an 'expert' chronicler in meteorology, see: Barnaart junior, 'Dagverhaal van merkwaardige voorvallen', 44–45.

120 '[...] ende [...] den oppersten heere ende donderde seere met blicxemen en regenen.' Van Haecht, *De kroniek van Godevaert van Haecht*, 133.

> For they say [*natural philosophers*] that, through loud thunderclaps and lightning bolts, and through heavy downpours, the Lord our God tends to break the destructive and pestilential airs, vapours, and poisonous dews, and to remove their stench, though whether this is true or not, our lord knows best.[121]

This corresponds with the observations of Vermij and Jan Wim Buisman who argued that since the mid-seventeenth century, and especially since the eighteenth century, both Catholics and Protestants leaned towards viewing nature as a testament to God's providence and His care for all creation, rather than as a stage for His wrath and judgement.[122] In a Dutch context this shift in perspective is often encapsulated by the term 'physico-theology', which is represented by scholars such as Bernard Nieuwentijt (1654-1718), and was disseminated to a wider audience through ministers like Jan Floris Martinet (1729-95).[123]

Based on sources of experts and printed source material, Buisman has recently argued that storms and lightning in the eighteenth century were increasingly seen not as God's punishment but as manifestations of His glory and demonstrations of His divine handiwork. Storms and lightning were benevolent, as they clarified the atmosphere, enriched the soil, and eradicated epidemics.[124] Especially with the introduction of the conductor, lightning was regarded as harmless.[125] In printed media we can read that in 1777 contemporaries regarded lightning as the 'convincing evidence of His presence, power, and incomprehensible greatness of the eternal prime mover.'[126] The minister Martinet even encouraged parents to take their children outside during a storm, to teach them to observe the magnificence of God while overcoming their fear.[127]

In chronicles, however, there initially seems to be not so much a shift in explanations for lightning but rather an addition of a new explanation alongside the traditional explanation of a punishing God. In *Chapter 3* we will delve more deeply into

121 '[...] want seggen sij [nateurschrijvers] door harde donderslagen en blicksem stralen en door sware slagregenen, soo plagt de Heere onse godt de verderffelijcke en pestilentale Lugten dampen en vergiftige dauwen te breken en der selver stancken weg tenemen, dogh hoe dit is, ofte niet, dat weet onse godt best.' Lambert Rijckxz. Lustigh, *Kroniek I van Lambert Rijckxz Lustigh* (Huizen, 1973), 16.

122 Vermij, *Thinking on Earthquakes*, 185–86; Buisman, *Onweer*, 75–116.

123 Rienk Vermij, 'Bernard Nieuwentijt en de physico-theologie', *Documentatieblad werkgroep achttiende eeuw* 20, no. 2 (1988): 215–29; Buisman, *Onweer*, 69; J. W. Buisman, 'Het Onweer in Nederland in Godsdienst, Wetenschap En Kunst, 1752-1830', *Nederlands Archief voor Kerkgeschiedenis/Dutch Review of Church History* 78, no. 2 (1 January 1998): 230–31.

124 Buisman, *Onweer*, 108.

125 Ibid., 242–43.

126 *Hedendaagsche Vaderlandsche Letter-oefeningen, Waar in de Boeken en Schriften, Die Dagelyks in Ons Vaderland en Elders Uitkomen, Oordeelkundig Tevens en Vrymoedig Verhandeld Worden. Benevens Mengelwerk, Tot Fraaije Letteren, Konsten en Weetenschappen Betrekkelyk. Zesde Deels, Tweede Stuk* (Amsterdam, 1777), 340.

127 Buisman, 'Het Onweer in Nederland', 231.

the positive effects of lightning in relation to epidemics, but for now, we look at how this positive notion led chroniclers to study the impact and characteristics of lightning in more detail.

One of the most intricate descriptions of a 'ball of lightning' can be found in Kluit's chronicle of Brielle, although other chroniclers made similar observations as well.[128] Kluit wrote:

> On September 12 [1748], lightning hit the grain mill, which, however, remained remarkably preserved by God's mercy. In the afternoon, around five o'clock, a heavy downpour suddenly began, accompanied by severe thunderclaps and terrifying lightning flashes, with a rumble that made it seem as if the earth was trembling underfoot, and the lightning was so vehement that one was momentarily blinded. Around six o'clock, lightning struck the grain mill, splitting a mill sail from the top end to the axle, right in the middle, so that the pieces flew in all directions, while a part of the outer wall was blown away, the lightning creating a small opening and flew into the mill. Here it cleaved the iron beam of the so-called outer wall batten, which was about a foot thick in diameter, right in the middle. Furthermore, it tore the wall six feet across one floor lower and probably then exited through a window opposite, in which not a single pane remained intact, and a good chunk of the frame was blown away. Furthermore, it blew away a piece of a frame one floor beneath, ripped out the window complete with its hinges, shattered the window frame with its ironwork, and tore the wall three feet beneath this frame. From there, it continued into the kitchen downstairs, where the miller's wife (who had just moved ten steps forward into the downstairs kitchen) had set down a bucket full of water, from which the bottom was blown out. The lightning then flew out through the window, which was scorched black, and the wall above the window frame was torn up to a height of three feet. It is quite remarkable that this lightning bolt, having blasted the bottom out of the bucket and even though the news had spread quickly, neither the bottom, nor the water that was in the bucket has been found. Furthermore, the damage caused by this storm was limited, which is more something we can marvel at than what we could have hoped for.[129]

128 Louwen, 'Kronijk der stad Purmerende [...] deel 1', 356; An exception to this are chronicles written by 'experts' in the field of natural research and meteorology. See, for example: Barnaart junior, 'Dagverhaal van merkwaardige voorvallen', 44–45.

129 'Terwijl wij overgaan tot het verhaal van een verschrikkelijk onweer hetwelk men in deze stad op 12 september heeft gehad, zijnde de bliksem in de stadskorenmolen geslagen, welke echter nog door des Heren goedheid zeer wonderlijk is bewaard gebleven. De namiddags kreeg men omstreeks vijf uur zeer schielijk een zware slagregen, vergezeld van zeer zware donderslagen en ijslijke bliksemstralen door welkers geklater

What is particularly striking about this description is how it simultaneously emphasises the potency of lightning and outlines the trajectory it traversed. The lightning navigated through an iron bar that was subsequently split in half. Then, on a floor below, the iron frame was destroyed, and the lightning ended its journey in a bucket of water on the kitchen floor, with all the water having been evaporated. Although a lightning strike was ascribed to divine agency, it adhered to a certain pattern, as Kluit noted its attraction to 'conductors' such as metal and water. Similar observations can be found in the chronicle of wine merchant and official, Albert Pietersz. Louwen (1722-98). On 6 July 1778, he chronicled multiple lightning strikes on the town hall, church, and bell tower. Lightning struck at the moment the clock was being wound. Although the man winding it merely lost consciousness and his 'body and clothes remained intact', the metal hands and numerals on the clock appeared to be scorched.[130] The hands resembled objects that had been exposed to fire, and even the lightning itself was described by Louwen as a fire that struck but did not ignite a blaze this time. He firmly propounded that: 'God was the primary cause of this incident, and the one who mercifully prevented further harm.'[131]

It is notable that Louwen did not discern that lightning was constituted of electricity. In the years that had passed between the observations of Kluit and Louwen, Benjamin Franklin (1706-90) invented the lightning rod, a low-resistance conductor that channels lightning from the air to the ground, thereby averting the possibility of lightning passing through other parts of a building and potentially igniting a fire. His experiments in the

het scheen of de aarde onder de voeten trilde en de bliksem was zo vehement dat men enige tijd als verblind was welke bliksem omtrent zes uur in de korenmolen sloeg, klovende een molenroede van het boveneinde tot aan de as, recht door midden, zodat de stukken herwaarts en derwaarts heen vlogen, terwijl inmiddels een stuk van de buitenmuur werd weggenomen waardoor de bliksem een kleine opening maakte en in de molen vloog daar hij van het zogenaamde buitenmuurbint de ijserbalk wel ter dikte van een voet in zijn diameter doormidden kliefde, vervolgens heeft dezelve een verdieping lager de muur over zes voet dwars door gescheurd en van daar waarschijnlijk door een daar tegenover staand venster in welk raam geen een ruit is ingebleven benevens een goed stuk van het kozijn weggeslagen verder nog in een lagere verdieping van een kozijn een stuk wegge slagen het venster met duimen en al weggerukt, het raam met zijn ijzerwerk te morzel en de muur drie voet gescheurd onder dit kozijn vandaar is dezelve voortgegaan in het beneden keukentje waardat de vrouw van de molenaar (niet langer geleden als dat zij tien treden was voortgegaan in de daartegenoverstaande keuken) een emmer vol water had neergezet, dewelke de bodem was uitgeslagen zijnde vervolgens gevlogen door het raam naar buiten, welk kozijn zeer zwart gezengd was en de muur boven het kozijn ter hoogte van drie voet gescheurd. 't Is seer aanmerkelijk dat dese blixemstraall den bodem uit den emmer hebbende geslagen en schoon aanstonts ront gesegt wiert, deselve nooit soo min als het water dat in de emmer geweest was is gevonden geworden. Verder is door dit onweer geen schade geschiet, dat meer te verwonderen als te hoopen was.' Kluit, 'Historische Jaerboeken der stad Briel, deel 1, 1e stuk, 1747-1751', 433–36.

130 '[...] Hij zoo aan zijn Lighaam als Kleederen onbeschadigt gevonden.' Albert Pietersz. Louwen, 'Kronijk der stad Purmerende bevattende der selver opkomste en voortgang, in handschrift door Albert Pietersz. Louwen, 18e eeuw, deel 2, tweede gedeelte', Noord Hollands Archief, Haarlem, 143. Collectie van A. Pietersz. Louwen, inv.no. 20, 552.

131 '[...] edog God den Opper Oorzaek van deze gewrogtens bewaerde ons nog genadelijk voor Brand en andere Verdere ongevallen.' Louwen, 'Kronijk der stad Purmerende[...] deel 1', 357.

first half of the eighteenth century were published in the form of five letters in 1751.[132] Three decades prior to Franklin's invention, knowledge about electricity was already present in the Low Countries. The Leiden professor Willem Jacob 's Gravesande (1688-1742) lectured his students on static electricity in the 1720s.[133] His friend, the renowned instrument maker Jan van Musschenbroeck (1687-1748), built the electrical machines for his lectures, while his younger brother, Petrus van Musschenbroeck (1692-1761), was the first to publish in 1746 on what later became known as the Leyden jar.[134]

While initially presentations on static electricity were predominantly limited to scholars and practitioners, one of the chroniclers from a patrician family attended a demonstration in Amsterdam at a public inn.[135] Jacob Bikker Raye (1703-77) wrote on 12 September, 1745:

> Today in the English alley, there is a machine to be seen. It consists of a round glass sphere that spins rapidly. Against this sphere is a tin pipe, about four feet long, with one end against the sphere and the other held in the hand by someone. He stands on two planks situated in a square box filled with pitch. This spinning creates a phenomenon where, if anyone tries to touch it, sparks fly out all over their body. I myself have stood upon it, and using my other hand or finger, ignited brandy in a spoon, and also did the same with a sword that I held in my hand [ignited the brandy]. When someone pointed their finger close to my leg, sparks flew out of my shin through two pairs of socks, without causing me any burn or pain. The only sensation was like being pricked by a pin when the sparks flew out. Thousands of people come daily to see it and to be 'electrified'. This machine was invented by a professor in Germany, and it does not harm humans.[136]

132 E. P. Krider, 'Benjamin Franklin and Lightning Rods', *Physics Today* 59, no. 1 (2006): 42–48.

133 Buisman, *Onweer*, 35.

134 Lissa Roberts, 'Science Becomes Electric: Dutch Interaction with the Electrical Machine during the Eighteenth Century', *Isis* 90, no. 4 (1999): 683–88.

135 Ibidem, 683–89.

136 'Heede is hier in de Engelse steeg te sien een macine, sijnde een ronde glase Bol die stark gedraaijt wort, waar tegens een blikke pijp van vier voet lang met het eene ent tegen de bol en het andere ent imant in de hant houdende, en op twee plankjes staande die in een vier kante bak alwaar pik in is legge, so veroorsaakt die drajing ten eerste dat het vuur, so imant als een ander hem wil aanraaken over al uijt het lijf vligt bij vonken, hebbende ik daar selfs opgestaan, en met mijn andere hant of vinger, brandewijn die in een leepel was in de brant gestooken, ook het selve met een degen gedaan die ik in de hant hat, imandt met de vinger digt aan mijn been wijsende vloog het vuur bij vonke uijt mijn scheene door twe paar kouse heen sonder dat het mij branden of eenige pijn veroorsaakte, als alleenig als het vuur daar uijt vloog was het het of men met een spelt geprikt wier, duijsende van mensen gaan dagelijks het sien, om sig te late lektariseeren, dese masine is door een proffessor in duijtslant uijtgevonde, en doet een mens geen quaat.' Bikker Raye, 'Notietie van het merkwaardigste', 94.

Although these public demonstrations of static electricity were predominantly perceived as entertainment, they played a pivotal role in acquainting a wider audience with the properties of electricity. For example, the aforementioned demonstration showed that electricity could traverse through metals, could leap to disparate materials, ignite them, and remained harmless (at lower voltages).

However, the relationship between electricity and lightning was still undiscovered in 1745. Seven years later, in 1752, Franklin substantiated his theory that thunderclouds are charged with electricity and that lightning is indeed an electrical discharge.[137] Petrus van Musschenbroeck was among the first Dutch scholars to repeat and validate Franklin's experiment, before a translation of his findings was disseminated to a wider audience. On 16 September 1756, in Warmond, and on the 14th and 20th of July, 1757, near Noordwijk, Van Musschenbroeck flew kites amid a thunderstorm to scrutinise the electrical properties of lightning.[138]

Though the knowledge concerning lightning expanded, and understanding how to safely conduct it developed, it was not until the 1770s that a broader and partially popular scientific campaign in favour of the lightning rod began to gain momentum. Widespread acceptance was still some way off, even though one of the first lightning rods in the Netherlands was installed in July 1778 on the tower of Castle Rosendael.[139] The well-informed chronicler Louwen from Purmerend was thus not familiar with the invention of the lightning rod, or even the concept of electricity in general, when he wrote about the thunderstorm discussed earlier in the same month.[140] According to him, lightning was some sort of fire caused by 'the compression of the air'.[141]

Over subsequent decades, an increasing number of lightning conductors were installed on ships and buildings. In 1779, the *Bataafsch Genootschap* introduced a prize question pertaining to this topic. That very same year witnessed the establishment of the first company, Schaap in Deventer, that specialised in the commercial installation of lightning rods.[142] Nonetheless, Buisman noticed that the broad acceptance of lightning conductors really took off only in the latter half of the nineteenth century. Before this period, installations were predominantly facilitated by private initiatives, both by installers and by clients. Buisman argued that the explanation for the limited interest in lightning rods might reside in the lack of standardisation and high cost.[143] While these factors are certainly significant, the chronicles suggest that there is more to the picture.

137 Krider, 'Benjamin Franklin and Lightning Rods'.
138 Buisman, *Onweer*, 38–40.
139 W. E. Bijker, *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change* (Cambridge, 1995), 270.
140 Louwen, 'Kronijk der stad Purmerende [...] deel 2, tweede gedeelte', 552; Buisman, *Onweer*, 48.
141 '[...] door de aen persinge van de lugt.' Louwen, 'Kronijk der stad Purmerende [...] deel 2, tweede gedeelte', 552.
142 Buisman, *Onweer*, 48.
143 Ibid., 46–53.

Taming God's Voice with Technology?

The chronicler Hellema from Wirdum, whom we met before in the section on comets, was also the co-founder of the *Onderlinge Brand-Assurantie-Sociëteit* (Fire Insurance Society), and emerges as one of the earliest chroniclers from the corpus to mention a lightning rod.[144] He wrote in February 1825 that:

> Despite the fact that most farmers who live here are insured against fire, Ruurd Hendriks Sijbrandij, following the example of other places, especially on the Bouwkant [a region near Wirdum], has placed a lightning rod on his barn at Barrahûs [a small village in Friesland]. This is considered by experts to be a reliable method of protection against lightning, but that is not believed by most men here, and so by the general public. The cost of the lightning rods is approximately 30 guilders and they are made by A. Roelofs in Finkum and Rienks in Belkum, the renowned craftsmen.[145]

There are two prominent observations to be made here. First, in specific areas like the Bouwkant, lightning rods appear more common than in other regions. This could indicate that *frequency-dependent bias* played a pivotal role in the acceptance of lightning rods, meaning that individuals were more receptive to innovations when they were embraced by other (influential) parties. Second, most 'men' in Wirdum possessed fire insurance and harboured scepticism about the efficacy of lightning rods as protective measures against lightning strikes. This scepticism may have been driven by anecdotal instances published in the local newspaper a mere six days after Hellema's commentary. For example, on 8 February, the *Leeuwarder Courant* reported an incident in the village of Marum where a barn and stable, equipped with a lightning conductor, were set alight, causing the death of six horses and eleven head of cattle.[146]

Thus, despite the fact that the two are not necessarily mutually exclusive, it appears from Hellema's chronicle that he placed greater confidence in his insurance than in a lightning rod. Eleven years later, whilst Hellema was serving as a churchwarden, the church council proposed the installation of a lightning conductor, as churches and towers were most prone to lightning strikes. Hellema and his colleagues dismissed the

144 H. Hylkema, *125 jaar brandverzekering op onderlinge grondslag: 1815-1940. (Gedenkboek van de Onderlinge brand-assurantie-sociëteit opgericht in 1815 te Wirdum)* (Leeuwarden, 1940).

145 'Niet tegenstaande de meeste boere huizingen in de Brandassurantie alhier verzekerd zijn, heeft eene Ruurd Hendriks Sijbrandij in navolging van andere plaatsen vooral aan den Bouwkant een afleider op zijne schuur te Barrahuis geplaatst, het welk door deskundigen als een zeker middel gehouden wordt om voor den Blixem beveiligd te zijn; maar het geen hier meest van alle man, en dus van het algemeen niet geloofd wordt. De kosten van gemelde afleiders ongeveer 30 Gld. en worden door A. Roelofs te Finkum en Rienks te Belkum, de bekende Kunstenaars, gemaakt.' Hellema, 'De Dagboeken van Doeke Wijgers Hellema, 1766-1856', 46.

146 Ibid., 61; 'Leeuwarder Courant', 11 February 1825.

proposition, asserting the inadequacy of the conductor's ability to channel lightning – an argument substantiated, in their view, by the incident in Marum.[147]

Although installing conductors would have resulted in less damage, and thus a reduction in the insurance premiums of his cooperative, Hellema was genuinely convinced of its ineffectiveness. This conviction was reinforced by his records of several instances where structures, despite being equipped with lightning rods, caught fire.[148] This exemplifies an (unintended) *confirmation* bias in play. Hellema exhibited a preference for information that supported his established beliefs, overlooking the instances where lightning rods functioned successfully. But what was the foundation of his resistance to lightning rods? It seems to be his conviction that conductors were a form of hubris, since he wrote that lightning is the 'voice of God.'[149]

For devout Christians like Hellema, lightning symbolised more than merely an act of God – it was perceived as a direct manifestation of His voice, a belief he recorded explicitly, bolstered by biblical passages such as *Job* 37:4-5 and *Exodus* 19-20, where God's voice is expressed through the phenomena of lightning and thunder—elements beyond human understanding. Consequently, the lightning conductor came to embody impiety, arrogance, and a vain endeavour to evade divine retribution. People were supposed to listen to and respect God's voice when He manifested Himself. From Hellema's perspective, people should take out fire insurance to repair the damage afterwards, or use conventional means like prayer to prevent lightning from striking as these actions would not attempt to divert His voice.[150]

By December 1845, there was a noticeable change in Hellema's viewpoint on lightning conductors—he stopped asserting their inefficiency. He noted that 'the lightning rod on the Martinikerk of Groningen conducted the lightning without any damage', indicating his recognition that a lightning rod could indeed function effectively and had protected the Martinikerk from destruction.[151] In subsequent years, Hellema stopped mentioning lightning rods, possibly as their prevalence increased in the latter half of the nineteenth century, and opposition to them presumably diminished.

Such reflective observations on technological advancements are rather rare among chroniclers. Most typically, they simply recorded when the first conductor in the community was installed or when a conductor successfully averted a fire.[152]

147 Hellema, 'De Dagboeken van Doeke Wijgers Hellema, 1766-1856', 50, 88.

148 Ibid., 70–71.

149 '[...] dat dit middel te zwak voor den Blixem af te leiden bevonden is geworden, thans op het denkbeeld geraakt zijn, dat men in plaats van een, twee afleiders behoorde te plaatzen. Ook te Wirdum zijn thans de natuurlijke pokken ontstoken, in een huisgezin waarvan de meid gevaccineerd ware, en de zoon des huizes deze bewe Is dit ook niet een Stem des Heeren???' Ibid., 88.

150 Ibid., 41, 72, 88.

151 'Te Groningen was de bliksem op de Martenstoren, maar zonder schade door een afleider afgeleid.' Ibid., 100.

152 De Jong, *De dagboeken (1825-1855) van Lieuwe Jans de Jong*, 177.

The Reformed wine merchant Jan Willem Druijnen (1790-1854), however, offers a bit more depth regarding implementation and design. In September 1837, he noted that the first lightning conductor was fitted onto the St. Stephen's Church in Nijmegen. The wire was fastened beneath the cross's pinnacle and extended to a rain cistern in the old cemetery, following the design of Cornelis Kraijenhoff (1758-1840). Evidently familiar with Kraijenhoff's translation and commentary on L.S. Jacquet's *Proef eener elektrische natuurkunde* (1783), Druijnen made reference to it. He proceeded to extol in a hymn Kraijenhoff's accomplishments as a skilled and diligent scholar.[153]

Even though the acceptance of the lightning rod had become widespread by the mid-nineteenth century, the pace of its adoption was thus relatively slow compared to other countries.[154] In 1836, Kraijenhoff had highlighted that the Netherlands was still behind in embracing lightning rods.[155] According to Buisman, this delay, aside from the high costs, was due to decentralised governance. There were only a few initiators in local or provincial governments who commissioned the installation of lightning rods.[156] It was only under French influence that the national gunpowder magazine was fitted with a lightning rod in 1797. Moreover, Buisman argued that the acceptance of the lightning rod proceeded faster in the 'centralised countries.'[157]

However, that non-experts moved slowly to accept the lightning rod cannot be attributed solely to the factors outlined by Buisman. Moreover, religious beliefs did not invariably act as obstacles to the wider acceptance among society at large.[158] Based on the chronicles it appears that the extensive embrace of the lightning rod, notably during the latter half of the nineteenth century, coincided with the evolving understanding of electricity and the operational mechanism of the rod.[159]

This notion was even acknowledged by contemporaries like Krayenhoff, who wrote that such information was not accessible to the 'ordinary citizen' at a reasonable price and was written in a language that was not understandable for non-experts.[160] The observation and recording that a rod could conduct lightning did not immediately translate into an understanding of how it worked.[161] Consequently, it is probably not coincidental that the acceptance of the conductor became more widespread amongst

153 Van Druijnen and Van Druijnen, *Leven aan de Waal*, 142.
154 Buisman, *Onweer*, 53.
155 Cornelis Rudolphus Theodorus Baron Krayenhoff, *Handleiding tot het stellen van bliksem-afleiders* (Vieweg, 1836), 3.
156 Buisman, *Onweer*, 51–53.
157 'het meer gecentraliseerde buitenland' Ibid., 53.
158 Buisman, 'Het Onweer in Nederland'.
159 Buisman, *Onweer*, 135.
160 '[...] den eenvoudigen burger en de mindere volksklasse.' Krayenhoff, *Handleiding tot het stellen van bliksem-afleiders*, 4.
161 See also: Rogers, *Diffusion of Innovations*, chap. 1.

larger sections of the population at the same time chroniclers began writing about lightning as a form of electricity around the mid-nineteenth century.

Hellema's example shows us how this process worked. Sceptical about the efficacy of lightning rods in 1825, he started incorporating the notion of electricity in 1836. By 1840, he unequivocally stated that lightning was an electric discharge, citing its effect on an elm trunk.[162] Five years later, he conceded that the lightning rod was indeed functional.[163] In De Jong's chronicle, the term electricity is used for the first time in 1832, but his understanding of how lightning originated was not concrete until the 1852.[164] After that year he recorded several times that: 'most rain showers and dense blue clouds were brimming with electricity.'[165]

Conclusion

In this chapter we have seen how chroniclers' explanations of meteorological phenomena evolved over time. In many ways, my findings support the observations made in previous research: Divine explanations did not disappear entirely; God was increasingly seen as the clockmaker who set natural laws in motion; Religious denominations play little to no role in the acceptance of 'secular' knowledge about nature; and at the end of the early modern period natural phenomena were no longer interpreted preternaturally but symbolically.[166] Yet, this chapter also offers new insights into how this process unfolded among non-experts.

First, we have noted that chronicles contained both religious and natural explanations for meteorological phenomena, and chroniclers used the two explanations side by side. The same chronicler could explain one meteorological phenomenon solely according to natural processes, while interpreting another as the result of divine intervention. The fact that they could explain more and more phenomena through natural processes did not affect the phenomena for which they could not do so. As long as there was no better explanation than a providential one, traditional knowledge remained dominant, as we have seen with earthquakes and abnormal seasons (e.g. extremely cold winters).

This suggests that in the minds of early modern chroniclers, meteorology was not a coherent system, as it was to a greater extent for natural philosophers. Rather, they thought of phenomena individually. This also explains why the notion of an active and punishing God persisted into the nineteenth century, alongside the idea of a passive God

162 Hellema, 'De Dagboeken van Doeke Wijgers Hellema, 1766-1856', 14.
163 'Te Groningen was de bliksem op de Martenstoren, maar zonder schade door een afleider afgeleid.' Ibid., 100.
164 De Jong, *De dagboeken (1825-1855) van Lieuwe Jans de Jong*, 74.
165 '[...] de meeste buijen en zware blaauwe wolkens zwanger waren van electriciteit.' Ibid., 300, 307.
166 Walsham, *The Reformation of the Landscape*, 566.

who could be understood by studying His natural laws. These notions not only coexisted within society, but also in the minds of the chroniclers.

Secondly, we noted that, chroniclers used their chronicles to discover patterns and to interpret the preternatural phenomena they observed. They did this by making comparisons with examples from the past. Using the duration, length, and brightness of, for example, comets, chroniclers tried to decipher God's message. Although chroniclers rarely made concrete predictions (unlike much pamphlet literature), recording extraordinary phenomena did enable them to interpret events providentially in retrospect. Technological inventions like the thermometer and barometer assisted them in making more accurate comparisons.

New knowledge and technology could thus lead to the appearance of a better providential interpretation but also to its disappearance. After periodic comets were discovered by Edmond Halley (1656-1742), their providential interpretation faded away since comets could be predicted, allowing their appearance to be explained by mechanical laws rather than divine intervention. Yet, the fact that 'better' explanations were available in society did not mean that they were automatically accepted. The knowledge that lightning was a form of electricity was available since the 1750s. Yet, it took almost eighty years before we see this idea reflected in the chronicles. This knowledge was available but not accessible to non-experts in a way that they could understand it, which shows how important research into the reception of knowledge is.

It is, therefore, not coincidental that the implementation of the lightning rod gained momentum only around the second half of the nineteenth century. The reasons for the late acceptance of this technology have been attributed to the absence of a central state and high costs. Although these factors played an important role, this theory needs to be refined. The Netherlands had been a unitary state since 1795, but it took another half-century before the implementation at the provincial level gained momentum. This explains that at least in the first half of the nineteenth century, the Netherlands was still largely governed decentrally, meaning that local administrators had to be convinced of the usefulness of the lightning rod before it was implemented.[167] Secondly, new knowledge about lightning and the lightning rod was not readily accessible to non-experts. The fact that lightning consisted of electricity and not 'divine' fire was unknown to a well-read chronicler from a small town like Purmerend around 1800. It was not until around the 1840s that this changed, coinciding with the moment when the implementation of the lightning rod occurred on a large scale.

167 Judith Pollmann and Henk te Velde, 'New State, New Citizens? Political Change and Civic Continuities in the Low Countries, 1780-1830', *BMGN - Low Countries Historical Review* 133, no. 3 (20 September 2018): 4–23.

This shows that the availability of better explanations does not automatically lead to their acceptance, even when scholars and influential people used this new technology. This implies that there are alternative explanations for the acceptance of new knowledge and technology in early modern societies. They were not merely 'dragged along' in the wake of 'cultural entrepreneurs' as Mokyr wrote. Chroniclers were a critical group of people who accepted innovations on substantive grounds. In other words, *content* and *direct* biases played an important role in the acceptance of new explanations with regard to meteorological phenomena. As a result, chroniclers, like Mokyr's 'cultural entrepreneurs', played an active role in accepting new knowledge and technology, and consequently are an important factor for explaining cultural change.

Chapter 3

Explaining Epidemics. Combining New and Traditional Knowledge

Uncleanliness or unhealthy air do not necessarily cause cholera. The disease could also be triggered by other factors which are not yet known to us

- Chronicler Edouard Callion (1832), Ghent.[1]

1 '[Men heeft aldaer iets zeldzaem opgemerkt, het welk bewyst dat het] niet altyd onreynigheyd of ongezonde locht is die den Cholera veroorzaekt; maer dat de ziekte aen oorzaken moet toegeschreven worden, die tot hier toe onbekend zyn.' Edouard Callion, 'Gentsche kronijke: 1525-1835', vol. 6., Universiteitsbibliotheek Gent, Boekentoren, BIB.G.014248, 499.

Introduction

In the previous chapter, we observed a shift in the explanations for meteorological phenomena. The role of the divine changed: an active deity became more passive. We determined that this transition depended on the accessibility of new knowledge to explain the phenomenon. Comets and solar eclipses could be explained through natural processes earlier than earthquakes and abnormal seasons. Divine explanations moved to the background when they were no longer necessary to describe the phenomenon, allowing contemporaries to no longer fear, for example, lightning as a punishment from God, but rather to see it as a result of His natural laws.

Mokyr would describe this as a process of knowledge becoming increasingly 'tight'. Computation, formal methods and instruments increased the tightness of knowledge, meaning that what was known became more certain, leaving less, or little, room for alternative explanations.[2] Knowledge of phenomena which was 'untight' meant that there were various explanations, but that the evidence to support the explanations was limited. This means that for a specific phenomenon there might exist a wide range of incompatible ideas that cannot be resolved, and this leaves matters unsettled until a more effective method of testing the competing views is found, according to Mokyr.[3]

In the previous chapter, we have seen that with regard to comets, and lightning in combination with the conductor, that knowledge went – using Mokyr's terms – from 'untight' to 'tight'. Once comets could be predicted, and contemporaries understood that lightning was a form of electricity, the phenomena moved from the 'preternatural' to the 'natural' domain. Yet, there are also phenomena where knowledge became increasingly 'tight' but (initially) did not do so at the expense of traditional explanations. In the minds of contemporaries, such explanations were not 'incompatible'. They could exist side-by-side, or even complement each other. How traditional and new explanations related to each other in the process of knowledge that became increasingly 'tight' will be illustrated through the chroniclers' reflections on epidemics. It is a phenomenon that almost every early modern generation experienced. However, while various new explanations emerged, it remained difficult for contemporaries to grasp the origin and spread of epidemics, making it a suitable topic to examine the relationship between traditional and new as well as 'tight' and 'untight' explanations.

The aim of this chapter is twofold. Firstly, it will show that different explanations for phenomena, such as epidemics, could develop and coexist, without contemporaries believing them to be incompatible. Second, to continue what we started in the previous chapter, we will identify the conditions for the acceptance of new knowledge. For the first objective, this chapter builds on observations made by the sociologist Ann Swidler

2 Mokyr, *A Culture of Growth*, 45, 279.

3 Ibid., 45.

(2001), who argued that people's systems of belief are much more disjointed and less seamless than previously thought. In fact, people usually operate in several cultural systems at once, in which contradictions and inconsistencies cause no difficulty.[4] That this was also the case in the early modern period has been examined by Judith Pollmann. In her book *Memory in Early Modern Europe* (2017) she called attention to the fact that when it came to understanding the past, new explanations did not necessarily replace old ones but could coexist alongside them.[5] In this chapter, we will examine to what extent this also applied when chroniclers reflected upon epidemics.

The wide variety of explanations is particularly evident in phenomena whose causes and characteristics are difficult to verify empirically. For example, epidemics were interpreted as a punishment from God, but simultaneously, every effort was made to prevent their origin and spread with both religious and secular measures. A 'modern' explanation for epidemics did not emerge in the early modern period, although we do see new explanations arise, disappear, and integrate into existing ones.[6] By studying this process in detail, we can build on and extend the conclusion of *Chapter 2*, to demonstrate first, that new explanations of one phenomenon did not result in doubts about explanations of another phenomenon. Secondly, we will see that chroniclers used various explanations side-by-side to make sense of and to cope with the phenomena that they experienced.

Research into how non-experts experienced epidemics has attracted attention from historians since the 1980s. Initially, research focussed mainly on medical practitioners, resulting in a progressive narrative from Hippocratic and Galenic medicine to the corpuscular theory of Girolamo Fracastoro (c.1476-1553), and finally the 'modern' germ theory of disease, stimulated by Edward Jenner's invention of vaccination.[7] In 1989, the medical historian Charles E. Rosenberg called attention to the importance of studying the individual experience of diseases in both time and space, as well as how culture shapes the way we define diseases and, how diseases influence the creation of culture.[8] From then on, a growing number of historians have extended their inquiries beyond medical policies and theories to include the reconstruction of an epidemic's impact on the everyday lives of ordinary individuals.[9] By using various historical sources, such as diaries and judicial records, historians have shifted their focus from the literate elite –

4 Swidler, *Talk of Love*, 94.
5 Pollmann, *Memory in Early Modern Europe*, 2, 196–97.
6 The 'modern' theory of disease is the germ theory of disease. The idea that pathogens or 'germs' can cause disease.
7 For a recent overview see: John Henderson, *Florence Under Siege: Surviving Plague in an Early Modern City* (Yale, 2019); Samuel K. Cohn, *Epidemics: Hate and Compassion from the Plague of Athens to Aids* (Oxford, 2018); Mary Lindemann, *Medicine and Society in Early Modern Europe* (Cambridge, 2010).
8 C. E. Rosenberg, 'Disease in History: Frames and Framers', *The Milbank Quarterly* 67 (1989): 14.
9 *The Routledge History of Disease* (Routledge Handbooks Online, 2016), 4–5.

composed of governing classes, medical experts, and the Church – to a wider societal perspective.[10]

A well-known example is the diary of the tanner Miquel Parets (1610-61) which was published in 1991 by James Amelang.[11] Written during the Barcelona plague of 1651, this diary provides an insightful and critical account of the experiences and reflections from the perspective of a middle-class craftsman during the plague. A more recent example is offered by John Henderson in 2019 who examined how various experts and non-experts in Florence experienced and coped with the epidemic plagues from 1630 to 1633.[12] Using a significant amount of non-medical writings, such as plague poetry and plague narratives, he provided an interdisciplinary account of the impact of and reactions to this epidemic from medical, social, religious and artistic perspectives.[13]

This new cultural history of epidemics has led to a more multifaceted picture of how contemporaries dealt with epidemics by examining not only secular, but also religious measures and explanations.[14] The result of these approaches is the discovery of the gap between the explanations and experiences of 'experts' and 'non-experts' during epidemics. This does not mean that the explanations of non-experts lagged behind those of experts. Non-experts were not necessarily 'dragged along' as Mokyr would describe.[15] Chroniclers actively gathered and produced knowledge themselves and sought patterns to explain epidemics. For this, they used knowledge from medical experts, as well as from priests or preachers. In addition, many of them conducted their own research, leading to new explanations. How chroniclers combined different forms of knowledge, how this changed over time, and what explanations they arrived at are central to this chapter.

Corpus

Because I study epidemics from the perspective of chroniclers, my definition is based on how they wrote about it using terms like a 'general mortality', or *generaele sterfte*.[16] I interpret an epidemic as 'a widespread occurrence of an infectious disease within a specific time frame', which excludes chronic, occupational, or other categories of diseases.[17] The reason for this choice is that epidemics, unlike other diseases, were

10 Henderson, *Florence Under Siege*, 11.

11 Miquel Parets and James S. Amelang, *A Journal of the Plague Year: The Diary of the Barcelona Tanner Miquel Parets, 1651* (New York, 1991); See also: Giulia Calvi, *Histories of a Plague Year: The Social and the Imaginary in Baroque Florence*, Studies on the History of Society and Culture 8 (Berkeley, 1989).

12 Henderson, *Florence Under Siege*.

13 Ibid., 3.

14 Calvi, *Histories of a Plague Year*; John Henderson, *The Renaissance Hospital: Healing the Body and Healing the Soul* (New Haven, 2006); Carole Rawcliffe, *Medicine for the Soul: The Life, Death and Resurrection of an English Medieval Hospital* (Stroud, 1999).

15 Mokyr, *A Culture of Growth*, 120.

16 Luyten, *Kronijk uit het klooster*.

17 Rosenberg, 'Disease in History'; For more information on the definition of diseases as a social construct see: Charles E. Rosenberg, ed., 'Explaining Epidemics and Other Studies in the History of Medicine', in

generally interpreted as a collective punishment from God and were also explained by 'natural' processes. This makes it possible to study the interaction between the two ways of understanding.

To investigate this, I used a wordlist to find text fragments that concern epidemics in the same way as in the previous chapters (*Appendix 8*). I made use of 166 chronicles from the period 1500-1860, using 116 chronicles from the Northern Netherlands and 50 from the Southern Netherlands.[18] I found that 71 of the chronicles in the Northern Netherlands, and 41 of those in the Southern Netherlands contained entries on epidemics, of which I studied 701 fragments in close detail.[19]

Epidemic Period 1500-1860	Recorded in the Chronicles	Percentage of the Total Entries
Pest(ilence)	210	30%
Rinderpest/Cattle plague	154	21%
Dysentery	46	7%
Cholera	25	4%
Other	266	38%
Total	701	100%

Table 3. Most frequent epidemics in the chronicles, 1500-1860.

The most frequently recorded epidemics in the chronicles are listed in *Table 3*. Pest(ilence) and the rinderpest represent 51 per cent of the epidemics in the corpus, followed by dysentery (e.g., *roode loop*) and cholera (e.g., *Aziatische ziekte*). After this, a large number of various epidemics where recorded, although it is not always clear what the exact disease was. These diseases were described, for example, as 'fever' [*koorts*] or 'great sickness' [*grote ziekte*]. Together with diseases such as smallpox and influenza they represent the remaining 38 per cent of the entries about epidemics. It is noteworthy to mention that 73 per cent of the epidemics concern humans, 25 per cent concern animals, and 2 per cent concern plants.

When we look at how these diseases were spread over the early modern period, a few things stand out (*Figure 14*). The plague, or pestilence, was a frequent occurrence between 1500 and 1700, and especially in the second half of the sixteenth century and in the 1660s.[20] This infectious disease spread across Europe for centuries and mutated around 1348 into its most deadly variant known as the 'Black Death'. After the number

Explaining Epidemics (Cambridge, 1992), 293–304; Lindemann, *Medicine and Society in Early Modern Europe*, 51.

18 The full corpus consists of 204 chronicles: 132 from the Northern and 72 from the Southern Netherlands. Therefore, I used respectively 88% and 69% of the full corpus for this Chapter.

19 This is respectively 61% and 82% for the Northern and Southern Netherlands.

20 L. Noordegraaf and Gerrit Valk, *De Gave Gods: De Pest in Holland Vanaf de Late Middeleeuwen* (Bergen, 1988), 43–47, 152.

of victims reached its peak in the fourteenth century, the disease became less deadly. Yet, it remained endemic in Europe until the last major plague outbreak in the 1720s.[21]

During the same period, a new epidemic, the cattle plague, swept across Southern and Central Europe starting in 1709. Presumably the transnational oxen trade between Denmark and Holland served as the conduit that brought the epidemic to the Low Countries, where it started spreading in 1713.[22] The cattle plague mainly raged in the eighteenth century, with three 'waves' around 1713-21, 1744-55, and 1765-85.[23] The infection rates could reach as high as 100 per cent, and mortality ranged from 60 to 90 per cent. As a result, the Dutch Republic alone lost approximately 120,000 to 300,000 head of cattle during the first wave, which had major social and economic consequences.[24]

21 For international literature on the pest, see: Paul Slack, *Plague: A Very Short Introduction*, 307 (New York, 2012); Cohn, *Epidemics*; Frank Martin Snowden, *Epidemics and Society: From the Black Death to the Present*, Open Yale Courses Series (New Haven, 2019); For literature on 'pest' in the Low Countries, see: Noordegraaf and Valk, *De Gave Gods*; A. H. M. Kerkhoff, *Per Imperatief Plakkaat: Overheid En Pestbestrijding in de Republiek Der Zeven Verenigde Nederlanden* (Hilversum, 2019).

22 Adam Sundberg, *Natural Disaster at the Closing of the Dutch Golden Age*, Studies in Environment and History (Cambridge, 2022), 55–56.

23 For the first and the second wave, see: Ibid., 51–88, 212–50; For the third wave, see: Filip van Roosbroeck, 'Experts, experimenten en veepestbestrijding in de Oostenrijkse Nederlanden, 1769-1785', *Tijdschrift voor Geschiedenis* 128, no. 1 (1 January 2015): 23–43; Filip Van Roosbroeck, 'Caring for Cows in a Time of Rinderpest: Non-Academic Veterinary Practitioners in the County of Flanders, 1769–1785', *Social History of Medicine* 32, no. 3 (1 August 2019): 502–22; Filip Van Roosbroeck and Adam Sundberg, 'Culling the Herds? Regional Divergences in Rinderpest Mortality in Flanders and South Holland, 1769-1785', *Tijdschrift Voor Sociale En Economische Geschiedenis/ The Low Countries Journal of Social and Economic History* 14, no. 3 (23 January 2018): 31.

24 Sundberg, *Natural Disaster at the Closing of the Dutch Golden Age*, 59.

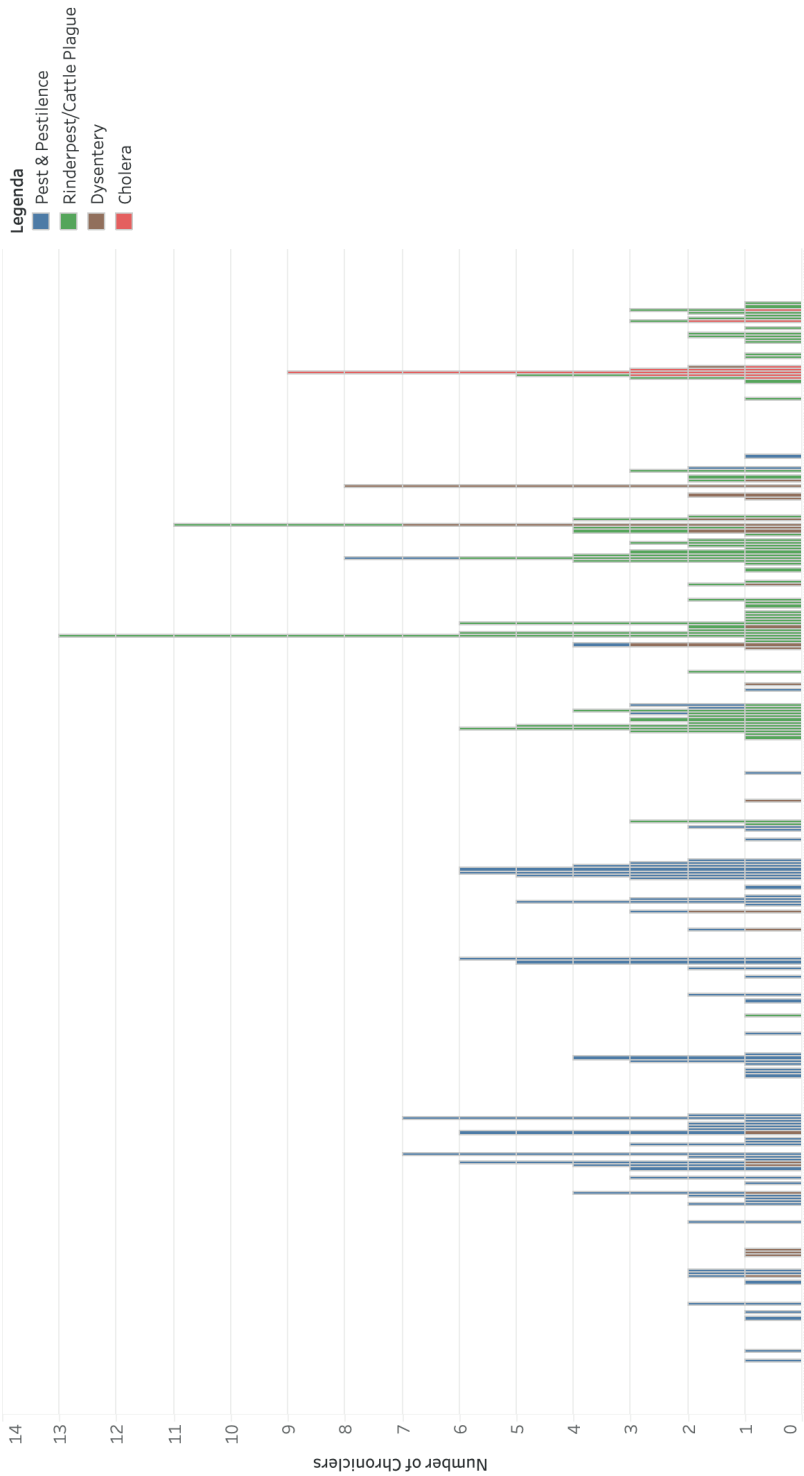


Figure 14. Number of chroniclers reporting on an epidemic per year.

Our period ends with the outbreak of cholera. Originating in Asia, this disease reached Europe around 1830 and the Netherlands in 1832. About half of those infected died from the disease, especially in the lower classes of society, leading to social tensions.[25] Initially, it was thought that the disease spread through the air, but in 1849, the English physician John Snow (1813-58) discovered that the disease also spread through contaminated drinking water. However, we will see that chroniclers had already been doubting traditional 'miasmatic' explanations for over a decade.

Plague, rinderpest, and cholera particularly left a great mark on the early modern period and in the lives of the chroniclers. They will therefore occupy a prominent place in this chapter, but other diseases will also be discussed, with the aim of investigating when and under what conditions new knowledge about epidemics was accepted and what consequences this had for existing knowledge. We will first discuss how chroniclers explained epidemics and where those explanations came from. Then, we will address the natural processes that, according to the chroniclers, influenced the emergence and spread of diseases in the sixteenth and seventeenth centuries. From the eighteenth century onwards, new explanations emerged, a greater role was attributed to environmental factors, and tension arose between medical theories and the observations of chroniclers. As a result, we will see how chroniclers solved these tensions and combined new medical insights with traditional theories.

Explaining Epidemics: Reasoning with Analogies

In the late summer of 1568, the Catholic lawyer and official in the Court of Flanders, Philip van Campene (c.1516-c.1567) found himself amidst an epidemic that had been spreading in the city of Ghent, one that would remain endemic for several more years. He meticulously chronicled the progression and the measures taken against the disease, beginning with an ordinance announced by the local authorities. Van Campene wrote:

> On the sixth day [of September] with the sound of a trumpet, the aldermen of the law [*Kuere*] have proclaimed an ordinance concerning the plague, warning that in the houses, where the plague is, people should put their dogs and cats to death, and that people coming from foreign and suspected regions are not allowed to lodge or stay [in the city]. The disease has been in this city since mid-August and increased daily, especially at St. Peter's, in the Savaenstraete and other places, so that now two scourges of the Lord circulate in these Netherlands, namely: war and plague, to punish the community.[26]

25 Snowden, *Epidemics and Society*, 233–67.

26 'Ten sesten hebben scepenen vander Kuere met gheluut van eenen trompette ghedaen publieren een ordonnantie, touchierende de peste, vermanende dat de ghebueren vanden huusen, daer de peste es, zouden

The measures listed by Van Campene proved insufficient. Over the next three years he described how the plague ravaged the city. The authorities took measures to prevent its spread. In 1569, trade in (soft) fruits was banned, and from 1570 houses where the plague ruled were marked with a bundle of straw, to indicate that no one should go near them.[27] When household members died of plague, they were buried at night so as to reduce fear among society. In addition, members of the affected household had to walk with a four-foot white cane for fourteen days after the last person had died or when there were no more signs of illness. A year later, measures were further tightened, and people from infected houses were forbidden from conversing or venturing out on the streets during the day.[28]

Van Campene's chronicle not only describes the measures taken by local authorities, but also incorporates his personal observations and beliefs. According to him, the pestilence was a divine punishment for the wars amongst Christians, particularly between Don Fernando Álvarez de Toledo, the third duke of Alba (1507-82), and William of Orange (1533-84).[29] During this period, the Netherlands were engulfed in a civil war, known as the Dutch Revolt. A year before the epidemic's outbreak, the Duke of Alba had marched into the Netherlands with an army of 10,000 soldiers to strike down the rebellious Calvinists and reaffirm the dominance of the Catholic faith. In 1568, the Prince of Orange undertook a failed expedition to 'liberate' the Netherlands, while '*geuzen*' attacked ships and coastal areas.[30] Like many contemporaries, Van Campene was afraid that the Netherlands would descend into a civil war such as was raging in France.[31] Divine punishment extended beyond the battlefield to the whole community, which Van Campene also considered responsible for causing the epidemic. Van Campene referred to the *Book of Jeremiah* (14:12) when he wrote:

dootsmijten huerlieder honden ende catten, ende dat hem nyemandt vervoorderen en zoude te logieren ende herberghen de lieden, commende uut vremde ende ghesuspecteerde contreyen, want de voornomde siecte sichtent halfougst lestleden heeft binnen deser stede gheweest ende daghelics vermeerdert, sonderlinghe up sint Pieters, inde Savaenstraete ende andere plaetsen, zo dat nu twee gheeselen vanden Heere upgheheven zijn in dese Nederlanden ende , te wetene: oorloghe ende peste, omme tghemeente te punieren.' Van Campene and Van Campene, *Dagboek van Cornelis en Philip van Campene*, 175.

27 Van Campene and Van Campene, *Dagboek van Cornelis en Philip van Campene*; Similar measures are also seen a few years earlier in the chronicle of: Adelbertus Cuperinus, 'Die Chronicke van der vermaerder en de vromer stad van 's-Hertogenbosch etc', in *Verzameling van kronyken, charters en oorkonden betrekkelijk de stad en Meijerij van 's-Hertogenbosch*, ed. Cornelis Rudolphus Hermans, vol. 1, 5 vols ('s Hertogenbosch, 1847).

28 Van Campene and Van Campene, *Dagboek van Cornelis en Philip van Campene*, 272.

29 Ibid., 175; This was widely believed by Catholics at the time, see: Pollmann, *Catholic Identity and the Revolt of the Netherlands*, 57–59, 92, 153–58.

30 Israel, *The Dutch Republic,* 155–78.

31 For more information on chronicles used to study the reception of news during the civil wars in France and the Netherlands, see: Baars, *Rumours of Revolt*, 54–84.

> The community is also afflicted by a period of dearth and pestilence, due to its sins and misdeeds, as we daily hear nothing but war, one Christian against the other. This was all foretold by the prophet Jeremiah. We, due to our evil deeds, estrange ourselves from God, both the priests and the common man.[32]

Van Campene continued by listing a number of sins, especially of monks and priests, but the epidemic was first and foremost a collective punishment from God.[33]

We see a similar conviction among Reformed chroniclers such as the farmer and mill master Claes Baerntsz. (1574-1651) from the small village of Hauwert in Holland. He wrote in 1636 that epidemics – unlike most other diseases – were a punishment for the collective sins of the community.

> [The people] who did not die of pestilence but remained alive should not think that they are better than those who were taken away by death. Because, among those who died of the plague, there were many pious and God-fearing people. Yes, much more pious and God-fearing than many of those who did not die of plague.[34]

This idea of epidemics as divine punishment was one widely shared among both Catholics and Reformed chroniclers. Chroniclers could find evidence for this while reading Scripture and other religious books, but more importantly from the sermons of pastors and preachers interpreting epidemics as a providential sign.[35]

The belief that epidemics were a collective punishment from God goes back to the *Book of Genesis*, where Adam and Eve, initially immortal beings residing in the Garden of Eden, free of disease, suffering, and labour, lost all of this when they defied God's command by consuming the forbidden fruit from the Tree of Knowledge of Good and Evil. This disobedience symbolised humanity's fall from grace and innocence. God expelled

32 'tGhemeente wierdt oock gheplaeght met dieren tijdt ende peste, ende dit al naer tvoorsegghen vanden prophete Hieremias, omme huerlieder sonden ende mesdaeden, dwelck ooc wel dient in desen benauden tijd gheconsidereert over al, want men daghelics anders nyet en hoort dan oorloghe, den eenen Christene jeghens den andere; wij, bij toedoene van quade werken, vervremden ons van God, zo wel de priesters als de ghemeene man.' Van Campene and Van Campene, *Dagboek van Cornelis en Philip van Campene*, 139.

33 Ibid.

34 '[...] Die [mensen die] niet gestorven en sijn aen de Pestelentie: maer int leven syn ghebleven dat sij beter syn, dan die gene die door den doot syn wech ghenomen. Want voorwaer daer sy onder die ghene die aen de Pest ghestorven syn, veel vrome ende Godt salijghe menschen gheweest. Ja veel vromer ende Godt salijger, als dien die niet aen den pest gestorven syn.' Claes Baerntsz, 'Kort verhaal der gedenckwaerdijgste gheschiedenissen van Westvrieslant', Noord Hollands Archief, Haarlem, 176 Losse Aanwinsten (verkregen tot 1984) 1530, fol. 161 verso.

35 Walsham, *Providence in Early Modern England*; Parets and Amelang, *A Journal of the Plague Year*; Van Egeraat, '"Zoo Zij Ghesindt Waeren"'; Walsham, *The Reformation of the Landscape*; Chroniclers also copied sermons during epidemics showing this. See, for example: Van Campene and Van Campene, *Dagboek van Cornelis en Philip van Campene*, 201.

Adam and Eve from the Garden of Eden, decreeing that they should endure disease, labour, childbirth pains, and ultimately, death. Essentially, diseases embodied the 'wages of sin'.[36]

In the Dutch context, scholars in the 1980s argued that religious explanations became more dominant in the seventeenth century as a result of the Reformation.[37] However, recent research on sixteenth-century chroniclers has demonstrated that there was no discontinuity between natural and divine explanations. These explanations continued to be used side by side, but in both centuries epidemics were in first instance interpreted as a punishment from God.[38]

In the previous chapter we saw how chroniclers were searching for providential signs and how they made comparisons between similar occurrences. To a large extent, this also applied to epidemics. Unlike for many meteorological phenomena, there were biblical analogies for epidemics. Chroniclers often drew upon biblical passages to create parallels with their own time striving to make sense of their experiences. This type of 'analogical' or 'synchronic' way of thinking was widespread in early modern Europe and is characterised by an emphasis on similarities rather than the differences between past and present.[39] Historians have demonstrated that a continuum was assumed between events in Scripture and contemporaries' own time. The experiences and lessons from the past were directly applicable to the present. As a result, preachers continually presented biblical analogies during weekly sermons. These were given not as abstract examples but as an impending reality.[40]

This way of thinking in analogies was not limited to an educated elite of scholars and clerics but was also prevalent among our chroniclers. One of the most frequent references was made to the *Book of Jeremiah,* which was also cited by Van Campene. The Catholic lawyer and brewer Willem Jansz. Verwer (c.1533-80) from Haarlem, however, paraphrased excerpts from *2 Samuel 24*:

> We poor sinful people humbly beg you through your boundless mercy, that just as you have punished and afflicted the prophet David and his people with such a terrible pestilence for their sins that, as it is written, seventy thousand men died in three days and through his prayers and penitence the pestilence ceased, O merciful Father, we also now acknowledge that you send this pestilence and punishment upon us, because of our great sins.[41]

36 Snowden, *Epidemics and Society*, 10–11.

37 Noordegraaf and Valk, *De Gave Gods*, 129–30.

38 Van Egeraat, '"Zoo Zij Ghesindt Waeren"'; Dekker, 'Coping with Epidemics', 229–47.

39 Jorink, 'Tekenen van Gods gramschap', 184–85; Jorink, *Reading the Book of Nature*, 30; Pollmann, *Memory in Early Modern Europe, 1500-1800*, 48.

40 Jorink, 'Tekenen van Gods gramschap', 186; Pollmann, *Memory in Early Modern Europe*, 48.

41 '[...] wij arme sondighe menschen bidden u oetmoedelijc deur u grontlooze barmarticheijt, dat Ghij ons, soe David die prophet om zijnen sonden willen in zijn volc met een zoe grusamen pestelentie gestrafft ende

Verwer hoped that the epidemic would end if he and his fellow townspeople, just like David, repented their sins, so that God would lift the 'period of dearth, pestilence [...] and war.'[42]

The combination of dearth, pestilence and war is a well-known premediated combination, often observed by chroniclers in especially the second half of the sixteenth century. Van Campene's fellow townsman, the Catholic Marcus van Vaernewijck (1518-69), a merchant and official from Ghent as well, noted in October 1566 that: 'Sieges of cities and war are sent by God, like pestilence and periods of dearth.'[43] He wrote this a month after the iconoclasm took place on 22 August. A period of dearth had preceded it from 1565 until the summer of 1566.[44] Like Van Campene he saw parallels between the events in his own time and those in the Old Testament where many of these disasters can be found in 'abundance', according to him.[45]

In addition to the patterns that were constructed, it is also noteworthy which patterns were not observed by the chroniclers. When chroniclers wrote about the combination of war, dearth and pestilence, they did not refer to the *Book of Revelation* (6:1-8) in which these plagues are represented by the four horsemen of the apocalypse as harbingers of the Last Judgement. Andrew Cunningham and Ole Peter Grell noted in 2000 that especially in sixteenth- and early seventeenth-century Europe, apocalyptic expectations and eschatological speculations were prevalent.[46] In 2001, Huib Zegwaart asserted that with the exception of a few case studies, research on apocalyptic thought in the Low Countries is understudied.[47] Van Egeraat's recent research on sixteenth-century pamphlets, however, has shown that compared to Germany, there were hardly any references to the Last Day in the Netherlands, and even fewer in chronicles.[48] This result is confirmed by my investigation of our larger corpus of chronicles.

Apart from the scriptures, sixteenth- and seventeenth-century chroniclers also employed secular historical examples to interpret epidemics. According to Van Vaernewijck, punishments from God were not only documented in the 'Old Testament

gheplacht hebt, dat na men leest in drie daghen seventich duijsent man gestorven zijn ende doer zijn bidden ende penitentie die pestilentie opghehouden is, O barmartighe Vader, nu bekennen wij oeck, dat Ghij dese pestelentie ende straff over ons sendt, omme onse groote sonden.' Verwer, *Memoriaelbouck,* 159.

42 '[...] duere tijt, pestilentie ende van [...] oorlog.' Ibid.

43 '[...] belegghen van steden ofte oorloghen, die Godt zent, als pesten ende diere tijden.' Van Vaernewyck, *Van die beroerlicke*, 297.

44 Van Dixhoorn, 'The Grain Issue of 1565-1566', 171–204.

45 Van Vaernewyck, *Van die beroerlicke tijden*, 103.

46 Andrew Cunningham and Ole Peter Grell, *The Four Horsemen of the Apocalypse: Religion, War, Famine, and Death in Reformation Europe* (Cambridge, 2000), 1.

47 Huib Zegwaart, 'Apocalyptiek: overzicht van een verwaarloosd gebied in het Nederlandse bijbelonderzoek', in *oden, christenen en hun Schrift. Een bundel opstellen aangeboden bij het afscheid van C.J. den Heyer*, ed. C. Houtman and L.J. Lietaert Peerbolte (Baarn, 2001), 130–46.

48 Van Egeraat, '"Zoo Zij Ghesindt Waeren"', chap. 4.

[...] but could also be read and experienced in abundance in historical writings.'[49] Some chroniclers therefore included lists of miracles and preternatural events in their chronicles, usually commencing with the birth of Christ and then progressing into their own time. One of these chroniclers was the Catholic official and *politiemeester* Justus Billet (1593-1682) from Ghent. Drawing on historical examples, he observed a direct causal relationship between the epidemic and its causes, demonstrating a combination of analogical and providential reasoning. When people lived in sin, God intervened, and when they repented, God halted the plague. For instance, Emperor Hadrian (76-138) died from a mysterious illness, 'by the punishment from God, because he persecuted Christians.'[50] In the year 1057, a plague beset the city of Ghent, but after the inhabitants expressed remorse and prayed to God, Mary, and Ghent's patron saint Macharius (?-1012), the plague ceased.[51]

These historical examples, often used in sermons to interpret and explain epidemics, also reveal how patterns derived from Scripture were used to make connections between events in the past. In the sections of the chronicle that discussed events before the time of the author, we often see a close relationship between epidemics, dearth and war, with particularly the first two phenomena often linked together. Billet noted in 890 that for example: 'a large and terrifying pestilence emerged after a period of dearth'[52] and in 1157 'a long period of dearth was followed by a terrifying and vehement pestilence.'[53] Billet observed numerous other patterns such as pestilence and periods of dearth. What struck him and other chroniclers about these and similar observations was that these 'punishments' did not occur without a warning. Preceding the period of dearth and famine in 890, Billet recorded various prodigies:

49 '[...] int aude testament ghevanghen [...] dwelc men ooc bij veel hijstorien overvloedelic lesen ende ondervindenmach.' Van Vaernewyck, *Van die beroerlicke tijden*, 103.

50 '[...] door een straffe Godts, om dat hij de Christenen soo vervolcht hadden.' Justus Billet, 'De cleene ofte corte chronycke van Dhr. Justo Billet, begrypende in forme van eenen register ... van saecken principalick gheschiet binnen de Stadt van Ghendt, midtgaders van eenighe steden van Vlaendren, van Duytslandt ... tot den jaere 1564. In twee volumen, waer naer noch dry andere sullen volghen, eyndende met de jaere 1666, deel 1', Stadsarchief Gent, Bibliotheek 1LF2 and GSA1, fol. 10 verso.

51 'Soo was tot Ghendt een dusdanighe groote peste dat sij daeghlicx wech sleipte 5 ofte 600 zielen, maer door de vierighe ghebeden tot Godt, ende door de intercessie van Maria, ende den H. Macharius, soo cesseerde de selve.' Ibid., fol. 49 recto.

52 '[...] ende uijt desen dieren tijt sproter een soo groote, ende afgrijselicke peste.' Billet, 'Den polytye boeck [...] deel 7', fol. 76 recto.

53 '[...] wiert tot Milaenen, [...] twee sonnen, ende eenighe daeghen daernaer twee maenen, als voorboden van groote straffen die souden volghen, [...] eenen grooten dieren tijt, die ghevolcht wiert van een schrickelicke, fenijnighe peste.' Justus Billet, 'Den polytye boeck [...] deel 8', fol. 59 recto.

> In the year 890, there were many signs seen in the heavens, and on earth, that could not be interpreted as anything but presages of God's wrath [...] For example, there was an earthquake in Rome that caused much ruin, and 2 monsters were born, one child had three heads, and a foal with three feet. In Puglia, a fountain changed its water into blood.[54]

In the previous chapter we discussed that signs in the sky, such as comets, could be a warning for future disasters, but were difficult to interpret when they occurred. Escaping the punishment of God was hardly, if at all, possible. Contemporaries accepted the idea that not only the sinful but also the innocents were punished by an epidemic. According to Van Vaernewijck, 'in a communal plague, the good must suffer with the bad, and often the good and innocent suffer the most.'[55] Nevertheless, the 'innocents' could, to some degree, prepare themselves for God's wrath by heeding His signals. Van Vaernewijck stated that contemporaries shared the belief that 'if a change is imminent or if a plague is coming, God will announce it with signs in heaven, or on earth.'[56]

Providential signs on earth were for example the birth of 'monsters' or events that could be interpreted in an analogical way.[57] Van Vaernewijck for example wrote in a paragraph on 'how the children in Ghent *prefigured* the coming time'[58] [my italics] that:

> Sometimes with innocent creatures, such as among the children, as when plague is imminent, the children hold customary processions beforehand and go singing through the streets, such as when corpses are carried to the grave; when there is to be a war, they tend to imitate battles and fights among themselves, and so forth.[59]

54 'Inden Jaere 890, waerender veel teeckenen aen den hemel, ende op der aerden gesien, niet connende bedieden, als presagien van de gramschap Godts, [...] soo wasser binnen Roome een eertbevinghe die veel Ruinen causeerde, ende 2 Monsters gheboren, ende gheworpen, het eene kint hadde drij hoofden, ende een veulen met drij voeten. In Puglia veranderde een fonteijnen haer water in bloedt.' Billet, 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 deel 7', fol. 76 recto.

55 '[...] in een ghemeen quale van een ghemeente de ghoede met de quade te lijden moeten hebben, ende dicwils de ghoede ende onschuldighe aldermeest.' Van Vaernewyck, *Van die beroerlicke tijden*, 297.

56 'Men zecht ghemeenlic, alsser eenighe veranderinghe van tijde zal gheschien ofte eenighe plaghen regneren, dat Godt dat pleecht met zeker teekenen in den hemel of in der eerden te vertooghen.' Ibid., 256.

57 Alan W. H. Bates, 'Monstrous Exegesis: Opening Up Double Monsters in Early Modern Europe', in *The Body of Evidence: Corpses and Proofs in Early Modern European Medicine*, ed. Francesco Paolo de Ceglia (Leiden, 2020), 119–48.

58 'Hoe die kinderen te Ghendt prefighureerden den toecommenden tijt.' Van Vaernewyck, *Van die beroerlicke tijden*, 256.

59 '[...] somtijts met onnoosel creatueren als onder die kinderen, ghelijckerwijs alst peste wesen zal, zoo pleghen die kinderen daer te voren costumelic processien te maken ende ghaen al zijnghende achter straten, alzoo men de lijcken ten grave waert draecht; alst oorloghe zal zijn, zoo pleghen zij onderlinghe bataillen ende strijden te conterfeeten, ende alzoo voort.' Ibid.

Here, Van Vaernewijck made an explicit analogy between a prodigy and the plague that awaited the community. This in combination with the other examples shows that contemporaries used both examples from the past and prodigies in the present to uncover the meaning of extraordinary phenomena by analogy.

This way of providential reasoning with preternatural events and analogies was shared by both Catholic and Reformed chroniclers until the seventeenth century. The Reformed teacher Pieter van Godewijck (1593-1669) from Dordrecht wrote about plague epidemics in his city in the years 1636-37 and 1657. With a reference to *Jeremiah* 17:27, he believed that 'the Almighty God has a thousand methods and rods with which to chastise humanity, all creatures stand ready at His service.'[60] This note explains why he recorded preternatural events such as the birth of a 'monster' in his hometown between the two epidemic waves in 1641, with the remark: 'what the significance of this is, or will be, is known only to the Almighty God.'[61]

Based on the examples discussed above, it is clear that chroniclers interpreted epidemics as a manifestation of divine providence, which was frequently preceded by a preternatural sign or prodigy. They derived this understanding from biblical and secular historical examples that they used to interpret and explain epidemics, often through analogies. For most people, the knowledge and skill to make such connections probably came from sermons. It is known that preachers tried to interpret disasters during their services, yet chroniclers also make such connections themselves.[62]

Natural Processes: The Emergence and Spread of Epidemics

While chroniclers interpreted epidemics as a punishment from God, they also acknowledged that diseases occurred through natural processes. We have already seen that chroniclers recorded measures such as culling (stray) dogs and cats, and restricting travellers from staying overnight, which were believed to inhibit the progression of the plague. Historians have shown that, on the one hand, contemporaries believed that diseases were transmitted directly or indirectly between individuals, and, on the other hand, that diseases originated and spread through elements such as (corrupted) water and air, with certain places fostering specific illnesses. These explanations are often

60 'Den Almachtigen God heeft duysent middelen & roeden, daer de Menschen mede konnen gestraft werden, alle Creatuyren staen tot synen dienst gereet.' Van Godewijck and Van der Schouw, *Dese heerlicke stadt*, fol. 78 recto.

61 '[...] wat voor beduydingh dat dit is, of wesen sal, dat is de Almachtige God bekent.' Ibid., fol. 58 recto; Bates, 'Monstrous Exegesis', 119–48.

62 Jorink, 'Tekenen van Gods gramschap', 186.

categorised as contagionist and anti-contagionist (or miasmatic), respectively.[63] In 1992, Rosenberg suggested that during most epidemics 'both styles of explanation were employed in combination with one element or another featuring more prominently.'[64]

Research has shown that medical experts favoured miasma-based explanations, but it is less clear what the beliefs of non-experts were when faced with such horrifying biological events.[65] Did they heed the advice and knowledge of medical experts, or did they have alternative explanations? If so, what influenced these beliefs? Charting the patterns constructed by chroniclers can provide insight into the natural processes they associated with epidemics. While examining the entries on epidemics in the chronicles, I have created three categories that chroniclers used to describe the natural processes: miasmas, contagion, and the influence of weather. Depending on the type of epidemic, a chronicler could use a combination of one or more of these categories to describe the natural processes.

Corruption and Miasmas

We have seen that chroniclers observed correlations and patterns between periods of dearth and the emergence of an epidemic by drawing on their contemporary experiences as well as biblical and historical events. Yet, these biblical and historical examples provided little insight into the natural mechanisms that caused and spread epidemics. When chroniclers themselves experienced epidemics, they speculated on what influence the various events had on each other.

The Catholic corn inspector from Ypres, Augustyn van Hernighem (c.1540-c.1617) for example, observed several times in the 1580s that pestilence and dearth occurred simultaneously. Moreover, he wrote that malnutrition predominantly affected poor individuals, but that the subsequent disease was contagious to the entire population.[66] This is mirrored in the chronicle of the Brussels merchant and local officer Jan de Pottre (1525–1601). On 4 December 1590, he recorded that 'many individuals fell ill due to extreme poverty, and also because they had consumed a large number of cranberries.'[67]

These sixteenth-century chroniclers perceived a direct correlation between the lack of food and the emergence of an epidemic and could articulate the processes by which this transpired. The issue was not so much a lack of edible food, but rather that altered

63 For more information on de debate and the methodological problems with regard to contagion and miasma see: John Henderson, 'Historians and Plagues in Pre-Industrial Italy over the "Longue Durée"', *History and Philosophy of the Life Sciences* 25, no. 4 (2003): 481–99.

64 Rosenberg, 'Explaining Epidemics and Other Studies in the History of Medicine', 295.

65 Lindemann, *Medicine and Society in Early Modern Europe*, 52–53.

66 Van Hernighem, 'Beschrijving der stad Yper, deel 2', 248, 284, 320, 325, 333; See also: Luyten, *Kronijk uit het klooster*, 147; Van Haecht, *De kroniek van Godevaert van Haecht*, 13; De Pottre, *Dagboek van Jan de Pottre*, 186; Billet, 'De cleene ofte corte chronycke [...] deel 1', fol. 140 recto.

67 '[...] soe sijnder zeer veel sieken mede af ghecoemen van groote armoede, ende dat sy oock veel vinbesyen hadden gheeten.' Pottre, *Dagboek van Jan de* Pottre, 186.

dietary patterns precipitated by dearth caused contemporaries to fall ill, as exemplified by the excessive consumption of cranberries. The outcome was a contagious disease that could also infect other people. What chronicles may have meant by 'contagious' disease may be gauged from a comparable account in the chronicle of the priest Wouter Jacobsz. (c. 1521–95) from Amsterdam. He recorded that in June 1572, twenty-five individuals in the Convent of the Poor Clares fell ill due to poverty and famine, inflicted by the Calvinists – *Geuzen* who rebelled against the regime of the Duke of Alba – inducing 'severe unhealthiness within their bodies'.[68] As a result, 'they all carried a miasma that was unbearable. To dispel the stench and purify the air, several tar and pitch drums were lit within the convent.'[69]

What these excerpts show is that inadequate, or altered, nutrition was believed to catalyse the onset of an epidemic. Examining the patterns that chroniclers constructed to describe the emergence and progression of epidemics in greater detail allows us to gain insight into their medical knowledge. As one might expect, they were familiar with Hippocratic and Galenic medicine, which for more than two millennia was the predominant – though not exclusive – medical paradigm in the West, and to a certain extent, the Arabic world.[70] Its origins go back to Hippocrates (c.460 to c.377 BCE), whose collection of approximately sixty works, known as the Hippocratic corpus and written by multiple authors, introduced a radically new conception of medicine: Disease is a purely natural event that can be explained only by secular causes and that can be treated only by rational means.[71]

Hippocrates's philosophy of medicine was further developed by Galen of Pergamum (CE 129-c.210 CE), who codified his theory into the canonical four humours: blood, phlegm, yellow bile and black bile.[72] Each humour (in Greek: *khumos*), meaning 'juice' or 'flavour', in the body was needed to maintain a balanced equilibrium (*eucrasia*) with

68 'Die suspitie waerom dese cranckte onder dese aldus rees was die armoede ende benautheyt, welck in dit convent geledenwerden doer desen swaere benaude tijt ende toe // coemst van soeveel verjaechde clarissen als wuyt verscheyde plaetsen bij haer quaemen, die veelal doer lange hartseer, welck haer gestadelick gedaen was van den ongeschickte tyrannie der verkeerder guesen, groete ongesontheyt in haer lichaemen vercregen hadden.' Wouter Jacobsz, *Dagboek van broeder Wouter Jacobsz (Gualtherus Jacobi Masius) prior van Stein: Amsterdam 1572-1578 en Montfoort 1578-1579. Deel 1*, ed. Isabelle Henriette van Eeghen, vol. 1 (Groningen, 1959), 336–37.

69 '[...] die alle sulcke lucht over haer hadden, dat dieselfde niet te verdraegen was, sulx dat om den stanck daer te verdriven ende die lucht te suyveren int selfde convent veel teer ende pecktonnen gebrant werden.' Ibid., 1:336.

70 R.J. Hankinson, 'Humours and Humoral Theory', in *The Routledge History of Disease*, ed. Mark Jackson, The Routledge Histories (London, 2017), 34; Vivian Nutton, 'The Fortunes of Galen', in *The Cambridge Companion to Galen* (Cambridge, 2008), 255; Snowden, *Epidemics and Society*, 19.

71 Snowden, *Epidemics and Society*, 9; Lindemann, *Medicine and Society in Early Modern Europe*, 13 Of these works, some are especially well-known, such as the "Hippocratic Oath"; On the Sacred Disease; On Human Nature; Epidemics; and Airs, Waters, Places.

72 Each humour (microcosmos) corresponds with the four elements (macrocosmos). Blood - air; yellow bile - fire; black bile - earth; phlegm - water.

the other humours to promote health. Illness resulted from disturbances, imbalances, or corruptions of these humours, caused by 'non-naturals'.[73] Most chroniclers were familiar with elements from the theory of 'non-naturals', as they entail a healthy and moderate life.[74] The definition and description of the non-naturals were first used by Galen in his commentary on the Hippocratic writings on epidemics, where he referred to them as 'categories of health'.[75] The six non-naturals were behavioural and environmental factors, including: air, water and climate; food and drink; exercise and rest; sleep and wakefulness; excretion and retention; and passions and emotions. In particular, the first one, miasmas or corrupted air, was deemed one of the most significant causes of epidemics, according to Galen.[76]

From the examples above, it becomes clear that for chroniclers a distortion of the non-natural 'food and drink' could lead to an imbalance of the humours, creating miasmas such as described by Wouter Jacobsz.[77] The chroniclers' reflections on epidemics often refer to contemporary attempts to inhibit the spread of an epidemic by controlling the air. Wouter Jacobsz. wrote that people tried to purify the 'bad' air by igniting barrels of pitch, and in Billet's chronicle we read how Ghent's city council proactively implemented measures to prevent the emergence of miasmas. The new school for the poor [*armenschool*] was transformed into a spacious and clean building by the river Scheldt with extra-wide bedrooms for the children to ward off all kinds of diseases.[78]

In addition to poor nutrition, chroniclers described how organic materials could also directly contaminate the air. Here, they pointed to the non-natural of 'corrupted air' as a significant cause of epidemics. For instance, in April 1571, Godevaert van Haecht (1546-99), the Lutheran painter from Antwerp, was critical of the local authorities for causing an epidemic. He wrote that the citizens of Antwerp believed that 'the pestilence spread from a malodorous corpse hanging in the wind [i.e., at the gallows] that had succumbed to the plague.'[79]

A similar observation was documented by local official, Zegerus ter Stege (1535-?) from Steenwijk (Overijssel), who wrote that it was not just one infected body, but several casualties left on the fields following the Siege of Steenwijk (18 October 1580 – 23 February 1581) that triggered an epidemic. Due to the inability to swiftly bury the

73 Hankinson, 'Humours and Humoral Theory', 21–35.

74 See also: Paul van Dijk, *Volksgeneeskunst in Nederland en Vlaanderen* (Deventer, 1982).

75 James Kennaway and Rina Knoeff, *Lifestyle and Medicine in the Enlightenment: The Six Non-Naturals in the Long Eighteenth Century*, Routledge Studies in the History of Science, Technology and Medicine (Milton, 2020), 6.

76 Lori Jones, 'The Diseased Landscape: Medieval and Early Modern Plaguescapes', *Landscapes* 17, no. 2 (2 July 2016): 110.

77 '[...] groete ongesontheyt in haer lichaemen.' Jacobsz, *Dagboek van broeder Wouter Jacobsz*, 337.

78 Billet, 'Den polytye boeck [...] deel 2', fol. 46 recto.

79 '[...] dat de peste voorts waeyde van dat stinckende lichaem dat daer onder wint hinck en van der pesten gestorven.' Van Haecht, *De kroniek van Godevaert van Haecht*, 150–51.

deceased, he wrote, 'the air in Steenwijk has become utterly inflamed and contaminated. Initially with a pestilential disease, and subsequently with a severe plague.'[80] Ter Stege substantiated his account with figures: 'Initially it began with 6, 8, 10 deaths per day, peaking at mid-summer with one hundred and twenty victims daily, and in the autumn, 25, 30, 35 daily casualties.'[81]

The idea that the air could become infected was supported by empirical observations such as the one of Lambrecht van den Hoevel (?-1636). This secretary of Oisterwijck described how 'the birds, flying over the countryside, caught the pestilence and fell to the ground', at a time when his city was in the grip of an epidemic caused by corrupted air.[82] To escape the miasmas Van den Heuvel remarked that wealthier citizens, including 'councillors and some of the elite [*gequalifiseerden*],' fled for twenty-two weeks, leaving ordinary citizens behind.[83]

The fact that corrupted organic material often has a 'bad smell' makes it evident that people from all walks of life associated it with danger. Therefore, during epidemics, chroniclers frequently recorded that livestock was moved outside the walls of the city, streets were cleaned, restrictions were imposed on butchers, and bans were placed on perishable organic material such as fruit. These records show that an epidemic could originate locally due to poor nutrition, stench, or the rotting of matter. Yet, its spread occurred through people, animals, or goods, which could be 'contagious' [*besmettelijk*]. How did chroniclers think 'contagion' worked, and did their views change depending on the circumstances?

80 '[...] is de lugt tot Steenwijck geheel ontsteecken en geinfecteert, eerst met een pestelentiale kranckheijt, daerna met een heftige pest.' Zeyger ter Stege, *Aanteekeningen van Mr. Z. ter Stege, vermeerderd met nalezing en bijvoegsels* (Meppel, 1859), unpaginated.

81 'Daer aen met ten eersten alle dagen 6, 8, a 10 menschen sijn gestorven, en voorst in 't midden van de Somer des daags hondertth twintig menschen. Ende op den herfst dagelijcks 25, 30, 35 menschen.' Ibid.

82 '[...] voogelen over de vreijheijt vliegende het vier ontfangen en ter aarden vielen.' Lambrecht Van den Hoevel, 'Plaatsbeschrijving van Oisterwijk met kroniek van de jaren 1566-1609', ed. M. Pinkhof, *Bijdragen en Mededelingen van het Historisch Genootschap* 40 (1919): 158; See also: Jan Vivere and Anonymous, *Chronijcke van Ghendt: handschrift deelmakende van het archief van Burchtgraaf Vilain XIIII te Bazel in 't licht gegev. door Frans de Potter*, ed. Frans De Potter (Ghent, 1885), 327.

83 Van den Hoevel, 'Plaatsbeschrijving van Oisterwijk', 158–59.

A Contagion or the Contagion?

In 1563, the nun Maria Luyten (c.1540-70) from Weert (Limburg) recorded how an epidemic ravaged the entire city:

> This pestilence started in the Beekstraat at the tavern of *Billeken van Horne*. The daughter of the inn keeper became infected after she swept up the vomit of a man. Because of this, she passed away, but nowhere more people died than in the Langstraat. Both inside and outside the gate. In some houses nine or ten people died, or as many as there were present in that house.[84]

Five years later, in March 1568, Luyten wrote that a new pestilence was again sweeping through the town. This time, it started in a tavern at the Hoogstraat – an extension of the Beekstraat. The disease, according to Luyten, spared no one. Between twenty and fifty people died daily, the old and the young, the rich and the poor alike. In June, Luyten observed that the disease had reached its peak, but unfortunately in September, it reached her convent. She detailed how a servant of the convent had attended the annual fair, returned home ill, and was subsequently cared for in a separate room. The servant eventually died three days later, on 29 September. The three people who had cared for him also succumbed within two weeks, after which the disease stopped spreading within the convent.[85]

Between the two epidemics, separated by five years, we observe a recurring pattern and a notable difference in the spread of the epidemics. In both cases, the disease was believed to have originated in a tavern and thus perhaps introduced by a foreigner. The import and export of people, animals, and goods were strictly controlled during an epidemic. Yet, when analysing these fragments in more detail, it appears that contemporaries believed that diseases were 'transmissible' in more than one way.

In 1563, Luyten attributed the spread to the spit of a sick man, and in 1568, it was their own servant who had come into contact with contagious individuals at the fair. The convent remained unaffected between March and September, apparently due to minimal contact with people from the city. In the first case 'the contagion' was a substance, transmitted by contact through a chemical or vital poison which, in this instance, was the vomit of the man. In 1568, the people themselves were 'contagious'. Michael Worboys (2016) highlighted this subtle difference in the use of the word 'contagion', which is mirrored in the chronicles.[86]

84 'Deese pest quam eerst in de beeckstraat bij Billeken van Horne, met eenen man die daer in de herbergh was, daer het die dochter van cregh als sy opgeveght hadde daer hij gespouwt hadde, daer sij oock van storf; maer nergens storf het soo seer als in de langhstraet binnen en buijten de poort; want in sommige huijsen storvender wel 9 oft thien of soo veel als er in een huijs was.' Luyten, *Kronijk uit het klooster*, 159.

85 Ibid., 200–201.

86 Michael Worboys, 'Contagion', in *The Routledge History of Disease*, ed. Mark Jackson (London, 2017), 71.

The notion of 'the contagion' as an infected substance that caused disease was applied to both humans and animals. In the chronicle of the mill master and Reformed elder Claes Barentsz. (1574-1651) from Hauwert, a detailed description is present of how a 'lung disease' amongst cows was transmitted from one animal to another between 1638 and 1639. According to Claes Barentsz, the disease was highly contagious:

> This disease is of such a condition that when it appeared among cows in a certain home or land it rarely does not spread to other animals. It infects the other cows as well with their saliva or breath (so it appears) when another animal stands or goes next to an [infected] animal.[87]

Although Barentsz. could not confirm by direct observation that the disease spread in this way, it was a plausible hypothesis. When a human or animal was sick, this also meant that the bodily fluids were disturbed and infected. This idea of 'the contagion' did not explain how the spread of diseases through people and goods worked at times when no 'contagious' substance like saliva was involved. But the chroniclers also provided an answer to this mode of transmission, which Worboys termed 'a contagion'.[88]

Billet provided a detailed account of how 'a contagious' disease spread from March to November 1666. His account includes a list of twenty-three 'infected' areas from where the epidemic began to spread. In some cases, Billet could also determine where the disease started to emerge. The infection could be traced to a cobbler through whom the disease had been brought from Antwerp.[89] Another source of infection also came from outside – from an area 'not far from the gate of Bruges. These five houses were infected with commodities bought and brought from London in England to this city [of Ghent].'[90]

To understand how Billet compiled this list, we need to examine two volumes he wrote in the previous year. From an earlier volume of Billet's chronicle, it is evident that he was monitoring the progression of the 'contagious disease' in London, which had claimed approximately 8,000 lives in September 1665.[91] Therefore, it is not surprising that Billet drew a connection between the epidemics in London and Ghent. Seven months later, he wrote:

87 'Dese sieckte is so danige sieckte van Conditie, daer die Comt, onder die koe beesten in eenich Huijs ofte lant, daer verscheijden beesten sijn, daer sal het seer selden bij een blijven: maer besmet die andere Beesten oock met haer seever ofte Adem (alsoo het schijnt) Als eenen Beesten die daer bij staen ofte bij gaen.' Baerntsz, 'Kort verhaal der gedenckwaerdijgste gheschiedenissen van Westvrieslant', fol. 229 verso.

88 Worboys, 'Contagion'.

89 Billet, 'Den polytye boeck [...] deel 11', fol. 17 recto.

90 '[...] Ende een ander niet verre vande Brughsche Poorte. Dese Vijf huijsen sijn gheinfecteert gheweest, door goederen ghecocht ende ghebrocht van Londen in Inghelant binnen deser voorseijde Stede.' Ibid.

91 Justus Billet, 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 9', Stadsarchief Gent, Bibliotheek 1LF2 en lGDl, 529 (C. Handschriften), fol. 27 recto.

> Schautheet, a free captain from this city (living between the Predickheeren ende Recollecten Brugghe) returned with his ship from London in England from where he brought some commodities that he bought. Suddenly he died, as did the person who had coffined him and who had fallen ill in the process.[92]

According to witnesses, it was pestilence. The aldermen promptly isolated the captain's house, and those potentially infected were transferred to the plague house.[93]

The idea that epidemics mostly came from 'abroad' was widely shared among chroniclers. Yet this fragment also demonstrated that chroniclers believed that houses could be infected and that humans, animals, and goods could be carriers of disease. The latter applied especially when these could hold 'air'. For example, in an anonymous chronicle from Kortrijk it is described how in October 1667 an epidemic started at the home of Pieter Kesteloot, where wool was being spun from Tourcoing, France. The wool was contaminated with pestilence, resulting in the death of the entire family of ten children, including the servants who came into contact with the wool. The disease then spread throughout the city, causing many more deaths.[94]

The idea that wool, in particular, was a carrier of disease is a recurring theme in sixteenth- and seventeenth-century chronicles.[95] Contemporaries believed that due to the insulating and open structure of wool, it was a potential carrier of (bad) air. This idea is associated with the concept that miasmas caused diseases, as discussed in the previous section. The combination of miasmas and 'contagious substances' is most often cited by chroniclers to describe the origin and spread of epidemics.

The Influence of the Weather

Returning to the chronicle of Van Campene we see a surprising additional cause for the emergence of diseases. He wrote in July 1568 that the 'extraordinary heat [...] induced pestilence in certain locations.'[96] Van Hernighem wrote something along similar lines: 'around this time, the 12th of February, pestilence started to ignite within the city

92 'Schautheet Vrij schipper deser stede (woonende tusschen de Predickheeren ende Recollecten Brugghe) ghekeert met sijn schip van Londen in Inghelandt, vanwaer hij mede ghebrocht hadde eenighe particuliere goederen, voor sijne rekenijnghe, soo is hij subijtelick commen te sterfven ghelijck oock heeft ghedaen den persoon die hem hadde ghekist ende daer bij sieck gheworden.' Justus Billet, 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 10', Stadsarchief Gent, Bibliotheek 1LF2 en lGDl, 529 (C. Handschriften), fol. 33 verso.

93 Ibid.

94 Anonymous and Philippus Van de Maele, 'Chronycke van Cortryck', Rijksarchief Kortrijk, Fonds Goethals-Vercruysse, ms. 215, 60.

95 For a seventeenth-century example from the Dutch Republic, see: Anonymous and Jan Gerritsz Waerschut, 'Kroniek van Rotterdam', Stadsarchief Rotterdam, 33.01 Handschriftenverzameling inv.no. 1552.

96 '[...] de uutnemende hitte [...] ende waer uute in sommeghe plaetsen es een pestilentiale siecte gheresen.' Van Campene and Van Campene, *Dagboek van Cornelis en Philip van Campene*, 157; See also: Luyten, *Kronijk uit het klooster*, 178.

of Ypres, due to the mild weather which has never been seen before by anyone alive. The weather did not change, and it appeared to be summer instead of winter.'[97]

As discussed in the previous chapter, anomalous seasons were often interpreted as the result of divine intervention, but, according to some chroniclers, these anomalies also disrupted the balance between the humours and as a result caused illness. Yet, this pattern between the weather and the emergence of diseases was not common knowledge. Only those who had above-average knowledge of the theory of Hippocrates and Galen to a larger extent could know about the idea that there was a relationship between the seasons and the humours. A disturbance in the seasons could upset the balance of the humours, although other factors such as age and climate also played a role.

According to Galenic medicine, summers were supposed to be hot and dry and winters cold and wet. It is no wonder that deviations and their consequences were closely followed by some chroniclers. Billet offers one of the most illustrative passages that demonstrates how and which factors influenced the way in which contemporaries thought about epidemics. On 9 October 1666, he wrote that:

> The weather was very good, sweet, warm, and quiet, as if it were May, because instead of frost there was dew in the morning. As if it were summer, herbs, flowers and trees appeared young and green, similar to the summer season. Also, the sown grains, which were many, are already grown a half of a *vierendeel* high. Whether this is a good or bad sign is only known by God. What is certain, is that this warm weather may spread the contagious disease.[98]

In other words, Billet observes several deviations from the annual pattern. It was not only the presence of dew instead of frost that caught his attention, but also the state of the vegetation. Due to the sunny and warm weather the grain was already a '*vierendeel*' high, which was taller than normal around this time of year. How this deviation in the season was to be interpreted 'only God knew', but some patterns were evident. Warm weather during late autumn, and particularly in winter, was conducive to the proliferation of diseases. Therefore, it was vital for him to keep an eye on the weather.

97 '[...] ontrent desen tyt van den 12 van sporkele beghonste de peste zeer te onstekene binnen ypere want het en was noyt ghezien by mans leven datte zulck zoocht weder was alzoot bleef continueren want het scheen bet somere te synne van wynter.' Van Hernighem, 'Beschrijving der stad Yper, deel 2', 192.

98 'In desen tijdt. Soo was het een weder, soo goet, soet, waerme ende stille, alof het inden Meij hadde gheweest, want het daude des smorghens, in plaetse van Rijm, alof het inden Somer gheweest hadde gheweest, staende de Cruijen, de Blommen, ende de Boomen, soo Jeughdich ende soo groen, ghelijck men die siet in het Somer Saijsoen. Oock Soo staen der ghesaijde graenen, heel veijl, wel een half vierendeel hooghe, ofte beth ghegroijt; Of dit nu goeden ofte quaede Teekenen sijn, dat is Godt alleene bekendt; Dan het is seecker, dat dit waerem weder, niet goet en is voor de contagieuse Zieckte.' Billet, 'Den polytye boeck [...] deel 11', fol. 5 verso.

Two months later, little had changed, which heightened Billet's awareness about the consequences. He wrote:

> Wednesday, December 22 [1666]. Here in Ghent, and other places in Flanders, warm, pleasant, and damp weather, combined with clear sunshine and southern winds made it feel like summer, however, Christmas is upon us. Consequently, there was a common fear that a great disease would result in mortalities among people. In addition, people were afraid of a poor harvest due to cold nights, because the grains were too high, as they still grew lustily in the fields.[99]

Not only Billet, but others around him noticed a deviation from the natural pattern that allowed diseases to emerge and the grain to grow too early, making it especially vulnerable to cold weather.

Four days later, the danger had passed, and the weather became 'normal' again. The community was left with mixed feelings, showing that the emergence and spread of diseases was experienced differently among the population.

> Sunday, December 26, the day after Christmas day. The sweet weather started to change. A fierce and biting cold with frost and ice caused great joy among most people, both for the sake of their health and that of the fertility of the grains in the fields. However, poor people, who had a hard time keeping themselves warm, expressed their concern and sadness, because they knew that they would suffer tremendously until Easter was upon them.[100]

These excerpts highlight how different societal groups responded to unusual weather patterns and their correlation to diseases. As emphasised by Abraham Maslow (1908-70) and other psychologists since the 1940s, this did not depend just on cultural factors, but also on the socio-economic status of the authors.[101] People who lack basic

99 'Woonsdach den 22en dito. Soo was het hier tot Ghendt, ende apparent in alle andere Plaetsen van Vlaendren, een soo schoon, soet ende Vochtich weder, ghemeinghelt met schoon Sonneschijn, ende Zuijdelicken winden ghelijk of het somer hadde gheweest daer wij nochtans bij de kersdaeghen waeren; oversulcx wasser een ghemeene Vreese, datter eenighe groote Zieckten, ende sterften onder de Menschen soude commen, alsmede een slecht ghewas vande Graenen, alsoo die te hooghe, ende te gulsich stonden en groijden op het Velt, faucte van Rijmeghe, ofte Vorstighe nachten.' Ibid., fol. 31 recto-verso.

100 'Sondach den 26en xbre 1666 sijnde den 2en kersdach, soo begost het goet ende soet weder te veranderen, in een straffe ende bijtende caude, met Rheijm ende Vorst, daer over veel Menschen seer verblijdt waeren, soo om de ghesontheijt vande Menschen, als om de Vruchtbaerheijt vande Graenen op het Velt, doch de Aerme Lieden, die niet wel gheduffelt en waeren, bethoonden daerover druck en droefheijt, want sij wisten wel, dat sij veel souden lijden eer het Paesschen was.' Ibid., fol. 31 verso.

101 A. H. Maslow, 'A Theory of Human Motivation', *Psychological Review* 50, no. 4 (1943): 370–96; Abraham H. Maslow, *Motivation and Personality* (New York, 1954); Louis Tay and Ed Diener, 'Needs and Subjective Well-Being Around the World', *Journal of Personality and Social Psychology* 101, no. 2 (2011): 354–

needs such as shelter, warmth and security were primarily focussed on their struggle for survival, whereas more affluent individuals could literally afford to worry about more complex cultural phenomena and therefore constructed different patterns. However, this does not mean that the poor in this example could not have knowledge of the relationship between weather and disease. For them, a cold winter just posed a greater threat than catching a potential disease.

Although a higher level of education, and therefore more knowledge of humoral theory, is a plausible explanation for the different patterns that chroniclers constructed, the influence of contemporaries' socio-economic background should not be underestimated. While the size of this corpus enabled me to observe long-term developments, it was too small to link these developments to social profiles. Nevertheless, the following examples provide a basis for further research.

Although some chroniclers like Van Hernighem and Billet interpreted anomalous weather as both a possible punishment from God and a danger to the health of humans and animals, other chroniclers interpreted it as a blessing. The sixteenth-century Verwer wrote on 27 December 1575: 'This year it was a sweet and soft winter until Christmas, little ice and snow [...] This year, the summer was also dry and a beneficial harvest. Praise God.'[102] In contrast to the previous examples, Verwer linked drought and mild temperatures to beneficial harvests, especially that of barley when we take other years into account as well. Knowing that barley is one of the raw materials for beer, and given Verwer's profession as a brewer, it is not surprising that he thought in different patterns than, for example, Billet.

A similar observation can be found in the seventeenth-century chronicle of the farmer and aldermen Pieter Florisz. Gertses (c.1630-c.1716) from the small village of Jisp (Holland). Gertses recorded the dates on which his cows and calves were brought into the stables at the year's end. On 14 December 1652, he wrote: 'it was not without God [...] that we put our cows in the stable with beautiful and dry weather', indicating that the weather had been favourable enough for the cattle to remain in the fields throughout autumn.[103] Consequently, the farmer did not need to purchase hay, implying significant cost savings. In other words, and although the two are not mutually exclusive, a relatively warm winter was a blessing for a substantial part of society, while others feared potential disaster.

65; Uriel Abulof, 'Introduction: Why We Need Maslow in the Twenty-First Century', *Society* 54, no. 6 (1 December 2017): 508–9.

102 'Dit jaer tot Kersmis toe een soete sachte winter, nauwelix ijs of sneu [...] Dit jaer ist oock een droghe somer ghewest ende een schoone oost. Lof Godt.' Verwer, *Memoriaelbouck*, 171.

103 'Niet sonder godt [...] haelde wij onse koeije op het stal met moij weer droech weer.' Anonymous, 'Aantekenboek betreffende Jisp, met beschrijving,1647-1716', Waterlands Archief, Purmerend, 0954 Collectie persoonlijke documenten en handschriften, 1518-1968, inv.no. 1, unpaginated.

Conditions for the Acceptance of New Knowledge

Although it is difficult to determine whether Verwer and Gertses were aware of the influence of weather on the humours, their profession would undoubtedly have played an important, if not dominant, role in the way they thought about the relationship between weather and diseases. In the eighteenth century, we see the relationship between the influence of weather and the spread of diseases increasing among chroniclers. Moreover, alternative explanations for the origin and spread of epidemics also reached non-experts. New observations challenged existing explanations, leading to discussions between chroniclers and contemporaries. It is these reflections of the chroniclers that can provide us with insight into the conditions for the acceptance of new knowledge and how traditional and new explanations related to each other in the minds of early modern people.

A Corpuscular Explanation of Epidemics in the Eighteenth Century

In the small Dutch village of Huizen in 1713, Lambert Rijckxz. Lustigh (1656–1727), a farmer and alderman, sought to understand the rinderpest (cattle plague) outbreak that had spread across the Low Countries from 1713 until 1720.[104] To do so, he maintained a chronicle in which he documented all information that might help halt the epidemic. He was well-read and conducted his own research by making observations and engaging with ministers, officials, and other farmers, but did not receive any formal medical training at a university. However, he gave an exceptionally detailed description of the origin and spread of rinderpest. According to Lustigh, it was not only the 'corrosive' and 'poisonous' air that made people and cattle sick but also the 'fiery sparks' (*vierige vonckxkens/voncken*) within them.[105]

In spring 1713, Lustigh postulated that the plague was caused by the 'element air' that was shaped by God in a specific way and subject to change under the influence of meteorological phenomena.[106] Consequently, he believed that one location could be more infectious than another, depending on specific atmospheric conditions. During sunrise, sunset, and in the absence of clouds, the air was especially pestilential.[107] Clear skies

104 Sundberg, *Natural Disaster at the Closing of the Dutch Golden Age*, chap. 2.

105 Lambert Rijckxz. Lustigh, 'Kroniek van Lambert Rijckxz. Lustigh Te Huizen Voornamelijk Betreffende Gooiland, 1654-1727', Noord Hollands Archief, Haarlem, 176, Losse aanwinsten (verkregen tot 1984) van het Noord-Hollands Archief te Haarlem, inv.no. 1572, 15–17. For more information on Lustigh, see also: A. Nonymus, *Lambert Rijckszoon Lustigh, schepen van Huizen* (Huizen, 1973); J.G. Koeman, 'Lambert Rijksz. Lustigh', *Tussen Vecht En Eem. Centrale Organisatie van Vrienden van de Historie van Het Gooi En Omstreken*, May 1974.

106 Lustigh, 'Kroniek van Lambert Rijckxz. Lustigh', 2.

107 Ibid., 3.

and a strong sun intensified the power and contagion of the infected air, often resulting in a suffocating stench.[108]

Although the influence of the weather was described in more detail, Lustigh's description is similar to that of chroniclers of the sixteenth and seventeenth centuries. Moreover, he also drew analogies between his own time and events in the Old Testament. Referring to *Exodus* 1:7-9 and 12:37, Lustigh deduced that there were fewer than 600,000 Egyptians when they were punished by God for refusing to free Moses and the other Israelites. Comparing this to the number of cows that perished, he concluded: 'This fiery destructive plague of pestilence rages and prevails much greater and heavier here in our land than it ever did in the time of the stubborn Pharaoh in the land of Egypt.'[109]

With hindsight, Lustigh also realised that God had given some signs of impending punishments in advance, though at the time he did not understand their meaning.[110] In 1713, he reflected on an incident in 1707, when several villagers reported hearing moaning and crying in a field. Lustigh initially thought that his children had suffered a severe mishap, but they were merely playing. A search was launched to find the source of the sounds, but after locating the area, no one was found. Lustigh wrote that:

> At that time, I had noted this in a small notebook, but about two years ago I tore this notebook into shreds and discarded it and even though I read this omen then, and thought that it would never be fulfilled, I threw it away torn up along with some other papers. But unfortunately we now see this true sign in all its circumstances, both in the sickness, death, and burial of the animals as well as in the moaning, weeping, and lamenting of the humans to whom this has happened.[111]

What was most striking about this fulfilment was that on the same day, an ordinance was published regarding the rinderpest and a cattle farmer by the name of Gerrit Lambertsz. was burying five cows at exactly the same location as where the weeping was heard a few years earlier.[112]

108 Ibid.

109 '[...] dese vierige verderffelijke plage van pestilentie alhier te lande veel grooter en swaarder woet en grasseert als deselve oijt ten tijde van den verstockten pharao in Egiptenlant gedaan heeft.' Ibid., 66.

110 Ibid., 31–34.

111 '[...] Ik doen ter tijt op een kleijn kladtboeckje hadde aengetekent maar ontrent twee Jaar geleden doen hebbe Ik dit klatboeckje aen stucken gescheurt en wegh gedaan en alhoewel Ick dit voorteken doen noch las, en dagt dat het selve noijt vervullen soude, soo wirp Ik het gescheurt met eenige andere papieren wegh Maar Ach, maar Ach, soo siet men, dit waragtigh voorteken Jegenwoordigh in alle sijne omstandighheden Zoo in 't sieck worden sterven en begraven der beesten als oock in 't kermen weenen en stenen der menschen vervevallende.' Ibid., 32.

112 Ibid., 33.

At first glance, Lustigh's chronicle seems to ascribe the emergence of epidemics to providential and to 'corrupted air', as did some of the previously discussed chronicles. Yet there is also a notable difference. The corrupted air, often carried by dew, contained 'fiery sparks' which could cause a corrosive and burning sensation when they came into contact with a person's eyes.[113] These 'fiery sparks', inducing disease were borne not just by the air, but were also dropped on the earth by God. Subsequently, these particles would 'adhere' (*aenkleven*) to water and grass, rendering them contagious (*besmettelijck*). Consequently, not only the cows were vulnerable as they breathed in the air and consumed the contaminated water and grass, but also the individuals who tended to and milked them when they were venturing outdoors and whose 'bare legs […] were contaminated with great fervour and pain.'[114] Lustigh explained that this process was similar to what happened to the eyes. The pestilential air induced reactions in the tissue it touched and could even penetrate the skin.[115]

As I have argued elsewhere, the ideas in Lustigh's chronicle derived from Greek atomists, especially Lucretius (c. BCE 94-c. BCE 50).[116] Lucretius's ideas had been transformed into a consistent theory by the Italian physician Girolamo Fracastoro (c.1476–1553) and had been incorporated into the work of the renowned Dutch physician Johan van Beverwijck (1594–1647). Although Lustigh does not mention these medical experts by name, his account of how an epidemic spread was written along very similar lines, so we can assume that he was familiar with their work.[117]

As we have seen, chroniclers explained the spread of epidemics through miasmic vapours and contagious substances which could be transferred by direct contact (e.g., saliva), at a distance (miasmas), and through fomites, that is by substances or objects that spread the disease such as (woollen) clothing.[118] Fracastoro, and thus Van Beverwijck and Lustigh, agreed that miasmic vapours could cause pathological changes. However, they maintained that these vapours did not initiate contagions. Instead, this was caused by the 'seeds' carried through the air.

In other words, Fracastoro added a layer of complexity, in which these 'seeds' travelled in corrupted air, that could be absorbed by an individual either through inhalation or through the skin. These invisible particles or *semina*, as described by Fracastoro, could be produced in the sky when atmospheric conditions were conducive

113 Ibid., 3, 15–17.

114 '[…] hare bloote benen […] met groote vierigheijt en serigheijt besmet wierden.' Ibid., 3.

115 Ibid., 3, 14.

116 Theo Dekker, 'God's Invisible Particles as an Explanation for the Rinderpest Outbreak (1713–1714): The Reception of Medical Knowledge in the Dutch Republic', *European Journal for the History of Medicine and Health* 79, no. 1 (3 May 2022): 152–68.

117 Ibid., 162.

118 Francesca Maria Crasta, 'Fracastoro, Girolamo', in *Encyclopedia of Renaissance Philosophy*, ed. Marco Sgarbi (Cham, 2018), 6.

to their propagation. Once they had penetrated their host, these corrupted particles could multiply, leading to the putrefaction of humours. The resulting imbalance led to an excess of bodily fluids and, therefore, sickness. Fracastoro's concept of *semina* (seeds of disease) led to a new ontological theory of disease, marking a significant contribution to the discourse on the transmission and causes of disease among medical practitioners in the sixteenth and early seventeenth centuries.[119]

This theory found its way into Lustigh's chronicle through the medical works of Van Beverwijck. He was one of the most renowned Dutch physicians of the seventeenth century, who wrote in the vernacular and collaborated with Jacob Cats (1577-1660), the 'Dutch Homer' to popularise his *Schat der gesontheyt* (1636), *Schat der ongesontheyt* (1642), and *Heel-konste* (1645).[120]

The belief that 'contagious' particles could 'adhere' to the environment, people, and animals was thus endorsed by Lustigh, but not by others in his vicinity, as evidenced by their actions. On the last day of October, several farmers in the villages of Naarden and Hilversum declared they would bring their cattle in from the fields early, hoping to avoid infection. Lustigh observed that these farmers refused to believe that their cattle could have already been contaminated by these particles in the fields. His attempts to persuade them were met with derision. Once the cattle moved from the crisp autumn air into the warmth of the stables, huddled closely together, Lustigh described how the pestilential 'force' in the air became active and made its presence known.[121]

To convince these farmers, he used an analogy to which they could relate. Lustigh explained that when people spent a long time in a cold and damp environment, they often became unwell and fuzzy upon entering a warm house with a lit stove.[122] In the process, the cold infected vapours people carried with them became active, causing illness. The same thing happened to the cows that were moved to the barn from the cold pasture. In other words, it was not the warm air that caused illness in people or animals, but the disease-inducing particles activated in the air.[123]

Drawing on his thorough and meticulous investigation, Lustigh composed three sections of 'advice and remedies' aiming to assist his fellow citizens.[124] He listed practical measures alongside religious ones, sharing what he had learnt about the most effective methods to stop the rinderpest outbreak. But although Lustigh's advice might have been

119 Dekker, 'God's Invisible Particles', 157–59.

120 Ibid., 164.

121 Lustigh, 'Kroniek van Lambert Rijckxz. Lustigh', 23.

122 '[...] want dat is, gelijck een mensche die een Lange tijt in een dampige koude Lugt geweest is, en de koemende in warme Huijsen en voornaam daar een warme kaghel gestoockt wert, ende soo hij dan in de koude Lugt eenige onreijne en ongesonde dampen ontfangen heeft, ende soo in warme Huijsen ofte bij warme gestoockte kaghels koemende, het breeckt uijt, ten minsten met flauw worden of met bedraijinge.' Ibid., 23.

123 Ibid., 23.

124 Ibid., 53–55.

lifesaving, 'most [farmers] despised my words and counsel,' he wrote, recounting how some even threatened him with violence to silence him.[125]

We can read in his chronicle that Lustigh was deeply disheartened by his contemporaries' refusal to acknowledge the importance of his findings. He saw them as 'unwise and unwilling to learn', yet he was unable to persuade them, in spite of the various examples he presented.[126] This might be explained by Lustigh's confrontations with the church council. In 1700, he was reprimanded by the church council for facilitating 'esoteric' gatherings. After several meetings, the minister and the *schout* put an end to this, but this did not prevent Lustigh from straying from the ecclesiastical path again during the epidemic in 1714.[127] In that year, he is said to have baptised a deceased Catholic. Initially Lustigh was denied communion, but after expressing regret, he was readmitted. Although Lustigh was respected as *schepen* of Huizen, these conflicts may thus have caused villagers to see Lustigh as a troublemaker, according to J.G. Koeman.[128] Yet, this does not fully explain why farmers in the surrounding area also did not accept his advice and better explanation for the epidemic, knowing that it could save their livestock.

To explain this, we must also look at this case in an anthropological way. Although Lustigh and his contemporaries largely interpreted epidemics through the lens of Galenic medicine, he introduced a more abstract and complex explanation that could not be empirically tested or verified. Despite his theory of particles being plausible based on his observations, the more precise and intricate theories employed by medical experts, such as Fracastoro and Van Beverwijck were not widely embraced by non-experts, even though they were available in popular print media.

As we saw with the lightning rod in the previous chapter, it was important that contemporaries understood a new explanation and that they could empirically verify it. The latter was difficult because the corpuscular 'particles' could not be directly observed. Again, this illustrates that *content* bias played an important role in the acceptance of new knowledge.[129]

Another important factor that may have contributed to the non-acceptance of Lustigh's advice is the extent to which the explanation differed from traditional explanations. Vivian Nutton, who in 1990 studied the dissemination of the corpuscular theory of disease among medical practitioners, argued that it was 'not perceived as radically different but was easily incorporated into the Galenist system of interpretation.'[130] The added value of the theory was therefore limited for many contemporaries which,

125 '[...] maar sij veragten voor het merendeel mijne woorden en raatgevinge.' Ibid., 57.
126 'onverstandigen en niet leren willende.' Ibid., 29.
127 Koeman, 'Lambert Rijksz. Lustigh', 28–29.
128 Ibid., 28–29; Nonymus, *Lambert Rijckszoon Lustigh*.
129 Richerson and Boyd, *Not by Genes Alone*, 205.
130 Vivian Nutton, 'The Reception of Fracastoro's Theory of Contagion: The Seed That Fell among Thorns?', *Osiris (Bruges)* 6 (1990): 234.

according to Nutton, limited its popularity to the late sixteenth and early seventeenth centuries.[131] This makes it remarkable that a century later Fracastoro's ideas reappeared in Lustigh's work, but at the same time this demonstrates that for most non-experts, a new explanation must be distinctive and verifiable before it is accepted.

The corpuscular theory of diseases could not be proven with direct observation and was not distinctive enough for most contemporaries. Nevertheless, from the eighteenth century onwards, we see that chroniclers increasingly made notes about cases where existing theorisation did not correspond with their own observations. Initially, this did not lead to rejecting these explanations and their medical theory, but it did create space for alternative explanations that became visible from the nineteenth century onwards.

The Relationship Between Traditional and New Knowledge

Falsifying Traditional Explanations with New Information

Jan Kluit (1722-1811), a tax collector and official, wrote in 1748 about a 'mysterious' disease afflicting a regiment of the Scots Brigade stationed in Brielle during the War of the Austrian Succession (1740-48). The high mortality rates among the Scottish soldiers, according to him, warranted an explanation. Some referred to the work of the sixteenth-century chronicler François le Petit (1546-?), who worked from 1595 to 1598 as a notary in Middelburg seventy kilometres south of Brielle.[132] He argued that the air in the South Holland town of Brielle was miasmatic due to its location close to the sea.[133] Others suggested that it was not so much the air itself, but the drastic change in environmental conditions between Scotland and the Low Countries, which caused illness among the Highlanders.[134]

Both explanations demonstrate the importance that contemporaries ascribed to the influence of the environment in explaining diseases in the eighteenth century. On the one hand, the sea was viewed as a source of the emergence of miasmas; on the other, it was argued that a changing environment and climate could disrupt humours. The cause of the disease was mainly debated on a theoretical level within the framework of Galenic medicine. However, according to Kluit, there could also be alternative explanations. There were instances of other diseases attributed to sea air, which were also encountered inland. Furthermore, Petit had probably never visited Brielle, so he had assumed

131 Ibid.

132 Jean François Le Petit, *Nederlantsche Repvblycke, Bestaande Inde Staten so Generale, Als Particuliere*. (Arnhem, 1615), 136.

133 Kluit, 'Historische Jaerboeken der stad Briel, deel 1, 1e stuk, 1747-1751', 36, 501.

134 Ibid., 441.

something detrimental about the city that he could not substantiate.[135] Kluit found this unacceptable, as he wrote:

> For they reason in this way, that when one asks for their rationale, they reply that they have heard it from their parents, and thus they pass on these stories to their children and descendants, without having uncovered the naked truth of it all.[136]

Kluit asserted that not medical theory, but empirical observations, led to the 'truth'. He demonstrated this by using an example. It was widely believed that the air in Maassluis was healthy, despite the town's proximity to Brielle. Yet, Kluit, who confessed he was no expert in 'geometry', found it implausible that the air could change going from healthy to unhealthy over such a short distance.[137] Kluit followed this line of reasoning to explain the 'mysterious' disease affecting the Scots. He noted that a common belief was that the cities of Breda and Gorinchem had the purest air in the Republic. However, Kluit discovered that even more soldiers died in these cities. This seemed to rule out that 'miasmatic' air caused the deaths.[138]

The news reached Kluit that in Gorinchem there had already been a ban on potatoes and cabbage among the Scots because they caused diarrhoea. Combined with the knowledge on the number of deaths in various cities, Kluit started 'to investigate the true and essential cause of the disease and mortality of the Scots.'[139] He observed and analysed the Highlanders' diet in Brielle, since every Monday after they received payment, the Scots consumed large quantities of fruit and vegetables, which were particularly cheap that year at the vegetable market. After some observations, Kluit concluded that the disease was likely due to the quantity and preparation of their food. After sharing his findings, petty officers surveyed the vegetable market and advised the Highlanders to cook their meals and eat in a more 'civilised' manner. Kluit observed that these measures proved effective, and that the Scots grew as healthy as their Dutch counterparts. His conclusion, based on these observations, was that it was not the air that made the Highlanders sick, but their lifestyle – specifically, their food consumption.[140]

135 Ibid., 36–38.

136 'Want zij redeneeren op dese trant, dat als men hun na reden vraagt zij antwoorden dat zij het wel van hunne ouders gehoort hebben, en dese verhalen het dus weder aan hunne kinderen en nakomelingen, sonder van dit alles de naakte waarheit ontdekt hebben.' Ibid., 40.

137 Ibid., 41–42.

138 Ibid., 440–43.

139 '[...] om de waarachtige en wesentlijke oorsaak van de siekte en sterfte der Schotten te ondersoeken.' Ibid., 443.

140 Ibid., 439–57.

As had Lustigh and Kluit, from the eighteenth century onwards, other chroniclers began to compare their own observations, along with the information they heard and read, with contemporary explanations and medical theory. As we will see in the next chapter, the new availability of demographic figures enabled chroniclers to discover new patterns, and the newspaper also allowed for the tracking of the spread of epidemics both domestically and abroad. For example, the Catholic Edouard Callion from Ghent chronicled how cholera spread across Russia and Europe, and finally reached Belgium in 1832. A committee was established, hospitals were set up, the city was cleaned, and information was distributed so that people could protect themselves from the disease. This included an emphasis on clean air, hygiene, emotional restraint, and dietary restrictions, all in line with Galen's non-naturals.[141] In addition, several masses and processions were performed in honour of Saint Nicholas (270-343), Anthony of Padua (1195-1231) and Ghent's patron saint Macharius to seek support and to pray to stop the epidemic.[142]

Callion closely followed who died where in the city and concluded in May 1832 that the disease was limited to certain neighbourhoods and that 'almost all the individuals affected by cholera belong to the lower class.'[143] Moreover, age also played a role as it was particularly the elderly people and children up to two years of age who died.[144] Apart from concluding that the disease originated abroad, and was confined to certain areas and age groups, Callion also focussed on determining how the disease spread. On 4 June, a child died 'whose body emitted a very contagious stench.'[145] It was widely believed that the disease spread through the air, a belief seemingly validated by the 'highly infectious stench' emanating from the victims. For this reason 'tar barrels [which] were burnt [...] to purify the air from the harmful vapours.'[146] Yet, according to Callion, poor nutrition and miasma were not the only causes of cholera.

In one of the halls of the former Bijloke Abbey, which at the time served as a hospital and home for elderly men (*oudemannenhuis*), a renovation had been carried out adhering to the highest contemporary standards, ensuring ample space and high ceilings. Despite this, cholera also broke out in this hall, reinforcing Callion's assertion that 'uncleanliness or unhealthy air do not necessarily cause cholera. The disease could also be triggered by other factors which are not yet known to us.'[147] This meant that, on

141 Edouard Callion, 'Gentsche kronijke: 1525-1835', vol. 6., Universiteitsbibliotheek Gent, Boekentoren, BIB.G.014248, 477–80.

142 Ibid., 482–85; See also: Jo Claes, *Geneesheiligen in de Lage Landen* (Leuven, 2005).

143 'Byna alle de persoonen, die door den cholera zijn aengetast, behooren tot de geringe klas.' Callion, 'Gentsche kronijke: 1525-1835', Vol, 6., 492.

144 Ibid., 577.

145 'Een kind was ontrent den avond overleden, wiens lyk eenen zeer besmettelyken stank uytwassemde.' Ibid., 494.

146 '[...] er pektonnen gebrand [...] om de locht te zuyveren van de kwaede dampen.' Ibid.

147 '[Men heeft aldaer iets zeldzaem opgemerkt, het welk bewyst dat het] niet altyd onreynigheyd of ongezonde locht is die den Cholera veroorzaekt; maer dat de ziekte aen oorzaken moet toegeschreven worden, die tot hier toe onbekend zyn.' Ibid., 499.

the basis of various observations, it could be ruled out that miasmas, whether caused by poor nutrition or not, were the exclusive source of cholera. Although it took another two decades before the physician John Snow (1813-58) proved, and subsequently published, that cholera was spread primarily by water rather than air, alternative explanations were already being diligently sought in the city of Ghent in 1832.[148]

With the availability of new information such as mortality rates, and observations made by chroniclers and others, medical theories could be increasingly tested and therefore falsified. In other words, knowledge became increasingly 'tight'. Not only 'cultural entrepreneurs', but also chroniclers such as Kluit argued that knowledge passed down from generation to generation did not necessarily lead to the 'naked truth'. Empirical research and comparisons with other sources were necessary to arrive at an explanation.[149]

Combining Old and New Ideas

However, empirical research did not (directly) undermine traditional explanations. New observations were often incorporated into existing theories. As a result, elements from germ theory of disease, Galenic medicine, and the purifying effect of lightning as a result of divine intervention were combined in early modern chronicles. This can best be demonstrated using the nineteenth-century chronicle of the Mennonite farmer from the small Frisian village of Poppenhuizen: Lieuwe Jans de Jong (1798-1855).

Like Callion, De Jong wrote extensively about the cholera epidemic. However, for the purpose of this paragraph, we will focus on his observations about what his contemporaries labelled the 'lung plague' (*contagious bovine pleuropneumonia*), a cattle disease that pervaded the Low Countries. After approximately 40,000 head of cattle had already succumbed in the province of Holland, the disease infiltrated two small villages in Friesland in February 1842.[150] De Jong meticulously recorded the disease's proliferation until his death in 1855.

In the initial year of the epidemic, De Jong neither reflected upon nor investigated the disease's transmission, but merely asserted that disasters were an indication of divine providence.[151] This changed in subsequent years. He began to note that the lung plague first appeared in the two small villages of Nijega and Doniawerstal. A committee of veterinarians promptly initiated an examination, concurring with the governor that the animals needed to be culled 'to stop the evil at the beginning.'[152] Unfortunately, this approach seemed to have little impact. By November of the same year, the disease

148 Snow, *On the Mode of Communication of Cholera*, 1849; For the famous map with the location of the water pumps and the infected areas, see the second edition: Snow, *On the Mode of Communication of Cholera*, 1855.
149 Kluit, 'Historische Jaerboeken der stad Briel, deel 1, 1e stuk, 1747-1751', 40.
150 De Jong, *De dagboeken (1825-1855) van Lieuwe Jans de Jong*, 153.
151 Ibid., 106.
152 '[...] het kwaad in den begin te stuiten.' Ibid., 153.

had also spread across the province of Drenthe and continued to be endemic in South Holland. Without access to a cure, infected animals were slaughtered across various provinces to curb the disease's spread, according to De Jong.[153]

In April of the following year, De Jong started pondering, 'what caused the mortality of so many calves?'[154] He began enumerating factors related to the previous summer's weather and diet, such as the ingestion of inferior-quality grass and even poorer drinking water due to periods of drought. As we have witnessed in chronicles from the sixteenth century onwards, contemporaries directly associated poor nutrition, weather, and the onset of disease. To counteract the drought and rejuvenate their pastures, some farmers proposed inundating their lands. During the same time, a mouse plague also occurred and, by flooding their land, farmers hoped to solve two problems at once.[155]

According to De Jong, this approach was ill-advised. He contended that storks do not consume dead mice, implying that leaving them to decompose in the fields would be detrimental. The fumes from the decaying mice, coupled with the dry warm air, resulted in miasmas harmful to the health of the livestock. Unlike other chroniclers, De Jong emphasised that these miasmas were not just 'contagious' but also 'salty', comprising saltpetre and phosphorus substances derived from the dry soil and dead mice.[156] When combined with water, this would – according to Lustigh – generate a 'contagious substance' (*smetstof*), harmful not only to livestock but possibly to humans as well, according to De Jong.[157] This was in addition to the fact that the unseasonably hot weather already impacted the quality of dairy products. Due to its inferiority, many individuals, including his own son Uiltje, suffered from fever, diarrhoea, and various lower abdominal diseases.[158]

Beyond the common explanations attributing epidemics to a contagious substance, abnormal weather conditions, and miasmas, De Jong also proposed more complex explanations, especially for the spread of the disease. For example, he contemplated, 'is it possible that the mother could have become infected [...] and passed it on to her calves [through breastfeeding]?'[159] He tried to recall if his cows had exhibited any symptoms of sore teats toward the year's end, suggesting the infection could also inhabit the udder.[160] After all, many of the cows were not producing much milk, though De Jong hoped this would improve once they were allowed back out to pasture.

153 Ibid., 164–65.
154 'Van waar de sterfte onder veel kalveren?' Ibid., 169.
155 Ibid., 235–39.
156 'Salty' refers to 'salt', a chemical compound composed of positively, and negatively charged ions. A well-known example is table salt composed of sodium chloride (Na^+Cl^-), or Salpeter ($K^+NO_3^-$).
157 De Jong, *De dagboeken (1825-1855) van Lieuwe Jans de Jong*, 239.
158 Ibid.
159 'Is het ook mogelijk, dat de moeder een ongesteldheid of ongemak heeft gekregen [... en] zich aan de vrucht overdroeg?' Ibid., 169.
160 Ibid., 169.

Throughout the course of the epidemic, De Jong sought to gather as much information as possible about the disease, taking into account observations from farmers, butchers, and veterinarians. He recorded in March 1851, 'The examples of infectiousness are incomprehensible; the stories about it are many and miraculous.'[161] What is striking is that De Jong frequently discussed observations made during the dissection of diseased cows. He wondered for instance, that 'the pulmonary ailment in many, if not all [cows], resulted in a significant accumulation of fluid in their chests. Is this blood turned into water? There is also little blood present during their slaughter.'[162] De Jong characterised the fluid as being yellowish, and hence potent and choleric. He pondered whether it could damage the delicate and tender tissue of the lungs, and whether bloodletting could prove beneficial, thus thereby reducing the transformation of blood into this harmful fluid, known today as pulmonary oedema.[163]

While De Jong interpreted his observations through the lens of Galenic medicine, he did not perceive an imbalance of the humours as the primary cause of the disease. For example, there were instances where cows birthed calves that were 'dead and corrupted'. Despite this, the cows appeared healthy and produced ample milk. This led De Jong to speculate about the potential for 'disease transference from mother to offspring'.[164] To account for this, De Jong advanced a theory informed by his understanding of smallpox and its corresponding vaccination.

De Jong was a proponent of vaccination and consequently had his children immunised against smallpox several times. This spurred him to consider the following:

> Might cattle also possess a contagious substance [*smetstof*] for lung disease, just as it is argued that all humans possess a smallpox matter [*pokstof*], which, through the transmission of this illness, develops and expands this matter, leading to sickness and death, depending on the greater or lesser amount of matter present in the body or lungs? Are there also those who do not possess the contagious matter of lung disease, or in whom it does not develop during the illness of others, and subsequently becomes active again?[165]

161 'De voorbeelden van besmettelijkheid zijn onbegrijpelijk, de verhalen desaangaande veel en wonderlijk.' Ibid., 279.

162 'De longziekte bij velen, zoo niet allen, veel water in de borst. Is dit in water veranderd bloed? Weinig bloed bij dooding.' Ibid., 284.

163 Ibid., 341.

164 'Was dit een ziekteverplaatzing van de moeder op de vrucht?' Ibid., 341.

165 'Zoude het vee ook een smetstof tot longziekte bezitten, even als men redeneert, dat alle menschen een pokstof bezitten, die door mededeling van deze ziekte, deze stof als ontwikkelt en uitbreidt en tot ziekte en dood brengt, al naar de meerder of mindere stof in het ligchaam of longen aanwezig? Zijn er ook, die geen smetstof der longziekte bezitten, of bij ziekte der overigen nog niet tot ontwikkeling komt, en naderhand nog weder tot werking komt?' Ibid., 285.

Despite the fact that lung disease, unlike smallpox, is caused by a bacterium rather than a virus, De Jong's analysis is strikingly accurate. It illustrates that the medical knowledge De Jong obtained from vaccinating his children was applied by him to his cattle. Crucially, the disease was still interpreted wholly through the lens of humoral theory, encompassing not only the non-naturals, which can disrupt the equilibrium of humours, but also a 'contagious substance' that can multiply and subsequently disturb the balance of bodily fluids.

In addition, his chronicle shows that De Jong's contemporaries were familiar with the idea that the disease was also caused by a 'contagious substance'. Unlike during the time of Lustigh's chronicle, written over a century earlier, this could be experimentally validated in the nineteenth century. New practices such as inoculation and especially vaccination – since Edward Jenner's discovery in 1796 – enabled diseases to be understood in novel ways, although largely within the existing humoral theory of Galen.[166]

With the availability of new information, knowledge, and medical practices, it thus became possible for chroniclers not only to challenge existing explanations but also to arrive at new interpretations that more closely corresponded to their observations. However, these new explanations did not supersede existing ones, as they continued to form part of the contemporary toolbox to understand and explain epidemics. Factors such as the weather, the corruption of organic matter, the role of miasmas, and disease contagion were all used to explain the origin and spread of the lung plague.

This means that better explanations not only require empirical validation to gain acceptance from non-experts, but also that traditional interpretations did not vanish instantly. In addition, to the emphasis on secular explanations, it is important to stress that at the same time De Jong also prayed to God to purify the contaminated air with lightning and thunder, so what we see in his chronicle is that 'traditional' and 'new' knowledge could comfortably coexist in people's minds.[167]

Conclusion

In this chapter, we have discussed how various explanations could coexist, using epidemics as a case study. Knowledge about epidemics remained for a substantial part 'untight' throughout the early modern period. New theories could not always be (empirically) falsified and traditional explanations therefore remained part of the contemporaries' toolbox to explain what they experienced. This resulted not only in the coexistence of divine and natural explanations, but also in various types of natural explanations. In addition, we have seen that the relationship between these

166 Lindemann, *Medicine and Society in Early Modern Europe*, 77; Jennifer D. Penschow, *Battling Smallpox before Vaccination: Inoculation in Eighteenth-Century Germany* (Leiden, 2021).

167 De Jong, *De dagboeken (1825-1855) van Lieuwe Jans de Jong*, 210.

explanations changed over the long term and discussed the circumstances under which new knowledge was accepted.

From the sixteenth up to the nineteenth century, epidemics were interpreted as a collective punishment from God, but the way they were providentially interpreted changed. In particular, until the first half of the eighteenth century, chroniclers used biblical and historical examples to explain epidemics. References to the Old Testament played an important role, as did the combination of pestilence, famine, and war. The patterns they observed are as telling as the patterns that were absent. Epidemics were not interpreted as the end of times, but always as a divine test or punishment.

Consequently, religious measures such as prayer were not sufficient, secular measures were just as important. According to the chronicler Lustigh, for example, God gave humans the knowledge to stop epidemics. Therefore, the authorities were expected to take measures. Like their governments, chroniclers tried to determine how epidemics originated and how they spread. In doing so they used elements of Galenic medicine. Which elements were used depended on the epidemic, but also on the level of education and the socio-economic position of the chronicler. In other words, although knowledge, such as the Galenic medicine or the corpuscular theory of disease was available in early modern society, this did not mean that it was picked up by society at large. Therefore, it is necessary to focus on the cultural translation of knowledge and to examine which elements of a medical theory were appropriated, and under what conditions knowledge spread.[168]

The corpuscular theory of disease, which was picked up by Lustigh but not by his neighbours, is a good example of new (expert) knowledge that circulated but was scarcely adopted by society. Two factors played an important role in this. On the one hand, the theory could easily be integrated into existing explanations, which makes it not distinctive enough. On the other hand, the 'particles' could not be observed, and thus the theory was purely hypothetical. Although one could argue that Lustigh's explanation better matched empirical evidence, that was not enough for its acceptance. Abandoning old ideas occurred almost exclusively when they could be refuted.

Around the mid-nineteenth century, we observed a diverse mix of explanations in the chronicles. Some of these were the same as in the sixteenth and seventeenth centuries.[169] Epidemics were interpreted as a punishment from God, yet unfolded through natural processes. Elements of Hippocratic and Galenic medicine, such as humoral theory and the influence of weather on the emergence and spread of diseases, played a significant role. Moreover, in contrast to the 1710s, the idea that diseases could also spread through pathogens was accepted following the invention of vaccination. The example of De Jong

168 Lässig, 'The History of Knowledge', 29–58.

169 For more information on the non-naturals in the eighteenth century, see: Kennaway and Knoeff, *Lifestyle and Medicine in the Enlightenment*.

suggests that chroniclers accepted this knowledge only when they understood and could empirically observe how diseases were transmitted through pathogens.

This means that with regard to medical knowledge, *content* and *direct* biases played a crucial role in the acceptance of new knowledge, as was the case with the meteorological phenomena in the previous chapter. Religious explanations continued to play an important role for the chroniclers, which shows that they could operate in several cultural systems at once.[170] What we might perceive as contradictions and inconsistencies caused no difficulty, and also did not obstruct the acceptance of new knowledge. Yet, a process of cultural translation did take place, in which expert knowledge was adapted and applied by non-experts. This chapter has shown how chroniclers did this, and that the chronicle is therefore a valuable source for analysing this process.

Finally, we observed some significant changes in the way chroniclers wrote about epidemics around the second half of the eighteenth century. Analogies with historical and biblical events receded into the background, and chroniclers increasingly began to compare the spread of epidemics with earlier periods using newly available demographic data.[171] The next chapter discusses how this new practice emerged, and how existing explanations were confronted with new empirical observations.

170 Swidler, *Talk of Love*, 94.

171 Among scholars this changed around 1650. Since then Nature was still regarded as a revelation of God, but it was no longer the analogy with biblical passages, but increasingly the order and structure of the creating itself, that were signs of his almightiness. See: Jorink, *Reading the Book of Nature*, 30.

Chapter 4

Accepting and Interpreting the World Through New Numbers

One third of the cattle recovered and two thirds died. This was a special predestination of Divine Providence

- Chronicler Albert Pietersz. (1722-98), Purmerend.[1]

1 'Een derde van het ziek geworde Rundvee gebeterd, en Twee derde van dezelve Gestorven zijn; waerlijk eene een bijzondere Voorbeschikkinge der Goddelyke voorzienigheijd.' Louwen, 'Kronijk der stad Purmerende [...] deel 2, tweede gedeelte', 280.

Introduction

In the previous chapters we have seen that knowledge about nature and epidemics was more likely to be accepted once the chroniclers could verify and understand the new explanations themselves. However, this was not the case for every phenomenon. As we will see in this chapter, chroniclers not only accepted new knowledge and technology on substantive grounds, but also had other motives to accept innovation. Richerdson and Boyd already stressed the importance of *frequency-dependent* bias in explaining cultural change. Even so, it is surprising to find that a technology widely praised by scholars for its substantive qualities was not accepted by most chroniclers on its characteristics.[2] This compels us to think more fundamentally about the cultural conditions for the acceptance of new knowledge and technologies by non-experts in contrast to experts. In this chapter, we will do so through the acceptance and chroniclers' use of one of the most fundamental new technologies that Europeans adopted in the early modern period: Hindu-Arabic numerals.[3]

In the previous chapters, we have seen in passing that from the eighteenth century on, chroniclers increasingly started to use quantitative data to explain and compare epidemics and meteorological phenomena. These data were presented mostly in Arabic numerals and enabled contemporaries to study, perceive and express their world in a quantitative way. New patterns were uncovered between mortality rates and locations. Temperature measurements, the amount of rainfall, and the thickness of the ice were used to make comparisons and gain insight into both in natural phenomena and God's disposition towards society. The characteristics of Arabic numerals, such as 'easier' calculations, comparisons, and the emergence of modern mathematics, have led historians, mathematicians, and neuroscientists to argue that Roman numerals were replaced by Arabic numerals because the latter were simply 'better'.[4] Yet, while the use of Arabic numerals enabled a new way of thinking, it does not necessarily mean they were accepted for their unique features that enabled them to perform more complex calculations.

While studying the chronicles, particularly the records of prices, I noticed that Roman and Arabic numerals were used side by side in the sixteenth century, without a preference for one over the other. This led me to ask why contemporaries used one or

2 Richerson and Boyd, *Not by Genes Alone*, 120, 205.

3 From now on, I will use the shortened term 'Arabic numerals'. For the debate on 'Western', 'Hindu-Arabic', and 'Arabic' numerals, see: Stephen Chrisomalis, *Reckonings: Numerals, Cognition, and History* (Cambridge, 2020), xvi–xvii.

4 Keith Thomas, 'Numeracy in Early Modern England. The Prothero Lecture', *Transactions of the Royal Historical Society* 37 (December 1987): 103–32; Georges Ifrah, *From One to Zero: A Universal History of Numbers* (London, 1985); Stanislas Dehaene, *The Number Sense How the Mind Creates Mathematics* (New York, 2011); Michael E. Hobart, *The Great Rift: Literacy, Numeracy, and the Religion-Science Divide* (Cambridge 2018).

the other. By examining how chroniclers used Roman and Arabic numerals and when this changed, I have attempted to reconstruct the motives for the acceptance of Arabic numerals. Secondly, I studied how chroniclers reasoned with Arabic numerals, how it enabled them to arrive at new explanations, and what caused them to increasingly make use of systematically structured numbers in the form of lists and tables.

Corpus

For the first question I made use of 151 chronicles from the period 1500-1850, using 106 chronicles from the Northern Netherlands and 45 from the Southern Netherlands.[5] I have used only chronicles where I could verify whether the original contained Arabic numerals. For example, in some published editions of sixteenth-century chronicles, Roman numerals have been transcribed to Arabic numerals, therefore these chronicles were not included in the analysis. Subsequently, I extracted all the Arabic numerals from the chronicles and the sentence in which they were used. For Roman numerals, I used a wordlist as in the previous chapters (*Appendix 9*). By combining these two methods, I was able to investigate which numerals were used in the chronicles, the context in which they were applied, and to what extent this changed in the early modern period.

For the second task of this chapter, I used a subset of 117 chronicles in which the 'dates' and 'page numbers' were tagged.[6] The use of numerals in these two contexts was left out in my analysis because this part focusses on how chroniclers used Arabic numerals to examine and interpret the world around them. Subsequently, I extracted all Arabic numerals and the sentence in which they were used from the chronicles and used a word-frequency model to count all Arabic numerals in these chronicles between 1500 and 1830. The data are presented in box and whisker plots and demonstrates when chroniclers began to use numerals more frequently in the early modern period (*Figure 22*).[7]

From Roman to Arabic Numerals

An Alternative Explanation

One of the first answers to the question of why early moderns replaced Roman numerals with Arabic numerals comes from Keith Thomas. He argued in 1986 that:

5 The full corpus consists of 204 chronicles: 132 from the Northern and 72 from the Southern Netherlands. Therefore, I used respectively 80% and 63% of the full corpus for the first part of this chapter.

6 This subset consists of 83 chronicles from the Northern and 34 chronicles from the Southern Netherlands.

7 For a distribution of the number of chronicles used per 30-year period, see also Appendix 10.

> Roman numbers were very clumsy [...] they had no symbol for zero and no concept of place value. They were [...] useless for calculations [...] The new arithmetic of the pen [...] combined the two operations of recording numbers and making calculations. It was also quicker.[8]

In the same period, the mathematician Georges Ifrah (1947-2019), whose work is the most popular and influential study of the history of numerical notation, wrote:

> To see why place-value systems are superior to all others, we can begin by considering the Greek alphabetic numeration [Arabic numerals]. It has very short notations for the commonly used numbers: no more than four signs are needed for any number below 10,000. But that is not the main criterion for judging a written numeration. What matters most is the ease with which it lends itself to arithmetical operations.[9]

This consensus has held at least since the 1980s. More recently, the cognitive neuroscientist Stanislas Dehaene (2013) elaborated on this argument and argued that Arabic numerals are not only the most efficient ever developed but also 'perfect'.[10] In other words, both in the historical and the cognitive literature on numeracy, scholars argue that Arabic numerals are superior in contrast to the cumbersome Roman numerals, which are not suitable for calculation, and as a result, they faded out of everyday use.[11] They have attributed the acceptance of Arabic numerals to the ease with which they lend themselves to arithmetical operations, their place-value system, and the use of the number zero which enabled 'scientific' developments, and commercial and administrative practices.[12]

These claims, however, are based on the use of Arabic numerals by experts. No one has studied how non-experts used or experienced Arabic and Roman numerals.[13] As a result, it has proven difficult to study what motivated non-experts to use Arabic instead of Roman numerals and how they used them.[14] According to Thomas, who, in 1986,

8 Thomas, 'Numeracy in Early Modern England', 106.

9 Ifrah, *From One to Zero*, 431.

10 Dehaene, *The Number Sense*, 88.

11 Alexander Murray, *Reason and Society in the Middle Ages* (Oxford, 2002); Dehaene, *The Number Sense How the Mind Creates Mathematics*; Jiajie Zhang and Donald A. Norman, 'A Representational Analysis of Numeration Systems', *Cognition* 57, no. 3 (1995): 271–95.

12 Hobart, *The Great Rift*, 1988; Dehaene, *The Number Sense*, 88; Thomas, 'Numeracy in Early Modern England'; Jessica Otis, 'By the Numbers: Understanding the World in Early Modern England' (University of Virginia, 2013).

13 There is not even a full-length English monograph on Roman numerals, according to: Chrisomalis, *Reckonings*, 194.

14 Thomas, 'Numeracy in Early Modern England', 104.

called attention to the fact that numeracy has received far less attention from historians than the subject of literacy, 'it is impossible to answer such questions.'[15] This was true at the time when source materials were less accessible and the technology to study them was different. At the same time, he argued that: 'the subject is of equal importance to anyone concerned to reconstruct the mental life and cognitive apparatus of the past, for numbers and number systems are among the most basic of all mental categories.'[16]

Waiting for better data, existing explanations and motives for the increasing use of Arabic numerals by 'professional' users have been extrapolated to the society at large. They have been coupled with three other common, and mutually dependent, explanations for the rise of Arabic numerals in historical literature: The emergence of government bureaucracies; market capitalism; and formal education in combination with the advent of widespread literacy and the printing press.[17] Yet, none of these claims have been tested against empirical material bequeathed by non-experts.[18]

This is not surprising as corpora written by non-experts and spanning a long period are rare. Historians have to be creative in gaining insight into the use of numbers in early modern societies. Very recently, Jessica Otis (2024) drew on sources written by experts but also used by non-experts in the 'first book-length study of numeracy in early modern England.'[19] She employs a combination of arithmetic textbooks and almanacs to study numeracy in early modern England. The textbooks are used to demonstrate how an increasing number of (newly trained) experts learned how to calculate with Arabic numerals, while almanacs enabled her to study numeracy among the population at large.[20] Almanacs were widely read from the seventeenth century on, and contained mostly practical information related to times and dates, which was initially expressed in both Arabic and Roman numerals.[21] With this type of research, in combination with handwritten sources such as probate inventories, it became possible to observe that

15 Ibid.

16 Ibid., 103.

17 Marjolein Kool, *Die conste vanden getale: een studie over Nederlandstalige rekenboeken uit de vijftiende en zestiende eeuw, met een glossarium van rekenkundige termen* (Hilversum, 1999); Rebecca Jean Emigh, 'Numeracy or Enumeration? The Uses of Numbers by States and Societies', *Social Science History* 26, no. 4 (2002): 656; Jessica Otis, '"Set Them to the Cyphering Schoole": Reading, Writing, and Arithmetical Education, circa 1540–1700', *The Journal of British Studies* 56, no. 3 (2017): 454.

18 Ifrah, *From One to Zero*, 1985; Tore Frängsmyr, John L. Heilbron, and Robin Elaine Rider, *The Quantifying Spirit in the 18th Century* (Berkeley, 1990); P. M. M. Klep, 'A Historical Perspective on Statistics and Measurement in the Netherlands 1750-1850', in *The Statistical Mind in a Pre-Statistical Era: The Netherlands 1750-1850* (Amsterdam, 2002), 29–69; Hobart, *The Great Rift*; Chrisomalis, *Reckonings*; Jessica Marie Otis, *By the Numbers: Numeracy, Religion, and the Quantitative Transformation of Early Modern England* (New York, 2024).

19 Otis, *By the Numbers*.

20 Otis, 'By the Numbers', 101; Otis, '"Set Them to the Cyphering Schoole"'.

21 Jeroen Salman, *Een Handdruk van de Tijd: De Almanak En Het Dagelijks Leven in de Nederlanden, 1500-1700* (Zwolle, 1997); Nicolaus Mulerius, *Almanak voor het Schrickel-iaer, nae de geboorte Christi, M.VIc.III.* (Groningen, 1604); Otis, 'By the Numbers'; Otis, '"Set Them to the Cyphering Schoole"'.

the transition was picked up by society at large. The reason why users did so, however, remains somewhat of a mystery.

It was the linguistic anthropologist Stephen Chrisomalis (2020) who recently theorised about what motivated society at large to replace Roman with Arabic numerals.[22] He did so using Richerson and Boyd's theory of cultural change.[23] Based on thought experiments, combined with his earlier comparative study on a global history of numerals, he argues that it was not *content* bias that played a role in the acceptance of Arabic numerals, but *frequency-dependent* bias. As we have seen, the former works on the basis of the characteristics or a verified understanding, while the latter works on the popularity or frequency of the phenomenon.[24]

Yet, Chrisomalis went one step further than most scholars in the tradition of evolutionary studies of cultural transmission, by studying the decision-making processes underlying *frequency-dependent* outcomes.[25] Other studies focus on the outcomes, rather than on the processes underlying those outcomes, which means that they did not recognise important variability in the concept of *frequency-dependence*, according to Chrisomalis.[26] In other words, this means that although it is the case that the frequency of a cultural trait in some population of individuals influences the probability that additional individuals will adopt it, the motive or process for acceptance can differ among individuals, which has an impact on the explanation of cultural change.

Although Chrisomalis has described his hypothesis as undertheorised and incompletely demonstrated, it is worth testing with empirical evidence.[27] Chronicles are an excellent source for this because the authors used Roman and Arabic numerals in different contexts, and their use changed over time. Chroniclers used Arabic numerals in the first instance for the more elementary function of representation. They did so for years and dates, but also for quantities such as prices. In contrast to computation, representation is a universal and defining property of numerical notation because it is impossible to imagine a written numeral system that does not represent numbers that are intended to be read. It is therefore important to investigate Roman and Arabic numerals not only for the properties in which they differ but also for those in which they coincide, and the different contexts in which they were used by contemporaries.

22 Chrisomalis, *Reckonings*.
23 Ibid., 92–93; Stephen Chrisomalis, *Numerical Notation: A Comparative History* (Cambridge, 2010).
24 Chrisomalis, *Reckonings*, 92.
25 Ibid., 92–93.
26 Ibid., 116.
27 Ibid., 118.

The Use of Roman and Arabic Numerals

Representation

The first chronicler in our corpus who used Arabic numerals in his chronicle was the anonymous author of the chronicle about Overmaas, probably the priest Petrus Treckpoel (1442-c.1508) from Beek, near Maastricht. Beginning in 1497 he kept a chronicle in which he frequently used Arabic numerals to record dates, along with Roman numerals.[28] In the fragment below, the Arabic numeral '1496' was written in red ink and referred to the underlined combination of written and Roman numerals: 'Duisent iiii^{c} jaer xcvi'.[29] The use of different colours and the position of the two numeric systems highlight that the Arabic numerals were the novelty and the Roman numerals the custom. In addition, the same year was written down in two different ways, which demonstrates that he did not want to omit the Roman numerals, perhaps because some of his readers might not yet be able to understand Arabic numerals. Consequently, the placement of Arabic numerals could illustrate the chronicler's familiarity with the new system, without requiring readers to be fluent with the innovation.[30] But how did Arabic numerals end up in Treckpoel's chronicle? What motivated him to use them? And why did it take half a century before other chroniclers started to incorporate Roman next to Arabic numerals while they were already circulating in their society?

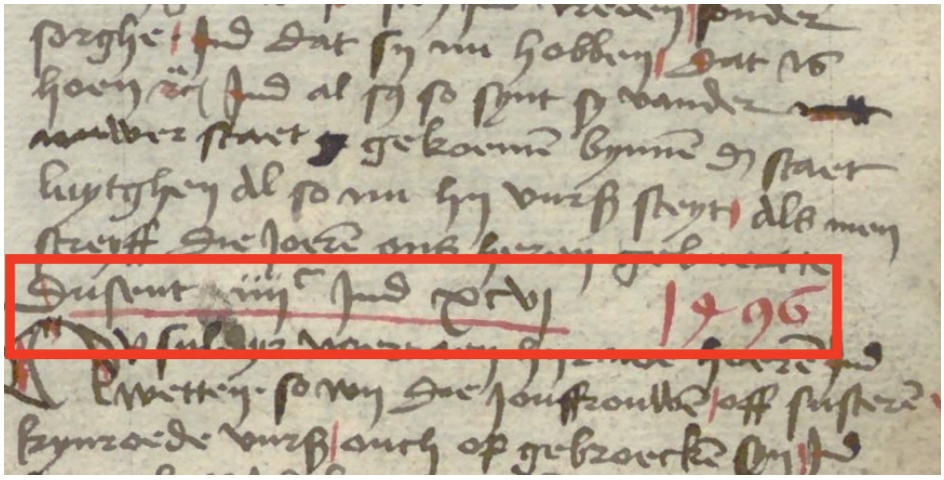


Figure 15. The year 1496 as represented as written, Roman and Arabic numeral in Treckpoel's chronicle.[31]

28 Anonymous, 'Chronijk der landen van Overmaas en aangrenzende gewesten door eenen inwoner van Beek', ed. Jos Habets, *Publications de la Société Historique et Archéologique dans le Limbourg*, 1870, 11–197.

29 Roelant van den Dorpe, 'Chronicles: Brabant: Cronike van Brabant', Koninklijke Bibliotheek België, Brussels, INC B 1.373 (RP), fol. 61 recto.

30 Chrisomalis, *Reckonings*, 113.

31 Van den Dorpe, 'Chronicles', fol. 61 recto.

Figure 16. The use of Roman and Arabic numerals per chronicler between 1500 and 1650.[32]

32 I used only contemporary manuscripts for this figure. No copies from later periods are used or transcriptions that could not be verified with the original.

Arabic numerals were first introduced in Southern Europe in the late tenth century, and from the twelfth century on, they increasingly spread across Europe.[33] The spread has mainly been explained by historians as a result of global trade, market capitalism and formal education in combination with the advent of widespread literacy and the printing press. Attention was paid particularly to printed arithmetic books in the vernacular and their distribution to explain familiarity with Arabic numerals.[34] This started in Treviso – near Venice – in 1478 and on 9 September 1508, the first Dutch arithmetic textbook: *Die maniere om te leeren cyffren*, was published by Thomas van der Noot in Brussels.[35]

Shortly afterwards, printed arithmetic textbooks in the vernacular were also available in the rest of the Netherlands, and we have evidence that they were used by the chroniclers in our corpus.[36] Yet, the chronicles also indicate that Arabic numerals were only gradually accepted, depending on the context. Based on a selection of 57 chronicles written between 1500 and 1650, it appears that Arabic numerals started to be frequently used by chroniclers from the 1560s (*Figure 16*). Moreover, only one chronicler, the Reformed merchant Laurens Jacobsz. Reael (1536-1601) from Amsterdam, exclusively used Arabic numerals in his chronicle.[37] The other chroniclers in the period between 1500 and 1550 mainly used Roman along with Arabic numerals, usually side by side, but also in combination with each other. The chaplain Christiaan Munters (c.1505-55) from Kuringen, for example, recorded the price of grain in September 1532 as 'xv st[ivers] one oort', or that it rained 'between four and v hour'.[38]

Although the 'new' Arabic numerals were scarcely used in the first half of the sixteenth century, there were technical developments in the use of Roman numerals among the chroniclers. This was especially true for higher numbers such as years, as we have seen already in Treckpoel's chronicle. Based on the corpus of sixteenth-century chroniclers, it appears that they mainly used four different ways of writing down the years of dates in Roman numerals: (1) 'In the year of our Lord MCCCCLXIX'[39], (2)

33 John Newsome Crossley, 'Old-Fashioned versus Newfangled: Reading and Writing Numbers, 1200-1500', *Studies in Medieval and Renaissance History* X (2013): 79–109.

34 Emigh, 'Numeracy or Enumeration?'; P. M. M. Klep and Ida H. Stamhuis, *The Statistical Mind in a Pre-Statistical Era: The Netherlands 1750-1850* (Amsterdam, 2002); Otis, *By the Numbers*.

35 Herman Pleij, *De wereld volgens Thomas van der Noot, boekdrukker en uitgever te Brussel in het eerste kwart van de zestiende eeuw* (Muiderberg, 1982), 71; Hobart, *The Great Rift*, 141.

36 N. Alting Mees, 'Aanteekening over Den Bakker-Kroniekschrijver Jan Gerritsz. (van Waerschut)', in *Rotterdams Jaarboek*, vol. 2 (Rotterdam, 1914), 53; For the arithmetic book of Waerschut, see: Bernaert Stockman, *Een corte ende eenvuldige instructie, om* [...] *te leeren cyfferen* (Dordrecht, 1606).

37 Laurens Jacobsz Reael, 'Uittreksel uit de Amsterdamsche gedenkschriften van Laurens Jacobsz Reael, 1542-1567', ed. J.C. Breen, *Bijdragen en mededelingen van het Historisch genootschap* 17 (1896): 1–60.

38 '[...] het corn tot Hasselt xv st. een ort [...] tsavonts tuschen vierende v uren.' Munters, *Dagboek van gebeurtenissen*, 14, 132.

39 'Inden jaer ons Heren MCCCCLXIX.' Anonymous, 'Chronijk der landen van Overmaas', 31.

'In the year mcccc and lxxviij',[40] (3) 'the year XIIcLXVI',[41] (4) 'In the year thousand IIIICLXIIII'.[42] The first and second examples represent the classical notation of Roman numerals, although in the second example the numbers are divided into two chunks.[43] In the third and fourth examples, the chroniclers used a positional numerical system for Roman numeral phrases.

The positional system is characteristic for Arabic numerals, but it had been used even before its adoption. The inventive positional Roman numerals were developed in 1130 by Johannes Ocreatus, an acquaintance of Adelard of Bath (c.1080-c.1152).[44] He used the Roman numeral-phrases for 1 through 9 (I, II, ... IX) along with the special sign (O, called *cifra*) to indicate an empty position. Moreover, the positions of numerals were separated with full stops, for example, I.O.VIII.IX. to represent 1089. This feature would later be resurrected – or reinvented – to separate different denominations of currency.[45]

In contrast to Arabic numerals, for Roman numerals, it is not necessary to apply the principle of place-value. Yet, it does offer the possibility to write down large numbers more concisely than when using the classical (additive) method of writing down Roman numerals. With the positional system, the value of any numeral-sign in the phrase is determined by its position – position dictates the power of the base that is to be multiplied by the sign in question. If the order changes, the value changes, so that 1493 has a different value than 9341, although they consist of the same characters. This means that Arabic numerals are expressed as the sum of multiples of the power of some base. For example: 9341 is represented by: (9 x 1000) + (3 x 100) + (4 x 10) + (1 x 1), which is completely different from traditional Roman numerals.

Additionally, Roman numerals do not use multiplication to represent their value. To use them, one simply adds up the values of all the signs: MMMDCXXVII = 1000 + 1000 + 1000 + 500 + 100 + 10 + 10 + 5 + 1 + 1. Here, in principle, it does not matter if the figures are mixed up, although it is customary to write down the numbers one after the other from high to low.[46] Here, the value of the numeral is not determined by its place in the series, as is always the case with Arabic numerals. Although the positional-value system was not necessary when using Roman numerals, chroniclers did frequently employ it.

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40 '(I)Nt jaer mcccc ende lxxvii.' Anonymous, 'Kroniekje van Groningen, uit de 16de eeuw', ed. W. Zuidema, *Bijdragen en Mededelingen van het Historisch Genootschap* 12 (1889): 103.

41 '[...] den jaere XIIcLXVI.' Anonymous, 'Het discours of de kroniek der heeren van Breda', ed. pater Placidus Pennings O.M.Cap, *Bijdragen en mededelingen van het Historisch genootschap* 65 (1947): 347.

42 'Int jaer dusent IIIICLXIIII.' Jan Allertsz and Jansz, Cornelis, *Rotterdamse kroniek: aantekeningen van Rotterdamse stadssecretarissen, 1315-1499 (1570)*, ed. H. ten Boom and J. van Herwaarden (1981), 29.

43 Chunking is the division of a collection of objects into groups of units, which speeds up the process of perception and accurate quantification by the brain. See: Chrisomalis, *Numerical Notation*, 15.

44 Henry George Farmer, 'Who Was Johannes Ocreatus?', *Journal of the Royal Asiatic Society* 71, no. 2 (April 1939): 261–261.

45 Chrisomalis, *Numerical Notation*, 120.

46 MMMDCXXVII could also be written as: DXXCIIVMMM = 500 + 10 + 10 + 100 + 1 + 1+ 5 + 1000 + 1000 + 1000 = 3627

In the third example I discussed above, the chronicler could have written the year 1266 as: MCCLXVI, which is even one token shorter, but instead he used a place-value system and divided the Roman numerals into two chunks of '12 x 100 and 66', namely: 'XIIcLXVI.'[47] This was also done in combination with written numerals, as presented in the fourth example, whereby the chronicler used a hybrid form of written and positional Roman numerals.

Before Arabic numerals were widely used, sixteenth-century chroniclers were thus experimenting with positional variants of the (normally ciphered-additive) Roman numerals. This shows that they were familiar with Arabic place-value numeration, although they did not necessarily use Arabic numerals. Yet, it does give us a sense of the features of the new system that may have appealed to them, and thus provides insight into both how the traditional Roman and new Arabic systems were perceived. For example, they show us how far chroniclers could, and sometimes would, go in modifying rather than replacing an existing notation. The replacement of the Roman numerals was going one step further, and thus simply the most extreme consequence of whatever set of factors motivated chroniclers to think about notation in the first place.

In the second half of the sixteenth century, Arabic numerals were increasingly used alongside written and Roman numerals.[48] The priest Adelbertus Cuperinus (c.1500-60) from 's Hertogenbosch for example recorded most quantities in written and Roman numerals, but in 1546 he wrote down: 'a *hoet* [c.1100 litres] barley xxvj guilders, a *mauwer* [c.140-170 litres] oat ij guilders 5 stivers'.[49] Something similar applies to the lawyer and brewer, Jan Willemsz. Verwer (c.1533-80) from Haarlem. He recorded quantities such as the price of a pound of soap, which costed 'VI stivers or 8 stivers'.[50] The city official and merchant Gerard Vremdt (c.1544-c.1622) from Culemborg, even combined the two systems in one element to represent the year 1588 as 'XVC88'.[51]

Most chroniclers mixed the systems without any clear underlying pattern. The socio-economic background of these authors is heterogeneous, which means that their social profile does not offer an explanation. The lawyer and advocate in the Council of Flanders, Philip van Campene (?-1567) from Ghent for example wrote: '88 reasons' and 'six hundred and L thousand guilders.'[52] In the smaller city of Ypres, we

47 Anonymous, 'Het discours of de kroniek der heeren van Breda', 347.

48 After the second half of the seventeenth century Roman numerals were almost completely replaced by Arabic numerals. Roman numerals were rarely used since then, and almost exclusively in copies of publications published by the local authorities, or for references to princes, popes, or chapters.

49 '[...] dat hoet garsten, xxvj gulden; een mauwer havere heeft gegauwen ij gulden 5 stuvers.' Cuperinus, 'Die Chronicke', 126.

50 '[...] VI stuvers of 8 stuvers.' Verwer, *Memoriaelbouck*, 71.

51 'Anno XVC88 den 20. July.' Gerard Vremdt, 'Geschiedkundige Aanteekeningen van Gerard Vremdt, Notabel Burger Der Stad Culemborg in de Tweede Helft van de Zestiende Eeuw', ed. P.J.W. Beltjes, *Gelre. Bijdragen En Mededeelingen* 44 (ca. 1941): 165.

52 '[...] 88 redene [...] zes hondert en L duusent guldens.' Van Campene and Van Campene, *Dagboek van Cornelis En Philip van Campene*, 193, 239.

see something similar. The corn inspector Augustyn van Hernighem (c.1540-c.1617) from Ypres also used the two types of numerals interchangeably. For example, when he recorded food prices, Van Hernighem used both Roman and Arabic numerals on the same page without preferring one or the other (*Figure 17*).[53]

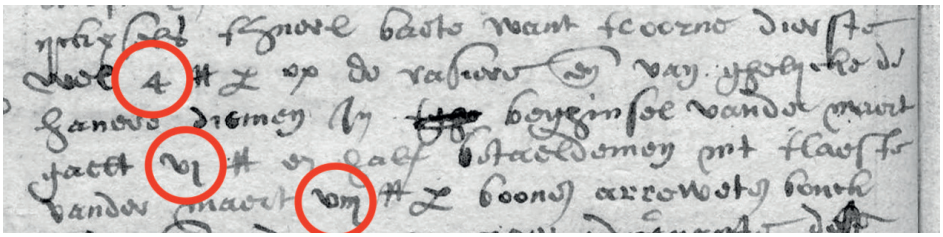


Figure 17. The Arabic numeral '4' and the Roman numerals 'vi' and 'viij' in Van Hernighem's chronicle.[54]

The use of Roman and Arabic numerals by chroniclers is complex and, to say the least, versatile. The Antwerp lawyer Jan van Wesenbeke (c.1547-c.1594) recorded dates and quantities in duplicate, as had Treckpoel (*Figure 18*), while the Antwerp painter Godevaert van Haecht (1546-99) mainly used Arabic and only sporadically Roman numerals. This demonstrates that chroniclers were rarely consistent in the way they recorded numerals, and most of them used the two systems interchangeably. This phenomenon is visible not only in manuscripts but also in printed work. Historian Jack Williams (1997) observed that sixteenth-century Bibles and prayer books mixed Roman and Arabic numerals in ways that he described as 'schizophrenic'.[55]

However, we can also look at this from a different perspective. Just because it seems unpractical to us does not mean that contemporaries experienced it that way. It demonstrates that multiple notations can coexist in parallel for the benefit of the author and the (potential) reader. That Arabic and Roman numerals were used interchangeably by chroniclers in the sixteenth century demonstrates that there were not only grounds for replacing Roman numerals, but also for retaining them. These observations force us to reconsider the claims of various scholars that Western Europeans started using Arabic, instead of Roman, numerals because of their ability to perform algorism. To gain a better understanding of the factors underlying the acceptance Arabic numerals we first need to examine how chroniclers calculated with Roman numerals.

53 '[...] wel 4 pond op de rasiere ende van ghelycke de havere diemen In beghinsel vander maert gaelt VI pond en half betaeldemen int tlaeste vander maert VIII pond par boonen arreweten bouck[wiet].' Augustyn van Hernighem, 'Beschrijving Der Stad Yper, Deel 6', Rijksarchief Kortrijk, Fonds Goethals-Vercruysse, ms. 296, 120.

54 Ibid., 120.

55 Jack Williams, 'Numerals and Numbering in Early Printed English Bibles and Associated Literature', *Journal of the Printing Historical Society* 26 (1997): 7.

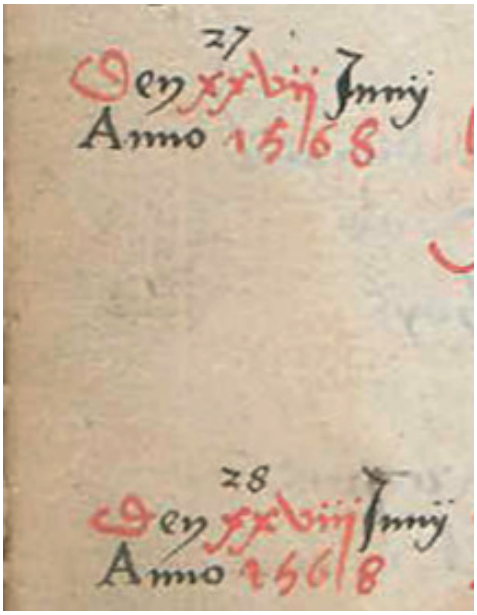


Figure 18. 27 Den xxvij Junij Anno 1568 & 28 Den xxviij Junij Anno 1568 in the chronicle of Jan van Wesenbeke.[56]

Calculating with Roman Numerals

The nun Henrica van Erp (c.1473-1548) from De Bilt, wrote in 1517: '19 Philips guilders and other gentlemen gave 9 Philips guilders. Together, the sum is xxviii Philips guilders.'[57] This computation is relatively straightforward, but what stands out is that the two elements of the sum were written in Arabic, while the sum was written in Roman numerals. Although Van Erp used Arabic numerals for this computation, there is no sign that they were more 'efficient' for her than Roman numerals. How she did the calculation cannot be deduced from this excerpt, but probably it was performed in her head, by finger counting, or by using a counting board. The latter instrument was most probably one of the reasons why Roman numerals were in use for a long time along with Arabic ones because this device made it possible to perform complex calculations with Roman numerals.

Counting boards or *abaci* are occasionally mentioned in historical sources, and only a few have survived.[58] This makes research on these instruments and the practice

56 Jan van Wesenbeke, 'Chronyke van 1567 tot 1580', Felixarchief, Antwerpen, Pk. 108, 10.

57 '[…] 19 philipsgulden en de andere heeren gaven 't samen 9 philipsgulden. Somma te samen xxviii philipsgulden.' Henrica van Erp, Maria van Zuylen, and anonymous, 'Kroniek van Vrouwenklooster in De Bilt', Universiteitsbibliotheek Utrecht, 1254 (6 A 13), 110.

58 Alain Schärlig, 'Un Bas-Relief À Trèves: Ces Romains Calculent, Ils Ne Jouent Pas!', *Antike Kunst* 47 (2004): 65–71; Cheryl Periton, 'The Medieval Counting Table Revisited: A Brief Introduction and Description of

of how to use them difficult. However, there are signs that counting boards were used by the population at large, also by non-literates, until the eighteenth century.[59] The historian Cheryl Periton (2015) did extensive research on counting boards, and how they were used. She did not do this purely by reading, but by effectively teaching herself to work with the board based on a large number of early modern arithmetic texts that taught its use. Periton demonstrated that handling the counting board was not especially difficult to learn since 'even those of limited capability could reliably arrive at accurate solutions.'[60] This made it suitable for all four operations of addition, subtraction, multiplication, and division, which probably explained its longevity as a calculation tool.[61]

The counting board came in many forms, but in general it was a board or a table with lines, or a marked cloth covering placed on a hard surface. Loose jetons or counters (usually blank) were placed on the cloth and manipulated as needed.[62] In *Figure 19* the board and the practice as can be seen on the right. As read from the bottom up, the horizontal lines on the counting board signified ones, tens, hundreds, thousands, and so on (i.e., I, X, C, M). A jeton placed between two lines – such as the counter between the hundreds and thousands line on the left – indicates five of the line below i.e., five hundred (i.e., D). This combination of base-five and base-ten characteristics was particularly convenient when paired with Roman numerals, which had separate symbols for five, fifty and five hundred.[63]

In short, the jetons took their value from their place on the counting board. In Roman and Arabic numerals, this is for the right: M.CC.XXXX.I or 1241, and next to it: L.XXX.II or 82. The use of jetons on a counting board already had two important features that are characteristic of a positional numerical system. First, the place-value notation and second, albeit implicitly, the zero which is represented by a line without a jeton. We have just encountered the use of place-value notation when recording years. Although this notation form was not necessary to write Roman numerals, it was often done by chroniclers when dealing with large numbers, but why?

Its Use during the Early Modern Period', *Bulletin (British Society for the History of Mathematics)* 30, no. 1 (2015): 1.

59 Periton, 'The Medieval Counting Table Revisited', 1–2.

60 Ibid., 48.

61 Ibid., 48.

62 Ibid., 2.

63 Otis, 'By the Numbers', 90–91.

Figure 19. Typus arithmeticae, an allegorical woodcut by Gregor Reisch in: Margarita philosophica (1503).[64]

The city official of Leuven, Willem Boonen (1547-1618) used Arabic numerals to represent dates, but Roman numerals for computations.[65] He included several lists with sums on the number of (mounted) soldiers in his chronicle. The elements and the sum are all written as positional Roman numerals (*Table 4*). Looking at the first number of mounted soldiers of Mr Philips de Cleves, it is recorded as 'ii^{c} xvj' instead of using the ciphered-additive structure 'ccxvj'.[66] Writing down numbers using place-value makes it easier to perform the calculations on a counting board, since the structure of the notation corresponds to the lines on the counting board (e.g., ii^{c}, means two jetons on line C).

64 Gregor Reisch, *Margarita philosophica* (Schottus, 1503).
65 Boonen, *Geschiedenis van Leuven*, 65–70.
66 Ibid., 66.

Mr Philips de Cleves	ij^{c} xvj horses.
Jr Machiel van Bergen	lxx horses.
Cornelis van Bergen	ij^{c} horses.
Jacques de Saint Pol	xiiij horses.
De marckgraeve van Antwerpen	I horses.
Messire Jehan de Grecq	xlij horses.
Hendrick de Zwaeve	xx horses.
Sum	vj^{c} xij horses.

Table 4. Positional Roman numerals in Boonen's chronicle.[67]

We see the same method of calculation in other chronicles as well. The chronicle of farmer and mill master from the village of Hauwert, Claes Baerentsz. (1574-1651) contains many lists that add up, in which he uses a place-value notation for Roman numerals. Especially surfaces of villages and the length of dikes per village in the province of Holland and West-Friesland played a prominent role in his chronicle. These were written down in the same way that contemporaries counted with currencies, namely, in different units. For surface measures, for example, these were: '*morgens – hondert' – roeden*'. A *morgen* is just a little smaller than a hectare (*Figure 20*).[68]

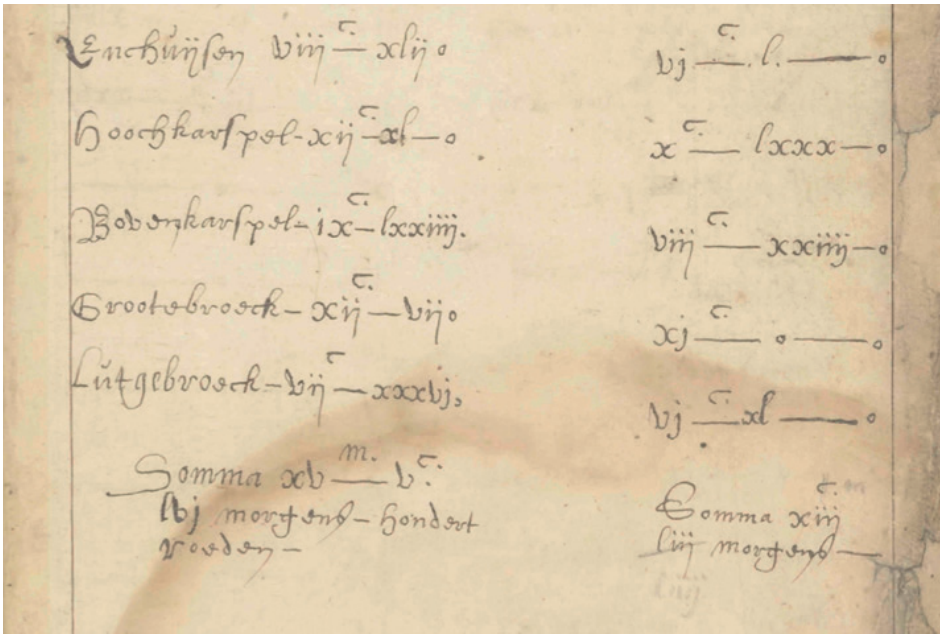


Figure 20. Positional Roman numerals in Claes Baerentsz.'s chronicle.[69]

67 Ibid.

68 1 hond/hont = 1/6 morgen = 100 roeden

69 Baerntsz, 'Kort verhaal der gedenckwaerdijgste gheschiedenissen', fol. 235 recto.

Figure 20 shows only a small part of the sum, but in total the sum consists of 21 parts in which the total was written down as: 'xv^{m} – v^{c} – lvi', or 15,000 – 500 – 56.[70] Such sums, and especially sums with coins, were often calculated on a counting board, even when the operation could also be performed by mental arithmetic. According to the psychologist and cognitive scientist Zhang and Norman, counting boards were always superior 'for simple calculation such as addition and subtraction', compared to other calculation methods.[71] The historian Periton, and more recently Otis, support this observation.[72] The combination of jetons and a counting board had numerous advantages, according to the latter:

> Counters were concrete, easily manipulable objects, which made addition and subtraction particularly intuitive. Someone other than the main calculator could also visually follow or physically assist in the movement of counters, making it possible for a small group of people to watch, comment on, or participate in the calculations as they occurred. This could be especially helpful in matters of credit and debit, as several parties needed to agree and trust that calculations had been done correctly.[73]

Although Arabic numerals are better suited for performing complex calculations and helped make modern mathematics possible, for these kinds of operations there was no substantive reason for most people to prefer Arabic numerals to Roman ones. As we have seen in the chronicles of Boonen and Baerentsz., the place-value system characteristic of Arabic numerals was used to simplify Roman numeral arithmetic in the sixteenth century. Moreover, between the late fifteenth and the early seventeenth centuries, most chroniclers used the various numerals interchangeably, and previous research has shown that contemporaries did the same between 1200 and 1500.[74] If *content* and *direct* biases had played a major role in the acceptance of Arabic numerals, the two systems would not have been used side by side and interchangeably for so long, because chroniclers would at some point have been convinced that Arabic numerals were 'better' than Roman ones.

70 Ibid.
71 Zhang and Norman, 'A Representational Analysis', 292.
72 Periton, 'The Medieval Counting Table Revisited'.
73 Otis, *By the Numbers*, 54.
74 Crossley, 'Old-Fashioned versus Newfangled'.

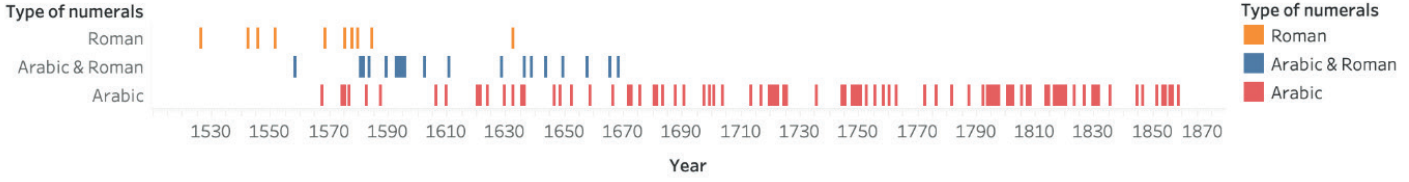


Figure 21. Type of numerals used in the chronicles for prices and measurements.

This supports Chrisomalis's hypothesis that it is likely that *frequency-dependent* bias caused the substitution of Roman for Arabic numerals, especially among society at large. The mutually complementary use of the positional Roman numerals and the counting board created a fully adequate and convenient tool for simple computations, which people were reluctant to part with. This changed in the second half of the sixteenth and especially in the seventeenth century. With the exception of dates, copied fragments of texts such as ordinances, and the texts in the chronicle that were dated before the author's own time, we see that prices, measurements and other things counted were expressed almost exclusively in Arabic numerals in the seventeenth century (*Figure 21*).[75] What explains this shift, if it was not primarily the properties of Arabic numerals? To study this in a more fine-grained way, we need to examine the possible motives of the chroniclers for replacing Roman with Arabic numerals.

Reasons for Accepting Arabic Numerals

Due to the near absence of non-experts who explicitly compared Arabic and Roman numerals, or talked about their reasoning, scholars have cited various factors to explain the transition from Roman to Arabic numerals in the sixteenth and seventeenth centuries. The external factors that are an important part of the explanation are the advent of widespread literacy and the printing press, on the one hand, and the integration of local economies and social institutions into global systems, on the other.[76] For England, according to Otis: 'men and women's adoption of Arabic numerals in the late sixteenth and seventeenth centuries was similarly motivated by commercial pressures and enabled by increasing literacy rates.'[77]

These external factors must also have played a role in the Netherlands.[78] In the late sixteenth and seventeenth centuries, the Republic's economy experienced unprecedented growth. During this period, Amsterdam was the capital market of Europe, where arithmetic with Arabic numerals became an important and useful skill. For more complex calculations involving interest rates, and percentages, algebra offered an advantage over the traditional counting board. This, according to historians, explains

75 That Roman numerals in the publications of the authorities, such as in ordinances, were still often used in the seventeenth century shows that both numeral systems were used alongside each other and for different functions.

76 Otis, *By the Numbers*, 63–88.

77 Ibid., 64.

78 For more information on the high literacy and numeracy rates in the Netherlands, see: Erika Kuijpers, 'Lezen En Schrijven. Onderzoek Naar Het Alfabetiseringsniveau in de Zeventiende-Eeuws Amsterdam', *Tijdschrift Voor Sociale Geschiedenis* 23, no. 4 (1997): 490–522; Tine de Moor and Jan Luiten van Zanden, '"Every Woman Counts": A Gender-Analysis of Numeracy in the Low Countries during the Early Modern Period', *The Journal of Interdisciplinary History* 41, no. 2 (2010): 179–208; Tine De Moor and Jaco Zuijderduijn, 'The Art of Counting: Reconstructing Numeracy of the Middle and Upper Classes on the Basis of Portraits in the Early Modern Low Countries', *Historical Methods: A Journal of Quantitative and Interdisciplinary History* 46, no. 1 (1 January 2013): 41–56.

why Arabic numerals were used by merchants and traders, but does not answer the question of why the rest of the population started using them.[79]

To arrive at an explanation for the transition from Roman to Arabic numerals Chrisomalis already suspected that *frequency-dependent* bias, which works on the basis of the popularity of some phenomenon, played an important role.[80] In the sections above, we have provided his hypothesis with empirical evidence since both Roman and Arabic numerals were used side-by-side in most sixteenth-century chronicles. Yet, Chrisomalis demonstrated that *frequency dependence* is not a 'unitary' phenomenon, meaning that there are a variety of decision-making processes underlying *frequency-dependent* outcomes.[81]

The motives related to *frequency-dependent* bias that subsequently played an important role in the acceptance of Arabic numerals are threefold, according to Chrisomalis: Perceived utility; conforming to a trend; and a way of communication he calls *networked*.[82] Perceived utility related to the phenomenon identified by James Surowiecki (2004) as the 'wisdom of the crowds', which means that for this specific case, it does not matter if Arabic numerals were superior to Roman numerals.[83] It is only because Arabic numerals were used more frequently in the world of trade from the thirteenth century on, that contemporaries presume that there must be something beneficial about them. Adopting Arabic numerals is not merely a trend, but reflects an assumption about how others made decisions about which numeral system to adopt.

Although in wisdom of the crowds, the most commonly used system is often better, in a trend it need not be so at all. While conforming to the trend, contemporaries may have thought that Arabic numerals were not 'better' in an absolute sense, but their attraction lies in conforming with the trend in order to acquire social status.[84] This may have been the reason for both Treckpoel and Van Wesenbeke to include both Roman and Arabic numerals in different colours to represent one and the same date. I thus demonstrated that they were aware of this innovation and wanted to show that they were proficient in Arabic numerals and so differed from those who were not. For this, they did not have to be scholars or merchants themselves, for whom the skill was important on substantive grounds, but rather it was the chronicler's motivation to display his mastering of this innovation to show he had skills similar to those who did.

79 Thomas, 'Numeracy in Early Modern England', 106, 111; Otis, *By the Numbers*, 64.

80 Chrisomalis, *Reckonings*, 103: Based on a comparative study on the acceptance of Arabic numerals with Chinese and Tibetan numerals.

81 Ibid., 93.

82 Ibid., 92–100.

83 James Surowiecki, *The Wisdom of Crowds: Why the Many Are Smarter than the Few and How Collective Wisdom Shapes Business, Economies, Societies, and Nations* (New York, 2004).

84 Chrisomalis, *Reckonings*, 94.

The third motive, named *networked*, differs from the first two because learning and using Arabic numerals provides access to a specific network, such as trade and finance. In this case, the motivation to learn Arabic numerals is not based on the characteristic properties of the numerals themselves (i.e., *content* bias), but because they became the standard language in which contemporaries communicated. In other words, their utility depended on their frequency in contact with others. Precisely for this reason, I agree with Chrisomalis that for professionals, like the sixteenth-century Amsterdam merchant Reael, this was the main motive for learning Arabic numerals because it became the new language of commerce, but for non-experts this motive applied only at a later stage.[85]

Observing New Patterns Through Arabic Numerals

Over the course of the seventeenth century, the use of Roman numerals declined. The Arabic numerals that replaced them literally changed the way people perceived the world. This applied not only to 'experts' who increasingly tried to understand the world through numbers, but also to the broader layers of society who learnt this new language. We have already seen that from the eighteenth century, chroniclers started using temperature measurements to compare the coldest winters. Moreover, health statistics led chroniclers to think about the origins and spread of epidemics in new ways. The interest of chroniclers in these lists and tables emerged around the mid-eighteenth century. The final part of this chapter asks how they ended up in the chronicles, what motivated chroniclers to use these numbers, how they reasoned with Arabic numerals, and the consequences for existing explanations.

The interest in ordered and systematised quantitative data has been labelled by historians as the 'quantifying spirit'.[86] The term is derived from the *l'Esprit géométrique* of the famous mathematician and natural philosopher Blaise Pascal (1623-62) but was translated and coined as the 'quantifying spirit' by the historians Tore Frängsmyr, John L. Heilbron, and Robin Elaine Rider. In their influential study: *The quantifying spirit in the 18th century* (1990), they formulated a new thesis to explain the 'passion to order and systematize as well as to measure and calculate' in eighteenth-century European societies.[87]

Their explanation for the emergence of the quantifying spirit around 1760 is twofold. One key ingredient was instrumentalism. The Scientific Revolution and, subsequently, the new experimental philosophy quantified the 'sciences' with the development of various 'scientific' instruments. The other factor was centralised states and administration. The bureaucracies of centralised states developed an enormous appetite for data and statistics, and therefore stimulated the collection of quantitative,

85 Reael, 'Uittreksel uit de Amsterdamsche gedenkschriften'.
86 Frängsmyr, Heilbron, and Rider, *The Quantifying Spirit in the 18th Century*, 2.
87 Ibid.

and especially demographic data to enable policy-making. In combination with the political philosophy of the Enlightenment, notions on the complementary character of truth and quantification were spread, which together explained the emergence of a quantifying spirit in eighteenth-century society.[88]

The Dutch historians Ida Stamhuis and Paul Klep elaborated on this thesis and produced two comprehensive volumes in 2002 and 2008, on the emergence of the 'pragmatic' Dutch quantifying spirit, known as the 'statistical mind'.[89] This 'pragmatic' variant of the European quantifying spirit developed outside academia, to respond to the commercial needs in the financial sector in the early modern Netherlands.[90] Moreover, it was locally inspired, in for example learned societies, and the result of the Scientific Revolution and commercial needs.[91] Klep and Stamhuis and the contributors to the volumes thus did not focus on the influence of prominent and more theoretical scholars such as Pierre-Simon Laplace (1749-1827), but examined 'pragmatic' scholars and experimental philosophers such as Nicolaas Struyck (1686-1769) and Willem Kersseboom (1691-1771).[92] The former used demographic data to calculate annuities more accurately, while the latter used meteorological instruments to record weather observations and to uncover new patterns. Consequently, they observed that: 'A varied, quite large group of professional men arose who were interested in measurements and statistical analysis.'[93]

The previous two chapters illustrated that chroniclers were also interested in demographic data and meteorological measurements, although that interest did not seem to be stimulated by commercial needs, and did not arise from scholarly practices. Therefore, there must be an alternative explanation for the chroniclers' increasing use of systematic and quantitative data from the eighteenth century on and how it resulted in new ways of thinking.[94]

The Relative Frequency of Arabic Numerals

For what purpose did chroniclers use Arabic numerals, and did the use of numbers increase compared to words in the early modern period, and especially after the age of the 'Quantifying Spirit'? Initially, these fundamental questions could not easily be answered because they require a close analysis of each numeral and its use in text. As explained in the introduction, I have used an annotated part of the corpus, enabling

88 Ibid., 2–23.

89 Klep and Stamhuis, *The Statistical Mind in a Pre-Statistical Era*; Ida H. Stamhuis and P. M. M. Klep, *The Statistical Mind in Modern Society: The Netherlands 1850-1940. vol. II: Statistics and Scientific Work* (Amsterdam, 2008).

90 Klep, 'A Historical Perspective on Statistics'.

91 P. M. M. Klep and Ida H. Stamhuis, 'Introduction', in *The Statistical Mind in a Pre-Statistical Era: The Netherlands 1750-1850*, ed. Paul M. M. Klep and Ida H. Stamhuis (Amsterdam, 2002), 18.

92 Frängsmyr, Heilbron, and Rider, *The Quantifying Spirit in the 18th Century*, 23.

93 Klep and Stamhuis, 'Introduction', 19.

94 Ibid., 13.

me to investigate how often and in what context Arabic numerals were used. This allowed me to study when chroniclers started using numerals in the form of lists and tables and how they reasoned with them.

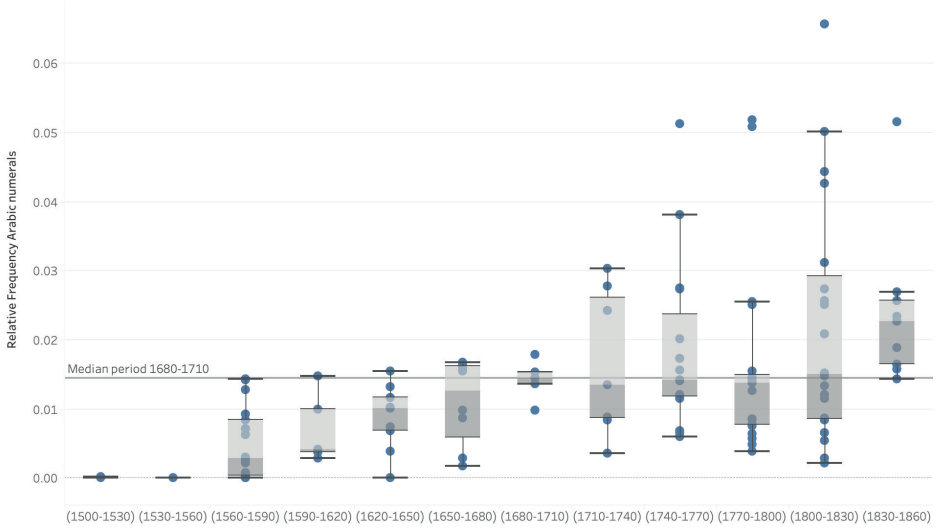


Figure 22. Relative frequency of Hindu-Arabic numerals per author per period of 30 years (1500-1830).

The distribution of the relative frequency of Arabic numerals for each chronicler is presented in box and whisker plots (*Figure 22*).[95] As we have seen in the first part of this chapter, there is an almost complete absence of Arabic numerals in the first half of the sixteenth century, which changed in the second half. Taking a closer look at the median from 1560 until 1710, it presents a steep increase that is almost linear. In this period, the transition was made from Roman to Arabic numerals, which explains that until the mid-seventeenth century there are still chroniclers that do not use Arabic numerals.

In the eighteenth century, the use of Arabic numerals stagnated. If we take the median of the period 1680-1710 as a reference point, it appears that in the eighteenth century as a whole, relatively fewer Arabic numerals were used, compared to the late seventeenth century. What changes is the distribution (or interquartile range) and the number of outliers. This is largely explained by the more frequent appearance of tables and lists in chronicles, especially when the chronicles are relatively short. However, we can establish that the 'rapid progression' of the quantifying spirit in society is not represented by a relative increase in the use of Arabic numerals in chronicles. Yet, lists and tables were increasingly included in chronicles which we can also observe from the increasing number of outliers in the box and whisker plots in the eighteenth century.

95 For a distribution of the number of chronicles used per 30-year period, see also Appendix 10.

After the 1730s, up to one third of the chroniclers frequently included demographic data.[96] This began with records of annual mortality rates of their own locality, but in the second half of the eighteenth century, population and (animal) health figures were structured in lists were compared in a structural way. Several scholars have noted that this was also done by experts, but, as I will show, this practice did not primarily develop among scholars to be subsequently adopted by the society at large. As we will see from the collection of population figures and (animal) health statistics, the chroniclers incorporated quantitative data into their existing practice of collecting useful information and knowledge to discover patterns. Moreover, they derived their data not exclusively from scholarly initiatives, but also through data collected on the initiative of local authorities, which were subsequently made publicly available in newspapers and periodicals.

The Access to Demographic Data

Sixteenth- and Seventeenth-Century Population Figures

How did demographic data find its way to chroniclers? Demographic historians have collected large amounts of demographic data, and by questioning their reliability they raised questions of how and under what circumstances these data were collected by contemporaries.[97] The first historian who examined the culture of collecting demographic data in the Northern Netherlands in depth was Leonie van Nierop (1919).[98] Besides existing practices of keeping birth, death and marriage records in church registers or for fiscal purposes, she argues that local authorities collected population figures in the first instance ad hoc, for example, during famine and epidemics. This was initially stimulated by crises and by legal motives, but over time, and especially from the eighteenth century on, governments became increasingly able to collect data on their populations in a more systematic way.[99]

96 14 out of the 49 authors between 1750 and 1799 included lists or tables in their chronicles.

97 G. J. Mentink, *De demografische ontwikkeling te Rotterdam en Cool in de 17e en 18e eeuw: een methodisch en analyserend onderzoek van de retroacta van de burgerlijke stand van Rotterdam en Cool* (Rotterdam, 1965); A.M. van der Woude, *Het Noorderkwartier: een regionaal historisch onderzoek in de demografische en economische geschiedenis van westelijk Nederland van de late middeleeuwen tot het begin van de negentiende eeuw*, A.A.G. bijdragen, 16 (Wageningen, 1972); Piet Lourens, *Inwonertallen van Nederlandse steden ca. 1300-1800* (Amsterdam, 1997); Petrus Gerardus van Druenen, 'Meten en tellen: Stedelijke inwonertallen in de Lage Landen: een alternatieve benadering' (2022).

98 Leonie van Nierop, 'De aanvang der Nederlandsche demografie', in *Economisch-Historisch Jaarboek: Bijdragen tot de Economische Geschiedenis van Nederland*, vol. 5 (Den Haag, 1919), 192–208.

99 Eric Ketelaar, 'Archiving People. A Social History of Dutch Archives', *Archiving People*, 1 January 2020, chaps 1–4.

In Amsterdam, mortality rates were since the eighteenth century published and visible at city hall, and since 1732 published in the local newspaper.[100] Other cities soon followed.[101] Local authorities were further stimulated to do so by scholars and learned societies demonstrating the usefulness of these data. Frequent and large quantities of demographic data allowed annuities to be calculated more accurately, and diseases could be monitored more closely.[102] Unlike the usefulness of these figures for scholars and (local) governments, their reception in the public domain has not been studied before.

We have seen in *Chapter 3* that chroniclers had always been interested in mortality figures, especially during epidemics. In 's Hertogenbosch in 1556, the chronicler Cuperinus wrote that: 'on a daily basis, five or six people died [...] in the city and in the ['groot gasthuys'] about sixteen or seventeen thousand'.[103] What changed in the eighteenth century was that chroniclers started to record demographic data on a regular basis. Not only mortality rates, but also how many children were born or baptised and how many people got married. These data were often structured in a systematic way and used to make inferences about the size of the community and the course of diseases. Before the second half of the eighteenth century, this type of comparative and diachronic reasoning with demographical data was completely absent among chroniclers. This reflects the absence of public demographic data. Once data became available, it was used by chroniclers, but this could also cease when the source of information disappeared.

This was, for example, the case in the chronicle of the teacher and poet from Dordrecht Pieter van Godewijck (1593-1669). Unlike the city of London and its 'Bills of Mortality', local authorities and medical practitioners in the Netherlands only sparsely mapped the progression of local diseases.[104] Of course, most people roughly estimated how many people died during an epidemic, or what the approximate population size was, based, for example, on the number of people who were buried, but not to a degree that they could make an accurate analysis. The approximate numbers of deaths from pestilence appeared in the media, but they did not chart the course on a weekly or seasonal basis. In the seventeenth-century chronicle of Godewijck, however, such a table is included (*Figure 23*).

100 Nicolaas Struyck, *Vervolg van de beschryving der staartsterren, en nader ontdekkingen omtrent den staat van't menschelyk geslagt* (1753), 143; 'Amsterdamse Courant', 8 January 1732.

101 Van Nierop, 'De aanvang der Nederlandsche demografie', 196.

102 Ibid., 197–207.

103 '[...] iae dagelycx, vyf of ses in een graft [...] soo min gestorven waren, soo in de stat soo int groot gasthuys, omtrent sesthien oft seventhien dusent.' Cuperinus, 'Die Chronicke', 138.

104 Lindemann, *Medicine and Society*; Frans W.A. Van Poppel and Jitse P. van Dijk, 'The Beginning of Health Statistics 1750-1870', in *The Statistical Mind in a Pre-Statistical Era: The Netherlands 1750-1850* (Amsterdam, 2002), 241–77.

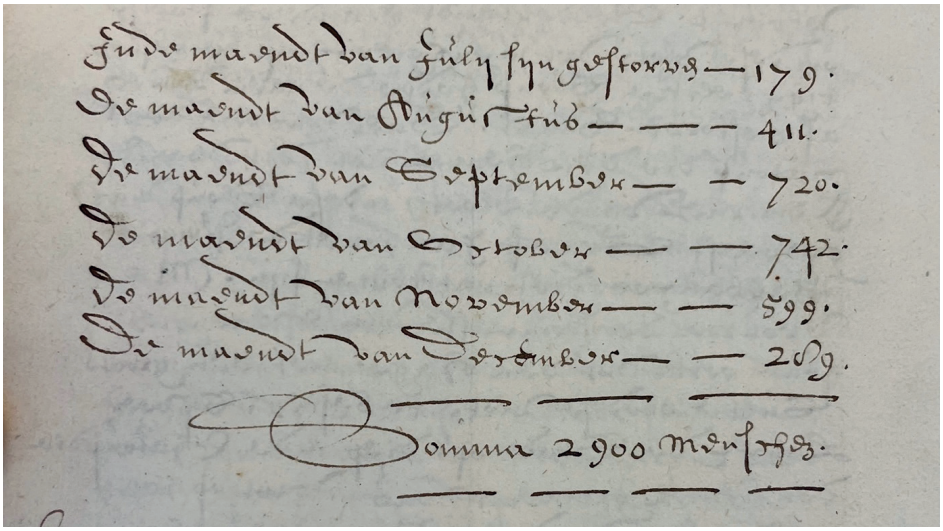


Figure 23. List with the number of deaths per month in the chronicle of Pieter van Godewijck.[105]

The table presents the monthly number of plague victims from July to December in the year 1636. The total number is rounded off in the table but written down in the texts as: 'three thousand five hundred & thirty-three.'[106] That the exact number was rounded off was common practice in the seventeenth-century media, the table, however, is the anomaly.[107] It is presumably derived from the physician Johan van Beverwijck (1594-1647), whom Godewijck knew personally. They not only lived in the same city, but they also worked together in 1636 to make medical knowledge accessible to the population at large.[108] Although Van Godewijck was not a medical expert, his access to Van Beverwijck explains the table in his chronicle. This is further supported by the fact that after Van Beverwijck's death in 1657, the number of deaths in Van Godewijck's chronicle entries are never more specific than 'thousands of people'.[109]

105 Pieter van Godewijck, '"Beschrijvinghe van Dordrecht"; Kroniek van Dordrecht Vanaf Het Ontstaan Tot 1668 Door Pieter Govertsz. van Godewijck Met Verder in Deze Band Uittreksels Uit de Rijmkroniek van Holland, Afschriften Uit Het "Houte Bouck" En Aantekeningen Betreffende de Gilden- En Achtenkwesties in de Jaren 1647-1650', Regionaal Archief Dordrecht, 150 Collectie van Handschriften, inv.no. 3. nr. 1389, fol. 54 verso.

106 '[...] drije duysent vijf hondert drye & dertigh menschen.' Van Godewijck, *Dese heerlicke stadt*, fol. 54 verso.

107 Theo Dekker, 'Statistiek van de koude grond: De opkomst van cijfers en tabellen in vroegmoderne kronieken', *De Achttiende Eeuw* 54, no. 1 (1 October 2022): 110–29.

108 Lia van Gemert, 'Johan van Beverwijck als "instituut"', *De Zeventiende Eeuw. Cultuur in de Nederlanden in interdisciplinair perspectief* 8 (1992): 99–106; Pieter van Godewijck, *Remedie voor de pest* (Dordrecht, 1636); Johan van Beverwijck, *Bericht van de pest*, 1636.

109 '[...] een groot getall duysenden van menschen.' Godewijck, *Dese heerlicke stadt*, fol. 73 recto.

The Publication of Domestic Population Figures

Until the early eighteenth century, chroniclers mainly recorded population figures from foreign cities such as Vienna, London, Paris, and often in relation to disasters.[110] Domestic mortality figures were not absent, but rare in contrast to those from foreign cities, because no one saw the need to make quantitative data on deaths available to the general population.[111] So when local population figures became available, they were written down immediately as we can see in a chronicle from Waasland (located between Antwerp and Ghent). This anonymous chronicler recorded in 1719 the number of people living in the Sint-Niklaas parish. In that year a census was conducted and according to the author, 3621 people lived in the area 'as far as the setts [paving] stretched', and 3752 on the countryside, which resulted in a total sum of 7373 souls.[112] Subsequently, further categorisation was made since there were '4920 communicants, 1416 families, and 262 *quesels* [*filia devota*, unmarried Catholic women]'.[113]

Several motives can be imagined for writing down mortality and population figures. Mortality rates in foreign cities were often regarded as extraordinary and sensational news. They were often not necessarily useful for studying the course of the disease, since, in general, the total number of deaths were published at the end or beginning of a year, even when they contained the mortality rates per month.[114] Also the censuses, such as in the Sint-Niklaas parish, were somewhat exceptional and, therefore, useful for the author to record because it was about his own locality. But, as we shall see, the collection of demographic figures also had a much more fundamental purpose.

Beginning in 1732 local newspapers in the Dutch Republic had started to publish the number of deaths and births on an annual basis. Amsterdam's example was quickly picked up in other cities. In 1737 the Haarlem newspaper passed into the ownership of Izaak (1681-1761) and his son Johannes Enschedé (1708-80), and beginning in January 1740, the city's death rates and the number of baptisms were published annually.[115] Once papers published them, chroniclers in the Dutch Republic began to record population figures annually, and sometimes even for decades.[116] The same phenomenon can be observed in

110 Anonymous, 'Historien Oft Kort Verhael van Eenige Gedenckweirdige Gebeurtenissen van 't Beginsel Des Weirelts', Oud Archief Ms. 50 bis, Stadsarchief Leuven, 181, 203, 237.

111 G. C. B. Suringar, *Onderzoek naar de doelmatigste inrigting van sterflijsten, ten dienste van de geneeskunde in het algemeen, en van de geneeskundige staatsregeling in het bijzonder* (Amsterdam, 1831), 11–12; Otis, 'By the Numbers', 237–48.

112 '[...] soo verre als de kasseye haer bestrekt.' Anonymous, 'Chronycke van Waes, et Le Chiffre Couronné de Léopold 1er', Koninklijke Bibliotheek België, Brussels, Hs 19157, fol. 274 recto-verso.

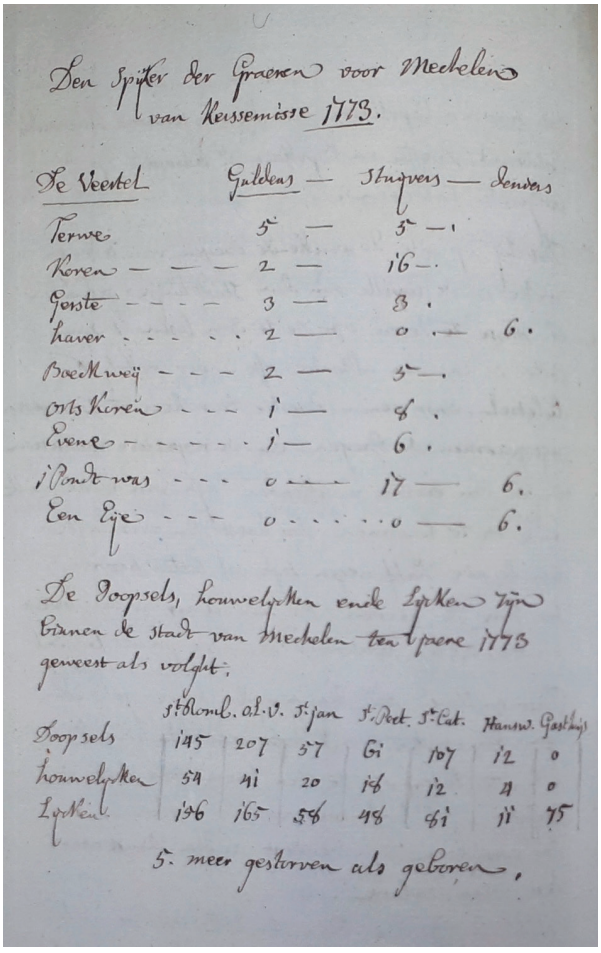
113 '[...] 4920 communicanten en 1416. familien ende maer 262 quesels.' Ibid., fol. 274 verso.

114 See for example: 'Oprechte Haerlemsche Courant', 16 December 1679.

115 'Oprechte Haerlemsche Courant', 5 January 1740.

116 Bikker Raye, 'Notietie van het merkwaardigste'; Van der Vinne and Van der Vinne, 'Aantekeningen van aanmerkelijke gebeurtenissen'; De Munck, 'Iaer-Boecken van Mechelen'; Callion, 'Gentsche kronijke: 1525-1835', vol. 1; Hendrik Dominik van den Nieuwenhuysen, 'Deel 1 kroniek van Mechelen door kapelaan Hendrik Dominik Van den Nieuwenhuysen', Stadsarchief Mechelen, Varia 832/1; Louwen, 'Kronijk der

chronicles from the Southern Netherlands since the 1770s with the appearance of local periodicals. For example, both Jozef Jakob de Munck (1740-92) and Hendrik Dominik van den Nieuwenhuysen (1724-80) from Mechelen copied population figures from the *Wekelyks Bericht voor de Stad ende Provincie van Mechelen* (1773-77), listing the number of baptisms, marriages and deaths per parish (*Figure 24*, *25* & *26*).[117]



Den Spitter der Graeven voor Mechelen van Heussemisse 1773.

De Veertel	Guldens	Stuyvers	Denders
Terwe	5 —	5 —	
Koren	2 —	16 —	
Gerste	3 —	3 .	
Haver	2 —	0 —	6 .
Boeckweij	2 —	5 —	
Orts Koren	1 —	8 .	
Evene	1 —	6 .	
1 Pondt was	0 —	17 —	6.
Een Eye	0 —	0 —	6.

De Doopsels, Houwelyckeu ende Lyckeu zyn binnen de stadt van Mechelen ten jaere 1773 geweest als volgt:

	St Rombl.	ad V.	St Jan	St Pet.	St Cat.	Hansw.	Gasthuys
Doopsels	145	207	57	61	107	12	0
Houwelyckeu	54	41	20	18	12	4	0
Lyckeu	136	165	58	48	61	11	75

5. meer gestorven als geboren.

Figure 24. Population figures Mechelen 1773 in the chronicle of J.J. de Munck.[118]

stad Purmerende [...] deel 2, tweede gedeelte'; Kluit, 'Historische Jaerboeken der stad Briel, deel 1, 1e stuk, 1747-1751'.

117 *Wekelyks bericht voor de stad ende provincie van Mechelen* (1774), 14; Hendrik Dominik van den Nieuwenhuysen, 'Deel 5 kroniek van Mechelen door kapelaan Hendrik Dominik Van den Nieuwenhuysen', Stadsarchief Mechelen, Varia 832/1, unpaginated; De Munck, 'Iaer-Boecken van Mechelen'.

118 Munck, 'Iaer-Boecken van Mechelen', 1786, unpaginated.

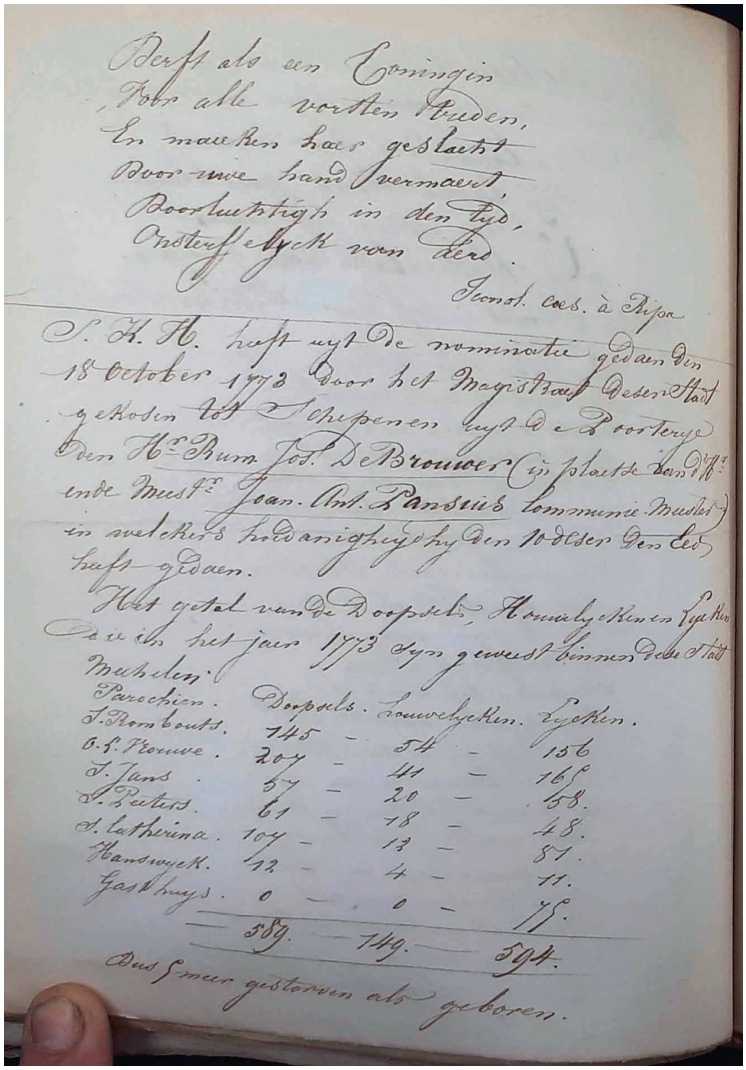
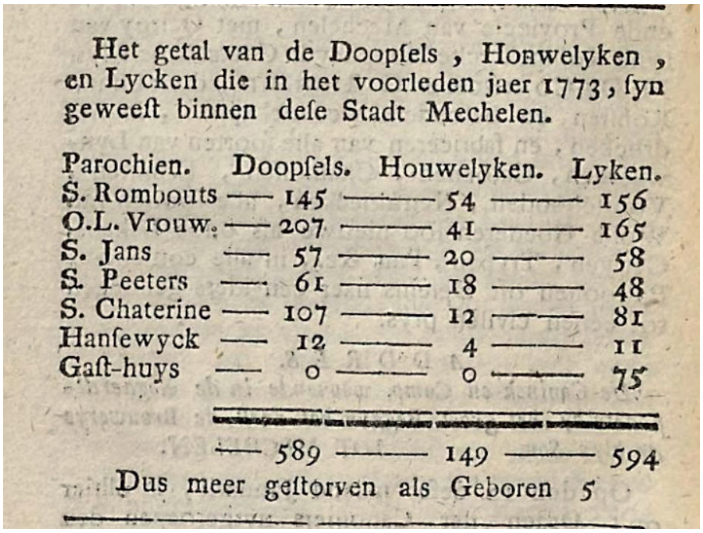


Figure 25. Population figures Mechelen 1773 in the chronicle of H.D. van den Nieuwenhuysen.[119]

119 Van den Nieuwenhuysen, 'Deel 5 kroniek van Mechelen', unpaginated.



Het getal van de Doopſels, Houwelyken, en Lycken die in het voorleden jaer 1773, ſyn geweeſt binnen deſe Stadt Mechelen.

Parochien.	Doopſels.	Houwelyken.	Lyken.
S. Rombouts	145	54	156
O.L. Vrouw.	207	41	165
S. Jans	57	20	58
S. Peeters	61	18	48
S. Chaterine	107	12	81
Hanſewyck	12	4	11
Gaſt-huys	0	0	75
	589	149	594

Dus meer geſtorven als Geboren 5

Figure 26. Population figures Mechelen 1773 in the Wekelyks bericht voor de stad ende provincie van Mechelen.[120]

Some authors who started chronicling in the second half of the eighteenth century included population figures since the 1730s, after which they continued in their 'own' time.[121]

In addition to publishing annual numbers of baptisms and mortality figures, the structure and number of demographic categories expanded rapidly in various media. Initially, population figures were published in the running text, but from the 1740s they increasingly had the structure of a list. Consequently, new categories were added, such as births, marriages, twins, stillborn babies, and how many young and old people had died.[122] Often these categories were (partially) copied by the chroniclers.[123]

Besides copying population figures on an annual basis, chroniclers also engaged with the numbers by restructuring the data they retrieved from newspapers and periodicals. The Haarlem painter Vincent Jansz. van der Vinne (1736-1811) compiled an overview based on the number of births and deaths between 1739 and 1754. It offers a striking overview of fluctuating births and deaths and enables a new way of analysing and interpreting quantitative data (*Figure 27*).[124]

120 *Wekelyks bericht*, 14.
121 Van der Vinne and Van der Vinne, 'Aantekeningen van aanmerkelijke gebeurtenissen', fol. 7 recto-15 recto; Munck, 'Iaer-Boecken van Mechelen', 1786, fol. 13 verso.
122 'Oprechte Haerlemsche Courant', 4 January 1746.
123 Van der Vinne and Van der Vinne, 'Aantekeningen van aanmerkelijke gebeurtenissen', fol. 8 recto-15 recto.
124 Ibid., fol. 7 recto-15 recto.

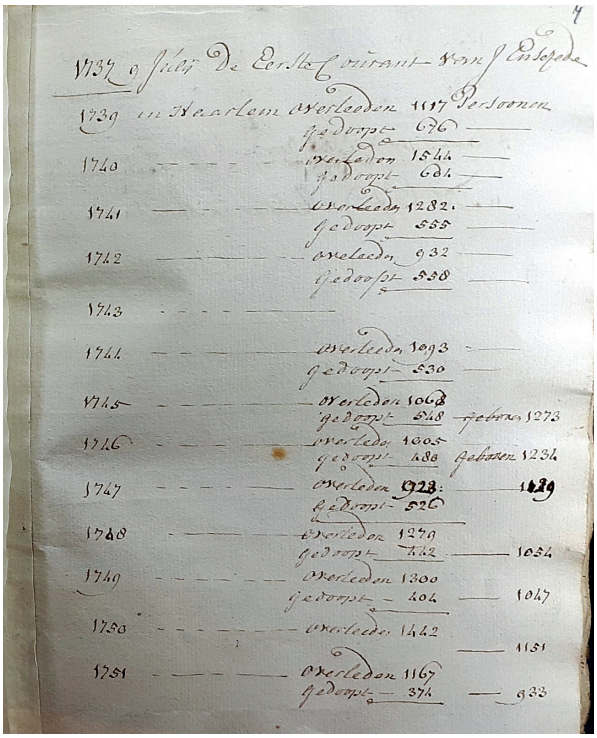


Figure 27. Number of baptisms and deaths in the chronicle of Van der Vinne. The list continues on the next page.[125]

How chroniclers engaged with data to gain new insights can be seen in the chronicle of the tax collector and official, Jan Kluit (1722-1811) of Brielle. His chronicle contains a list with population figures of Brielle between 1747 and 1766 (*Figure 28*).[126] At first glance, the results of the table are misleading, according to Kluit. He wrote:

> It would not surprise me that someone who is critical and compares this list of born children with deceased people, would reflect that the number of deaths far exceeds the number of births. From this, one might conclude that [...] Brielle residents were breathing unhealthy air and that more people died here than elsewhere as a result. I did not intend to go into this again [...] But I am obliged to clear up misconceptions and convince the world of the contrary. More so because I can prove this by experiment.[127]

125 Ibid., fol. 7 recto.

126 Besides his chronicle, I found several notes in Kluit's hand on population figures on which he performed calculations. Streekarchief Voorne-Putten, 501, inv.no. 26-27.

127 '[...] 't Zoude mij niet verwonderen, dat indien imand, die wat cretijcq was en deeze lijsen van de geboorne kinderen tegen die der overledene menschen confronteerde, reflectien maakte, omdat het getal der

In other words, in the past twenty years, 2163 children were born, while 2422 people died. Without taking into account the immigration numbers, the population declined by 259 people. This was problematic to Kluit because contemporaries might believe that excess mortality was caused by miasmatic air. Kluit, however, believed that he was able to refute this theory by experiment, which made him feel 'obligated' to explain the high mortality rates and the fact that the air in Brielle was actually healthy.

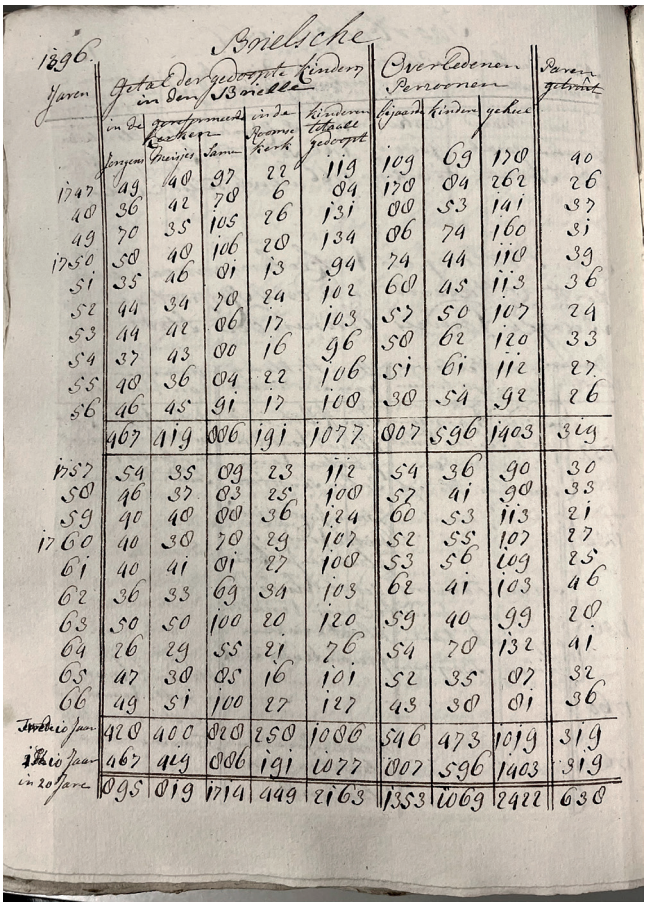


Figure 28. Population figures from 1747-66 in the chronicle of Jan Kluit.[128]

overledene persoonen verre overtreft dat der geboorne kinderen en dat daar uit zoude consteeren, dat [...] men alhier in den Briell eene ongesonde lucht in ademt en dienvolgens meerder menschen dan elders sterven. 'k Was niet voornemens dit stuk meerder aan te roeren [...] Maar ik ben verpligt tot wegneming van deze verkeerde begrippen de weerelt van 't contrarie te overtuigen, te meer, dewijl ik nu in staat ben om zulx proeff-kundig te kunnen betogen.' Kluit, 'Historische Jaerboeken der stad Briel, deel 2, 2e stuk, 1763-1767', 1397.

128 Ibid., 1396.

The total number of births and deaths, and especially the twenty-year period is misleading, according to Kluit. When examining the table more closely, it appeared that only in the first ten years was there excess mortality. In fact, it could be reduced to the years 1747 and 1748. In those years alone, 247 more people died there than were born. Kluit refers the reader to the *Nederlandsche Jaarboeken* and his own chronicle to explain the mortality rates.[129] In that period, a garrison of Scots was billeted in Brielle during the War of the Austrian Succession (1740-48) as we have seen. Kluit had investigated the phenomenon at the time and concluded that because 'of their rough way of life [...] most of them died.'[130] Because these Scottish soldiers were listed as 'bejaarden' [elderly people] there was an excess mortality in those years which was not caused by miasmatic air, but by excessively eating uncooked food, as we have seen in the previous chapter. Moreover, in the second decade from 1757 until 1766, there was a birth surplus of sixty-seven children. As a result, Kluit said, people could not rightfully claim that the air in Brielle was miasmatic, because proportionally fewer people died in Brielle than in the 'healthy [and] renowned high Germany'.[131]

Demographic data put Kluit in a better position to demonstrate that the excess mortality in Brielle was not linked to the environment but to cultural differences. It shows that he, but also others as we will see, collected quantitative data about the community not only because it was 'remarkable'. It also permitted them to better explain phenomena, developments, and current events.[132] This becomes even more apparent in times of crisis, such as an epidemic.

A New Way to Study Diseases: Monitoring Health Figures

In various countries there have been Covid-19 'dashboards' since 2019, with weekly and sometimes even daily updates that were provided by health institutes. However, the use of serial quantitative data was not common in the Low Countries before eighteenth century. As we have seen in *Chapter 3*, epidemics were studied primarily to understand why they had occurred and to determine the possible causes. Mortality rates were until the eighteenth century initially compared in an analogical way with historical and biblical events to understand what happened, and only then with one's own time. The aim was to gain insight into how the disease could be prevented and how it spread on a local level. For this purpose, the exact numbers and progression of the disease

129 For more information on the 'Dutch Yearbooks', see: Donald Haks, *Journalistiek in crisistijd: de (Nieuwe) Nederlandsche Jaarboeken 1747-1822*, Zeven Provinciën Reeks; deel 37 (Hilversum, 2017).

130 '[...] door hunnen ruiwe manier van leeven [...] meest alle zijn gesneuvelt en ten grave gedaalt.' Kluit, 'Historische Jaerboeken der stad Briel, deel 2, 2e stuk, 1763-1767', 1399.

131 '[...] gesond vermaarde hoog Duitsland.' Ibid., 1400.

132 For an example on the rinderpest, see: Louwen, 'Kronijk der stad Purmerende [...] deel 2, tweede gedeelte'; For an example during the Cholera pandamic, see: Callion, 'Gentsche kronijke: 1525-1835', vol. 6.

were less important. In the second half of the eighteenth century this changed, and contemporary figures became more important.

In the previous chapter, we met in detail with Lambert Rijckxz. Lustigh (1656-1727). He conducted extensive empirical research on the rinderpest in the 1710s. He recorded which cows around Huizen became infected and how the disease spread among various farms and several villages in the area.[133] Like Van Godewijck, he included a table in his chronicle which presented the number of deceased cattle per livestock farmer. He received this list from a certain Tijmon Lambertszoon from Blaricum, but it did not convince him to structure his own collected data in a more systematic manner to monitor the progression of the plague (*Figure 29*).[134] Half a century later, several chroniclers included health statistics on animals in their chronicles. They used them to make inferences about the impact of the weather seasons and various local factors. They were helped in doing so by the publication of animal health statistics on the initiative of the regional authorities. As a result, chroniclers could make quantitative comparisons in both time and space, which introduced a new way of studying epidemics based on numbers.

In 1745 a 'lover of the useful sciences', A. Visser, was one of the first who published mortality rates among cattle in various towns and villages. We can read in the introduction, that his motive was similar to Lustigh's: interpreting the rinderpest in relation to the divine providence, but this time with more quantitative data.[135] Before presenting his data Visser wrote: 'I tried to present these numbers in such a way that anyone can read them.'[136] The result is sixteen lists on how many cows and heifers died per region between November 1744 and April 1745. Fifteen for each town or village and one longer list that presented the sum of eleven localities.

133 Lustigh, *Kroniek I van Lambert Rijckxz Lustigh*, 100–112.

134 Ibid., 88.

135 Beminnnaar der Nuttigen Wetenschappen. A. Visser, *Beschouwing van gewicht, over den tegenwoordigen en verledenen gestraften tydt […]. Met een byvoegzel van't sterf-getal der beesten* (1745), front page.

136 'Ik hebbe getragt, om deze getallen zoo net op te geven, als voor iemand doenlyk is.' Ibid., 44.

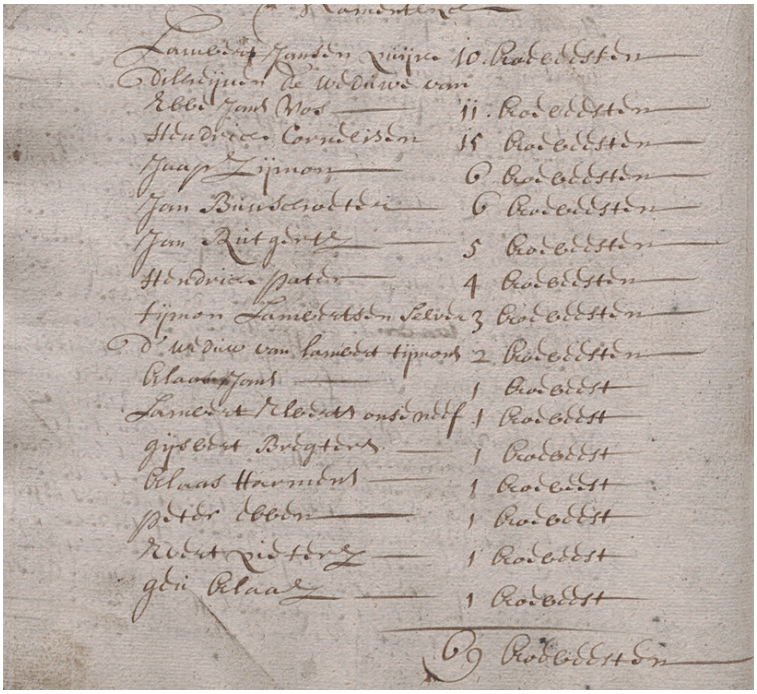


Figure 29. Number of cows that died from rinderpest per farmer in the chronicle of Lustigh.[137]

These lists were compiled on the initiative of the daily administration of the provinces of Holland and West-Friesland, the *Gecommitteerde Raden*, during the second massive outbreak of the cattle plague in 1744.[138] This inventory of livestock at regional level was set up to monitor the rinderpest both supra- and inter-locally.[139] Consequently, local authorities had to count their cattle and report how many were healthy, sick, cured, and died.[140] The results were not officially published at the time, but they did appear in Visser's work. A few years later, the chronicler Kluit, too, got his hands on the results, though via a different route. In 1757 the lists were made public in the *Nederlandsche Jaarboeken*, and because the cattle plague revived three years later, Kluit tried to figure out how many livestock died by extrapolating data from the

137 Lustigh, 'Kroniek van Lambert Rijckxz.', 88.

138 Piet Lenders, *Overheid en geneeskunde in de Habsburgse Nederlanden en het prinsbisdom Luik*, Anciens pays et assemblées d'États 103 (Heule, 2001), 9–42; Sundberg, *Natural Disaster*, 212–50.

139 *Nederlandsche jaerboeken, inhoudende een verhael van de merkwaerdigste geschiedenissen, die voorgevallen zyn binnen den omtrek der Vereenigde Provintiën, sederd het begin van 't jaer* [...] *Elfde deels Tweede Stuk* (Amsterdam, 1757), 693–98.

140 'Stukken Betreffende (Besmettelijke) Ziekten Onder Het Rundvee (Veepest), 19 December 1744 Tot 21 Juli 1769', West-Fries Archief, Hoorn, 0120 Oud archief Stad Enkhuizen; Marten Schagen, *Het eerste kapittel van Joels profetie overwogen en op 's lands toestand gepast: met een aenhangsel van boetstoffen, en bedestonden; Waerin, onder andere, Egypte's Veepest en Jona's derde hooftdeel, Verhandelt worden, door Marten Schagen, Bedienaer van Gods Woord onder de Doopsgezinden in Utrecht* (Haarlem, 1745), 409.

past.[141] He wrote: 'the exact number of the diseased cattle in our entire country I can only imagine. The exact quantity will probably never see the light of day.'[142]

Based on the experiences of the *Gecommitteerde Raden* during the second rinderpest wave, health statistics were collected again during the third wave in 1768.[143] From 21 March 1769 town and village councils had to compile lists in which they recorded the well-being of cattle in their locality on a weekly basis, and send it to the regional authorities.[144] As a result, the progression of the rinderpest could be closely monitored on a local and provincial level. A few weeks later, on 14 April 1769 the statistics were even made public as the *General list of infected, died, and cured cattle* [...].[145] The lists provided an overview of the number of infected; cured; and diseased cattle per region, followed by a table with the total number of dead and recovered cattle for every six months. At the time the tables were published, chroniclers included them in their chronicles. Consequently, they started to reason with them and derive conclusions from these lists. How and why they used these tables can best be illustrated in the chronicles of Kluit and Albert Pietersz. Louwen (1722-1798) from Purmerend.

Louwen, whom we met in the previous chapters, was a wine merchant with political ambitions. His city was severely struck by rinderpest. Purmerend was known for its cattle market, but from 1770 there was a total ban on the importation of Danish cattle.[146] In combination with his ambitions to obtain public office, this must have encouraged him to examine the development of the rinderpest. He regarded his work as 'research on the secular histories' and believed that the 'sciences' served as a 'guide in human life'.[147] One of the sources that he used was *De Maandelykse Nederlandische Mercurius*, a periodical published in Amsterdam, which included the health statistics from the *Generaale lyst*.[148] Louwen copied this table into his chronicle, which showed that 32,907 of the 101,990 cattle died in the past five months in the *Noorderkwartier* – roughly the Northern part of Holland (*Figure 30*). On the basis of these figures, he concluded that the high price for cattle and dairy was caused by the mortality rates in the region.[149]

141 *Nederlandsche jaerboeken*, 693–98.

142 'Het juiste getall van het gestorven vee in ons geheele landt verbeelde ik mij, dat veelligt noit aan het dagligt sal gestelt worden.' Kluit, 'Historische Jaerboeken der stad Briel, deel 2, 1e stuk, 1757-1762', 215.

143 W. M. Gijsbers, 'Kapitale ossen. De internationale handel in slachtvee in Noordwest-Europa 1300-1750' (1999), 94.

144 Schagen, *Het eerste kapittel van Joels profetie*, 693; Pieter van der Pols, 'Aantekeningen en bevindingen van Pieter van der Pols uit Katendrecht, 1719-1816', 33-01 Handschriftenverzameling van de gemeente Rotterdam, aanvullingen 1848-1987, inv.no. 4706, Stadsarchief Rotterdam, 80–81.

145 *Generaale lyst der besmette, gestorvene en gebeeterde runderbeesten* [...].

146 Gijsbers, 'Kapitale ossen. De internationale handel in slachtvee in Noordwest-Europa 1300-1750', 63, 94.

147 '[...] onderzoekinge der Wereldsche Geschiedenissen [...] Wetenschappen [...] rigtsnoer van het Menschelijke Leeven.' Louwen, 'Kronijk der stad Purmerende [...] deel 1', unpaginated.

148 It appeared since 1756 sixteen times a year and contained local and international news. *De Maandelykse Nederlandische Mercurius* [...] *Van July tot December 1769*, vol. 27. (Amsterdam, 1769), 107.

149 Louwen, 'Kronijk der stad Purmerende [...] deel 2, eerste gedeelte', 94–96.

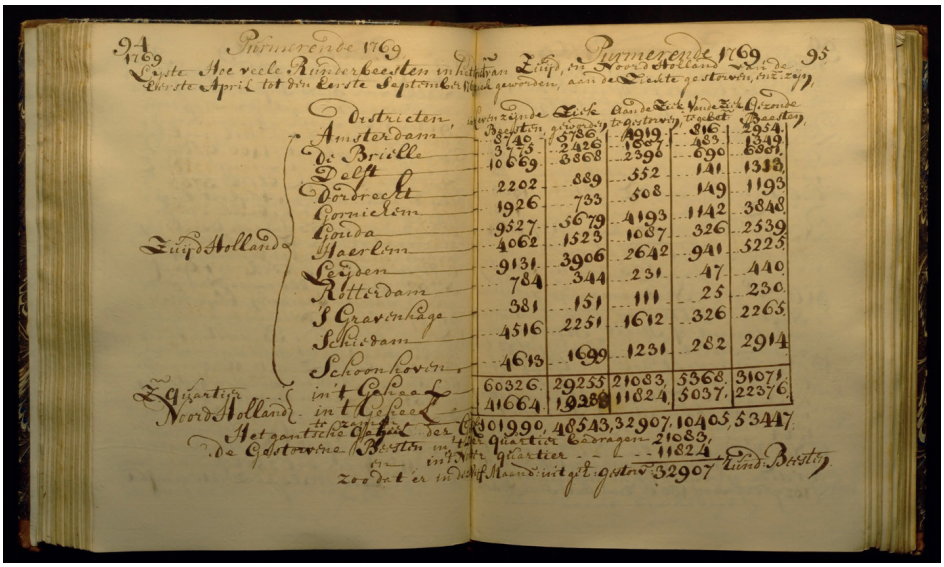


Figure 30. A list on the health conditions of cattle in the chronicle of Albert Pietersz. Louwen.[150]

Examining the tables more closely, Louwen concluded that from October to March two to four times more cattle died than from April to September.[151] He thus observed a causal relationship between weather seasons and epidemics supported by quantitative data. In addition to diachronic comparisons, Louwen also compared various cities with each other. For one of these comparisons, he used a table that was not used for the publication of the *Generaale lyst*, but only for Purmerend and the four regions surrounding the city.[152] Based on this table Louwen concluded that: 'On this [list] one can see that the mortality was not severe this year.'[153]

In addition to making diachronic comparisons within their own provinces, chroniclers also started making comparisons between provinces. In Kluit's chronicle we can read that while he was copying a list from the Rotterdam newspaper – based on the *Generaale Lyst* – he received a message that 'in the province of Friesland, in the year 1769, 98,000 head of cattle died from the rinderpest.'[154] Consequently, Kluit compared the mortality rates between the provinces of Holland and Friesland, and concluded –

150 Albert Pietersz. Louwen, 'Kronijk der stad Purmerende bevattende der selver opkomste en voortgang, in handschrift door Albert Pietersz. Louwen, 18e eeuw, deel 2, eerste gedeelte' Noord Hollands Archief, Haarlem, 143. Collectie van A. Pietersz. Louwen, inv. no. 19, 94-95.

151 Ibid., 116–117, 143.

152 Ibid., 115.

153 'Hieraan kan men zien dat de Sterfte in dit Jaar, alhier niet Swaer was, over deze Stadt.' Ibid., 115.

154 '[...] in de provincie van Vriesland in dit jaar 1769 – 98000 runderen aan de veepest gestorven zijn.' Jan Kluit, 'Historische Jaerboeken der stad Briel, deel 3, 1e stuk, 1767-1770', Streekarchief Voorne-Putten, Rozenburg, 501, inv.no. 5, 364.

like Louwen – that: 'necessarily, these mortality rates resulted in the scarcity in milk, butter and cheese. Moreover, it was the main cause that these products increased in price. Butter increased in mid-July up to 16 guilders.'[155]

The publication of quantitative data on the rinderpest enabled chroniclers to make more accurate observations and comparisons. Moreover, presenting the data in a structured and systematic manner allowed them to examine the relationship between events in greater detail. The spread of diseases in different areas could be monitored, and comparisons between seasons and years were made. As a result, factors such as the influence of the weather and the stabling of livestock on the spread of diseases were quantified. Consequently, this had an impact on food and especially dairy prices. Fluctuations in these prices could thus be better explained.

In addition to more accurately describing how various processes interacted with each other, chroniclers also drew more fundamental conclusions. Louwen wrote during the cattle plague in 1775:

> One third of the cattle recovered and two thirds died. This was a special predestination of Divine Providence. [...] One-third [of the cattle] were preserved so that man could provide for his necessary sustenance [...] what obligations have we not to such a merciful Father who visits his children with his disciplinary rod, but in his wrath and punishment wants to show his mercy.[156]

This fragment, like those examined in the previous chapters, shows that chroniclers provided explanations for phenomena on various levels. On one hand, they explained phenomena based on 'natural' processes, and, on the other, they searched for underlying patterns to gain insight into divine providence. From the eighteenth century on, Arabic numerals elevated both practices to a higher level, demonstrating that numeracy did not subvert religious beliefs but made it possible to see how He 'arranged all things by [...] number.'[157]

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155 '[...] uit deeze considirabele sterfte moest noodwendig volgen groote schaarsheid in melk, boter en kaas, dat ook oorsaak was, dat deeze producten seer in prijs steigerde, de boter liep omtrent half julij als tot 16 gulden.' Ibid., 365.

156 'Een derde van het ziek geworde Rundvee gebeterd, en Twee derde van dezelve Gestorven zijn; waerlijk eene een bijzondere Voorbeschikkinge der Goddelyke voorzienigheijd [...] eene derde gedeelte van het zelve over gelaeten op dat het zoo noodzakelijke vee tot onderhoud vanden Mensch [...] wat verpligting hebben Wij niet aan zulk eene Barmhartige Vaeder, die zijne Kinderen wel met zijne Tugtroede bezoekt, maar nogthans, in de Toorn en Straffe, zijne Genade wil bewijzen.' Louwen, 'Kronijk der stad Purmerende [...] deel 2, tweede gedeelte', 280.

157 Wisdom 11:20. Some historians argue that the use of Arabic numerals would have led to a more secular world. For this debate, see: Hobart, *The Great Rift*.

Conclusion

In this chapter, we used chronicles to examine how non-experts used numerals and how this changed between 1500 and 1850. Partly, this confirms the conclusions of earlier scholars. In the first half of the sixteenth century, there was hardly any use of Arabic numerals, but this changed rapidly in the second half of the sixteenth and in the seventeenth century. This transition occurred initially in the Southern Netherlands, and after the Fall of Antwerp, in the Northern Netherlands when they consolidated their place as the economic centre of Europe. As a result, historians have explained the acceptance of Arabic numerals with reference to the role of global trade, market capitalism and formal education, in combination with growing literacy and the appearance of the printing press.[158] In this scholarship, it was the unique computational property of Arabic numerals that was seen as a reason to accept this new technology in a more economically advanced world. Yet, this chapter has shown that for roughly a century chroniclers continued to use Roman numerals alongside Arabic numerals, and that there were also other reasons for them to accept Arabic numerals.

Before Arabic numerals became dominant, chroniclers adapted Roman numerals to make more complex calculations. We have seen the use of the place-value system in the chronicles, showing that Roman numerals remained useful as long as calculations were made with a counting board. Yet, from the late seventeenth century onwards, calculations in the chronicles were almost exclusively performed using Arabic numerals. This cannot be explained solely by *content* or *direct* biases, or because they were 'better' for calculations. Therefore, *frequency-dependent* bias must have played an important role.

Chrisomalis has suggested that it was not the feature of calculation, but rather their more frequent use, that led to the replacement of Roman numerals by Arabic.[159] By studying the decision-making processes underlying *frequency-dependent* outcomes, it appears that there were various motivations for non-experts to accept Arabic numerals. According to Chrisomalis, most people must have learned Arabic numerals to avoid being excluded from the sectors in which they had become the standard way of communication. Yet, we have discussed that until the seventeenth century, this was mainly applicable to experts and not to non-experts. In the sixteenth century, the other motives such as: perceived utility and conforming to the trend must have played an important role. For example, we have seen how some chroniclers conformed to the trend, demonstrating their mastery of this new innovation by showing that they spoke the same language as experts in the world of trade and finance. These findings demonstrate that the manner in which the transition occurred is not only more complex and multifaceted but also highlights the differences between experts and non-experts in accepting innovations.

158 Emigh, 'Numeracy or Enumeration?'; Klep and Stamhuis, *The Statistical Mind in a Pre-Statistical Era*; Otis, 'By the Numbers'; Chrisomalis, *Reckonings*.

159 Chrisomalis, *Reckonings*, 22–25.

In the second part, we continued by examining how chroniclers used Arabic numerals and if they started to use them more frequently, with a view to seeing to what extent there was evidence of a 'quantifying spirit'. Although the use of numerals, as opposed to words, did not increase between 1680 and 1830, the chroniclers clearly followed scholars' and practitioners' interests in the use of systematic and quantitative data. In particular, they began to add demographic data and weather-related measurements in the form of tables and lists. Chroniclers had been interested in such data before the eighteenth century, but they had not been widely available. Once local authorities and scholars began to collect and publish quantitative data in newspapers, periodicals, and other media, chroniclers soon began to use them for their own purposes.

In some way chroniclers attempted to discover new patterns based on this data, in a manner similar to that of authorities and scholars. For example, they established new patterns between environmental factors and diseases, trying to better understand the emergence and spread of epidemics. This practice was not new in itself, as we saw in the previous chapter. What changed was that from the mid-eighteenth century, historical and biblical examples were no longer used to explain epidemics. Rather they tracked the progression of disease using quantitative data. These data did not put an end to traditional explanations, however. Even as late as 1850, chroniclers interpreted epidemics as a punishment from God. The numbers merely enabled the chroniclers to better understand the message behind that punishment.

Examining the acceptance of Arabic numerals and how chroniclers used them demonstrated that this new knowledge and technology were neither simply disseminated from top to bottom, nor accepted exclusively for their unique properties. Innovations were accepted by chroniclers under various conditions, and they could have unique motivations for doing so. It demonstrates the importance of studying how and in what contexts novelty was accepted and in which contexts it took shape. Examining how new knowledge and technology were picked up by non-experts in addition to experts, forces historians to think in a more fundamental way about the complex chains of cultural translation and retranslation of knowledge. By studying this process, we are not limited to explanations for cultural change that are either top-down or bottom-up. In fact, it enables us to explain cultural change at different levels.

Conclusion

Our chroniclers witnessed a rapidly changing world. In the sixteenth and seventeenth centuries, the Southern and Northern Netherlands became a hotspot in the European economy that attracted many migrants.[1] Simultaneously, it was a period of intellectual and technological change. The traditional Aristotelian 'worldview' was gradually replaced by a mechanical worldview, thereby changing the relationship between God and the natural world.[2] The debate over these new ideas and technology was conducted across Europe, and not least in the Netherlands, which played an important role in the 'information revolution'.[3] Not only in books, but also in cheap printed materials, new knowledge became available in the form of newspapers, periodicals, and pamphlets, thus reaching an ever-growing group of literate people and exposing them to these new ideas. Yet, how this new knowledge was anchored in society, and especially among non-expert circles, remained somewhat of a mystery.

Cultural change has been explained by intellectual and socio-economic historians primarily as a top-down process. A small elite of scholars, or talented individuals who emerged as 'experts' in a certain field, made discoveries, technological inventions, and produced new knowledge. These 'better' or 'more efficient' ideas would then be accepted by the rest of society, resulting in cultural change.[4] How these ideas subsequently spread and under what conditions they were accepted by non-experts has, however, received little attention among historians, especially for the long term. Students of the Reformation, and more recently global and colonial historians, however, have shown that new knowledge was not simply disseminated in a top-down process.[5] Knowledge is created by the continuous interaction between heterogeneous actors and media, and continuously changes through complex chains of cultural translation and retranslation.[6]

Chroniclers, a heterogeneous group of upper- and middle-class authors, who were non-experts in most of the topics they wrote about, can provide insight into this process, as I have shown in this dissertation. Focussing on four different themes, I discussed, first, how we can examine and explain cultural change by using early modern chronicles, and second, how these chronicles can help us to better understand one of the key processes that underlie cultural change: the acceptance of new knowledge. In this conclusion, I will reflect on both questions and make some suggestions for further research.

1 De Vries and Van der Woude, *The First Modern Economy*.
2 Jorink, *Reading the Book of Nature*.
3 Davids, *The Rise and Decline of Dutch Technological Leadership*; Der Weduwen and Pettegree, *The Bookshop of the World*.
4 Mokyr, *A Culture of Growth*; McCloskey, *Bourgeois Equality*.
5 Judith Pollmann, 'Religious Identity in the Low Countries 1520-1650', *Pathways through Early Modern Christianities*, vol. 1 (2023), 285–89; Lässig, 'The History of Knowledge', 36.
6 Darnton, 'An Early Information Society; Lässig, 'The History of Knowledge', 43; Sarasin, 'More Than Just Another Specialty', 3.

Examining Chronicles as an 'Archive'

The Possibilities and Limitations of Chronicles

In 2016 Pollmann hypothesised that because chronicles are one of the few stable manuscript genres spanning the entire early modern period, it should be possible to use local chronicles to study cultural change over a long period.[7] During our project, Lassche has shown that the topics chroniclers wrote about largely remained the same. Kuijpers, et al., have argued that, in the course of our period, local chronicling remained popular among upper-middle and middle classes of society, even though social groups lower on the social ladder also adopted the practice.[8] In addition, this thesis shows that the purpose for which they were used remained stable as well.

Traditionally chronicles were considered as a form of historiography that aimed above all to record the history of a city or a village. Pollmann proposed that they could also be approached as collections of useful information. In this study I have shown that chronicles were indeed an important storehouse of information for their authors, and that they collected information for future use. The aim was not just to record 'memorable' events for future generations. In fact, a significant part of the information chroniclers collected was used to discover patterns. Based on these patterns, chroniclers arrived at new insights that permitted them to draw conclusions in order to better understand the events and phenomena they had experienced. By reconstructing these patterns, it became possible to investigate what chroniclers believed, how they reasoned, and under what conditions and in what form they accepted new knowledge.

However, the chronicle as a source for historical research also has some limitations. First, chronicles can be compared only on the basis of the central themes that recur through almost every chronicle. These are primarily political, religious, economical issues, and topics related to nature and climate that often had a direct impact on the lives of the authors.[9] Furthermore, it is important to note that most of the information in chronicles was written during periods of uncertainty and crisis. In relatively stable periods less was recorded. But there are other 'silences' in chronicles as well because there were also topics and information that the chronicler did not regard as 'useful' for future use. For example, and contrary to my expectations, chroniclers rarely wrote about technological changes. They hardly reflected on the introduction of the barometer or the thermometer, for example. Chroniclers mainly reflected on innovations that were controversial to them or required explanation such as the lightning rod. So, while the chronicle as a genre is relatively stable and often revisits the same topics, this does not

7 Pollmann, 'Archiving the Present', 231–52.
8 For more information on the origins, composition of the corpus, and the social profiles of the authors, see: Kuijpers et al., 'Profiling Local Chroniclers'.
9 Lassche, 'Information Dynamics', chap. 5.

mean that they recorded novelties in general, or that the same type of information was recorded every year.

A limitation that is simultaneously one of the strongest features of the genre is the variety in social profile of the authors. When a large number of chronicles are compared, it is primarily the similarities, and not the differences between the authors that stand out. Moreover, this corpus of 226 authors, covering a period of 350 years made it difficult to link reflections or explanations of the chroniclers to their social profile.[10] A much larger corpus might offer more insight based on for example, the socio-economic position, education level, profession, and region or the community a chronicler lived in. This corpus should ideally include more authors with similar social profiles, as well as a more diverse range, to determine which factors were most influential.

Yet, this corpus and study did enable us to draw some conclusions and to see that such factors are important and therefore require further investigation. Especially, in *Chapter 1*, we discussed the differences in the explanations and patterns observed by chroniclers who were 'experts' and 'non-experts' in a certain field. In *Chapters 2* and *3*, we saw that religious backgrounds play hardly any role in the way chroniclers explained meteorological phenomena and epidemics. At the same time, profession and the socio-economic position of a chronicler did influence how they explained epidemics. Moreover, we discussed the significant differences in the way chroniclers wrote about dearth in the Northern and Southern Netherlands. This means that local cultural and political factors also influence what was included in a chronicle and how the authors explained events and phenomena.

A larger, or even international, corpus could provide more insight into how certain explanations and practices are local, regional, or even 'national'. For example, to what extent the differences in the way chroniclers wrote about dearth were influenced by the role of local governments and Amsterdam's position as the granary of Western Europe, what impact the publication of mortality rates in newspapers and periodicals had on contemporaries' explanations of epidemics, or, as also addressed by Van Egeraat, to what extent explanations of meteorological phenomena, and especially 'disasters', are typically 'Netherlandish'.[11]

10 Of 30 per cent of the chroniclers we know very little about their social profile as explained in the *Introduction*.

11 Van Egeraat, '"Zoo Zij Ghesindt Waeren"', 132–53.

Studying Cultural Change through Chronicles

The Acceptance of New Knowledge and Technology

Keeping in mind the social profiles of the authors and the geographical distribution of this corpus, this study used chronicles to explain cultural change by making long-term comparisons. In *Chapter 1*, we explored what chronicles are, how authors used them for pattern recognition and subsequently reasoned with them. We saw that explanations for dearth remained fairly stable throughout the early modern period. Although famine and dearth have often been interpreted in the literature as punishments from God, this was not reflected in the entries where chroniclers wrote about their own time. According to them, extremely cold winters and epidemics were inflicted by God, but the dearth this would trigger was caused by human action. John Walter and Keith Wrightson, as early as 1976, demonstrated that it was not unusual for providential and human explanations for dearth to coexist, but surprisingly, the providential explanation for dearth is almost absent in the chronicles.[12]

A possible explanation is the 'escape from famine' in the Low Countries since the second half of the sixteenth century.[13] Because Amsterdam consolidated its position as the granary of Europe during this period, crop failures did lead to dearth, but not to famine. Chroniclers had to deal with significant price increases, but ultimately, there were hardly any structural shortages. Therefore, it was not extreme meteorological phenomena or diseases that initially caused a shortage of grain, but people who started hoarding and grain traders who took advantage of the scarcity in the eyes of the chroniclers.[14] Especially in the Southern Netherlands, chroniclers systematically recorded grain prices during periods of dearth because, on the one hand, the impact of dearth was greater there, and, on the other hand, they wanted to collect evidence against grain traders and governments.[15]

In the three subsequent chapters, I investigate under which conditions chroniclers accepted new knowledge, and how they engaged with it. In *Chapter 2*, we saw the transition of meteorological phenomena increasingly being described in terms of natural processes rather than as the result of divine intervention. This shift is characteristic of the early modern period and well known in the literature.[16] Recent studies of experts have shown that this process unfolded in a differentiated manner depending on the

12 John Walter and Keith Wrightson, 'Dearth and the Social Order in Early Modern England', *Past & Present*, no. 71 (1976): 22–42.

13 Curtis and Dijkman, 'The Escape from Famine', 229–58.

14 This has also been argued by: Hanlon, *Early Modern Italy, 1550-1800*, 101; Thompson, 'The Moral Economy', 76–136.

15 Curtis and Dijkman, 'The Escape from Famine'.

16 Walsham, *The Reformation of the Landscape*, 393; Mokyr, *A Culture of Growth*, 231; For the Dutch context, see: Buisman, *Onweer*, 84; Jorink, *Reading the Book of Nature*.

development of knowledge about the meteorological phenomenon in question.[17] This was also the case for chroniclers, especially when knowledge of the phenomenon was difficult to verify, so when knowledge remained 'untight'. For example, in the sixteenth and seventeenth centuries, comets and many other signs in the sky were interpreted as preternatural phenomena. Their meaning could be (partially) deciphered by comparing the characteristics of the phenomenon with biblical and historical examples and the context in which it occurred. It was not until comets could be predicted, and these predictions subsequently were confirmed, (i.e. once knowledge of that phenomenon became 'tight') that the belief in comets as a sign from God in relation to events on Earth disappeared.

Interestingly, when one meteorological phenomenon could be explained through natural processes, this had no impact on the religious explanations of other phenomena. The same chronicler could describe a solar eclipse in terms of mechanical or natural processes, while a comet or an extremely cold winter was interpreted as a sign or punishment from God. As long as traditional explanations were not conclusively rejected, chroniclers kept on using them to interpret specific meteorological phenomena. This resulted in a society where, until the nineteenth century, earthquakes, abnormal seasons, and to some extent lightning were mainly interpreted as the result of divine intervention, while many other meteorological phenomena were described in terms of natural processes by the same person.

In addition, we have seen that different types of explanations could also coexist for the same phenomenon. Previous historical research has already shown that various ideas and explanations coexisted for the same phenomenon in the early modern period. As long as knowledge about a subject remained 'untight', different explanations coexisted.[18] This was the case with earthquakes and abnormal seasons, but was most visible in the case of epidemics I discussed in *Chapter 3*. There we have seen how natural and religious explanations were used side by side and often complemented each other. This study has shown that also a single individual could operate on different thought systems at the same time. For example, in the middle of the nineteenth century, one and the same chronicler combined religious explanations and measures with elements from both the 'modern' (i.e. germ) and 'traditional' (i.e. miasma) theory of disease. The abandonment of 'traditional' explanations occurred primarily when knowledge became 'tight', so that they could be refuted. In other cases, they remained part of the chroniclers' toolbox to explain events and phenomena. The same individual could thus describe an epidemic in terms of natural processes from different medical theories and still be convinced that it was a punishment from God.

17 Vermij, *Thinking on Earthquakes*.
18 Mokyr, *A Culture of Growth*, 43–56; See also Vermij, *Thinking on Earthquakes*.

It may seem contradictory from a modern perspective, that different models of explanation could coexist in the mind of the same person, but this was not unique to the early modern period, as sociologists have shown.[19] The type of explanation depends on the moment and the context in which contemporaries find themselves. As suggested by Pollmann, there is no need for old ideas to disappear before new ideas are accepted.[20] We have seen that new knowledge could be accepted by non-experts, even when it was, according to experts, in conflict with other forms of knowledge. This offers historians an opportunity to investigate and rethink how new ideas were accepted and how they relate to existing ideas. As a result, and based on the examples discussed in *Chapters 2*, *3* and *4*, it appears that non-experts often do not think in 'closed' or strictly coherent systems, which explains why new knowledge about one phenomenon did not influence the explanations of the other.

So, to accept new knowledge, it was not necessary to reject or 'abandon' traditional knowledge.[21] Also new ideas and technology were not simply accepted because they were 'better' as the corpuscular theory of disease or the acceptance of the lightning rod illustrates. The late acceptance of the latter in the Netherlands has primarily been explained by the absence of a central government and the high costs. Yet also a new understanding of lightning and the technology to conduct it played an important role.[22] After Benjamin Franklin had demonstrated that lightning consisted of electricity, it took almost a century before chronicles reflect this knowledge. At the end of the eighteenth century, chroniclers still wrote that lighting consisted of fire, and only in the nineteenth century did a chronicler wonder if it was made of electricity.

Contemporary experts, such as Krayenhoff, were aware of the late acceptance and wrote that non-experts did not have easy access to new knowledge on electricity. Moreover, there already was a convincing explanation for lightning as the Voice of God, for which chroniclers could find evidence in Scripture and during sermons. Only after seeing that the conductor worked in combination with an understanding that lightning consists of electricity, did chroniclers accept the lightning rod as a useful instrument. Like the acceptance of elements from the corpuscular, and germ theory of disease, the example of the lightning rod shows that *content* bias played a more important role in the acceptance of new knowledge among non-experts than previously thought.[23] Chroniclers did not blindly follow the example of others, or what was written in the media. In that case *frequency-dependent* bias should have played a significant role and have enabled

19 Swidler, *Talk of Love*, 94.

20 Pollmann, *Memory in Early Modern Europe*, chap 2, Conclusion.

21 According to Becker, it was necessary for the philosophers to first reject contradictory traditional knowledge before new knowledge could be accepted. See: Carl Becker, *The Heavenly City of the Eighteenth-Century Philosophers* (New Haven, 1932), 131.

22 Buisman, *Onweer*, 51–53.

23 Richerson and Boyd, *Not by Genes Alone,* 205; Mokyr, *A Culture of Growth*, 282.

acceptance. However, for the chroniclers in this corpus it was important to see and understand how things worked before they accepted them.

In *Chapter 4,* by contrast, we discussed a topic in which *frequency-dependent* bias played an important role. While Arabic numerals enabled 'experts' to make more complex calculations in a simpler way, this feature was not important for non-experts. This conclusion confirms what Chrisomalis argued by providing empirical evidence.[24] As a result, the explanation that Arabic numerals became dominant in the seventeenth century because of their unique properties enabling one to perform complex computations is only part of the story. In the sixteenth century, chroniclers initially adapted Roman numerals to calculate with them but eventually replaced them with Arabic numerals.

In addition to the feature of written arithmetic, historians have pointed to external factors to explain the acceptance of Arabic numerals such as the rise of capitalism, the printing press, and growing literacy, as factors which standardised Arabic numerals as the new way to represent numbers. In this view, early moderns were thus 'dragged along' into using them, similar to the implementation of metric system that we discussed in the *Introduction*. Yet, by studying the process of 'dragging along' instead of the outcome, as addressed by Chrisomalis, it appears that the motives of the chroniclers in accepting new knowledge could significantly differ. This means that it is not only important to study which biases were at work, but the process and the motivations underlying the biases in studying the acceptance of new knowledge.[25]

In the second part of *Chapter 4*, I discussed how chroniclers used Arabic numerals, and asked whether they, like 'experts', developed a 'quantifying spirit', or interest in measurements and statistical analysis.[26] Although the use of numbers did not increase in relative terms, we did see an interest in systematic quantitative data in the form of tables and lists from the 1730s onwards. This coincided with the publication of temperature measurements, mortality figures, and other health and population figures in printed media. In the same period, chroniclers began to explain epidemics in a new way, as we have seen in *Chapter 3*.

Until the first half of the eighteenth century, epidemics were interpreted based on a mix of contemporary, historical and biblical analogies, while from the second half of the eighteenth century, the development of diseases in the author's own time became central to chroniclers' accounts. Moreover, chroniclers used these quantitative data to observe new patterns, such as the influence of climate, seasons and weather on the spread of diseases. However, this did not cause providential explanations to disappear; on the contrary, these figures enabled chroniclers to make more accurate comparisons

24 Chrisomalis, Reckonings, chaps 1–4.
25 Ibid., 115.
26 Klep, 'A Historical Perspective on Statistics', 19.

between different events and phenomena, thereby gaining a better understanding of divine providence.[27]

Chronicles and Cultural Evolution Theory

Based on these results, what have the local chronicles taught us, what have we learned about the processes underlying cultural change? Like Mokyr, I used models from cultural-evolution theory as proposed by Richerson and Boyd. They explain cultural change on a population level mainly through *indirect* biases, in which *frequency-dependant* bias plays a prominent role.[28] This is based on the idea that imitating a common cultural trait is 'to save on information costs by assuming that others have already tested the new cultural variant and found it acceptable.'[29] New knowledge, discovered and developed by 'experts', would in this way also spread among 'non-experts'. This assumption is particularly based on the (supposed) absence of direct comparisons between traditional and new knowledge among non-experts. When historians of science, for example, studied the acceptance of new ideas among 'experts', they often observed many metanotational comparisons, which involve people looking at the two systems and giving explicit comparisons. However, such comparisons are rare among the population at large, which made scholars suspect that not *content* bias, but *frequency-dependent* bias was at play.[30]

For many innovations, this may have been the case, as we also saw with the acceptance of Arabic numerals. But when chroniclers considered new knowledge about meteorological phenomena and epidemics, *content* bias also played an important role. As a result, chroniclers were much more critical in their acceptance of new ideas than one might expect. New and 'superior' ideas were not automatically accepted just because they were 'better', nor did chroniclers blindly follow the 'experts' who knew better. In most of the topics discussed in this study, chroniclers evaluated new ideas themselves, before accepting them.

In other words, the adoption of new knowledge is not a straightforward process that can be explained based on a small group of 'cultural entrepreneurs'. Its spread is a dynamic process shaped by continuous interaction at various levels of society. Cultural-evolution theory has the tools to study cultural change, but it can benefit from the insight of historians of knowledge to study the circulation of knowledge in society.

27 Hobart, *The Great Rift*.
28 Boyd and Richerson, *Culture and the Evolutionary Process*; Richerson and Boyd, *Not by Genes Alone*, 120, 205; Mokyr, *A Culture of Growth*, 120.
29 Mokyr, *A Culture of Growth*, 52.
30 Chrisomalis, *Reckonings*, 92.

Although additional research is required, on the basis of these chronicles, we can come to some conclusions on the conditions for the acceptance of new knowledge. It seems that new explanations that had an impact on existing explanations and were tied to fundamental cultural beliefs were mainly accepted based on *content* bias. A new 'natural' explanation had an impact on existing providential explanations, as we have seen with comets, lightning, and epidemics. In these cases, chroniclers accepted a new explanation only when they understood themselves that the explanation was 'more accurate'. Still, existing explanations were then preserved or adjusted as much as possible unless they could be refuted. For technological inventions, this was to a lesser extent the case, as we have seen with the acceptance of Arabic numerals. That case confirms the theory of Richerson and Boyd and the observations of Mokyr that *frequency-dependent* bias played a more prominent role. Although not discussed in detail, this was also the case for the acceptance of thermometers and barometers.[31]

Future Research and Final Remarks

With this study, I hope to have convinced readers that to study cultural change in the early modern period, chronicles can be an important source. Although this study is written from the perspective of non-experts in this specific genre, the added value of the chronicle for the history of knowledge would be even more decisive were this source to be combined with others. This study consisted mainly of comparing and analysing under which conditions (new) information was 'archived' in a chronicle, how chroniclers used that information to produce knowledge, and how that changed over a long period. Yet, a more fundamental understanding of cultural change, and more specifically of the acceptance of new knowledge could be achieved by also thoroughly examining the work of 'experts' and with more attention for the changing information landscape. For example, to study changing explanations of epidemics, one should ideally study the work of preachers, medical practitioners, government communication, and the media landscape in conjunction with texts by non-experts. In this way, it becomes possible to execute the agenda and the promises of the history of knowledge: To investigate the complex chains of cultural translation and retranslation of knowledge, and to explain cultural change at different levels in society.[32]

Additionally, more research could be done on the genre of chronicles itself. Beyond the changing media landscape addressed in Lassche's dissertation and the topics in this dissertation, one of the most prominent subjects in early modern chronicles awaits exploration. This is the changing political landscape. Research into how chroniclers

31 For research on the use and acceptance of the barometer by 'experts' and 'non-experts', see: Golinski, *British Weather*, chap. 4.

32 Lässig, 'The History of Knowledge', 43.

dealt with political changes, such as wars, crises, and regime changes, could lead to new insights into the changing political landscape, which might even be useful for the twenty-first century. This approach would not only enrich our understanding of historical perspectives, but could also offer parallels and contrasts with contemporary political dynamics.

In addition to demonstrating the value of chronicles for historical research, I hope to have shown how valuable chronicles can be in understanding events and phenomena in the present as well. Three months after starting this study, we were faced with the COVID-19 pandemic, which coincided with the writing of my chapter on epidemics. Climate change and meteorological disasters, such as droughts and floods, have been prominent in the news throughout the year, and 2023 was the warmest year on Earth ever recorded. Following the aftermath of COVID-19, there was a period of unprecedented inflation, just at the moment I was writing about periods of dearth. Over the past four years as I wrote this dissertation, we faced events and phenomena very similar to those that early modern chroniclers experienced and recorded. Studying how people from many walks of life tried to grasp a changing world may not remove today's challenges, but it might put them into perspective and possibly offer ways to cope with them.

Appendices

Appendix 1. Occupational Categories[1]

	Occupational categories	Number of chroniclers	%	% per category
1	Town secretaries and notaries	19	8,3%	
	Councillors and Lawyers	10	4,4%	
	Tax collectors and bookkeepers	10	4,4%	
	Civic administration	7	3,1%	
	Stewards	3	1,3%	21,4%
2	Clergy, monastics, ministers	29	12,7%	
	Education	4	1,7%	
	Physicians	1	0,4%	14,8%
3	Gentry and rentiers	3	1,3%	
	Military	3	1,3%	2,6%
4	Merchants	13	5,7%	
	Crafts and Trades	34	14,8%	
	Recordkeepers and writers for private companies	3	1,3%	
	Lower civic offices	6	2,6%	24,5%
5	Farmers	13	5,7%	
	Labourers	2	0,9%	6,6%
	Unknown	69	30,1%	30,1%
	TOTAL	229	100,0%	

1 For more information on the data compilation, see: Kuijpers et al., 'Profiling Local Chroniclers'.

Appendix 2. Overview of the Corpus[2]

	(Modern) provinces	Authors	Chronicles	Volumes	Number of words	Percentage of words
Northern Netherlands	Friesland	19	17	20	2.384.613	11%
	Gelderland	8	7	7	200.999	1%
	Groningen	6	6	6	858.873	4%
	Limburg	17	15	16	601.766	3%
	Noord-Brabant	12	12	13	570.555	3%
	Noord-Holland	40	38	49	2.760.167	12%
	Overijssel	11	8	8	404.160	2%
	Utrecht	10	8	8	273.464	1%
	Zeeland	8	8	8	256.747	1%
	Zuid-Holland	16	13	23	1.295.386	6%
	Total North	147	132	158	9.606.730	43%
Southern Netherlands	Antwerpen	19	18	32	1.837.532	8%
	Brussel	10	9	11	937.153	4%
	Limburg (Belgium)	4	4	4	129.176	1%
	Oost-Vlaanderen	23	19	44	3.764.231	17%
	Vlaams-Brabant	8	7	21	2.705.458	12%
	West-Vlaanderen	15	15	38	3.592.840	16%
	Total South	79	72	150	12.966.390	57%
Full corpus		226	204	308	22.573.120	100%

2 Ibid.

Appendix 3. Search terms: Dearth

* The asterisk is a wildcard that allows for searching for all possible suffixes following the prefix.

Dierte*, diertij*, duurt*, honger*, hongher*, gebre*, ghebre*, dier, diere, schaers*, rijsing*, rees*, prijs*, prys*, graan*, rogg*, duyr*, durent*, dieren, dierde, dyer*, dierste, dueren, Dierte*, diertij*, duurt*, honger*, hongher*, gebre*, ghebre*, dier, diere, schaers*, rijsing*, rees*, prijs*, prys*, graan*, rogg*, duyr*, durent*, dieren, dierde, dyer*, dierste, dueren, dierent*, duir, benaude, coorn*, Dierte*, diertij*, duurt*, honger*, hongher*, gebre*, ghebre*, dier, diere, schaers*, rijsing*, rees*, prijs*, prys*, graan*, rogg*, duyr*, durent*, dieren, dierde, dyer*, dierste, dueren, dierent*, duir, duerte, corens, schaers, benaude, coorn*, *guld*, stuver*, stuy*, stuij*, penn*, ƒ, ₣, haver, havere, lb, gr, terwe, gerst, ertten, haver, korn, vruchten, croonen, cronen, st., reaal, ducat*, corn*, coern*, eyer*, stuiver*, pond*, rog, graen, boeckweyt, eijer*, boter*, coeren, suyvel, tarwe, tbroot, bueter*, cooren, garst, schellyn*, ghers*, broot*, duer*, botter, kees, broet, herinck, koeren, daler, koren, granen, Rinsgl*, terwe, gelt, schelling*, dubbeltj*, boeckw*, Boucw*, graen*, Bouckw*, haever, schellij*, Taruwe, dur, oortien, pont, schelinghen, orten, armoed*, coren, gerste, geld, koorn, duijren, duuren, tarw, dirte, aerdappel*, aardap*, taruw, boekweyt, centen, boekwey, erwten, boekweij, rasier*, rassier*, cooren*, stvr*, tpont, stver, tcoor*, boecheijt, boeckeijt, maut, taerwen, borring, gouden, reael, ducaet*, taerwe, diers*, *guld*, stuv*, florijn*, pennin*, ƒ, ₣, ryns*, rijns*, lb, sterl*, cronen, kronen, penning*, pennijn*, pond*, oort*, grooten vlaems

Appendix 4. Transcription Christiaan Munters[3]

fol. 80 [recto]
Vicesima septembris svrydaechs in dy quatertemper woert een van myns genedighs heeren jongen den steen gesneden van eenen meester van Luyck in Jan Beckers huys te Cueringhen, ich heb den steen in myn hant gehadt, hy was grootgelyck een cleyn boen, ende dese jongen sterff hiervan, ich had hem dy sacramenten geadministreert.

Den xxii septembris op kermis Hasselt dach was te Hasselt het huysken van Bethleem van een gehouwen van ii oft iii boeven binnen Hasselt, daer waert een van gevangen.

Den xxiiii septembris te nieuw marckt golt corn tot Hasselt xi st.

Den xxv septembris is te Hasselt een manspersoen van Brie doot gevallen van synen bed, sy vondentem smorgens op syn hooft ende was doot, hij was droncken slaepen gegaen.

fol. 80 vo.
Den xxvii septembris galt corn tot Hasselt xii st.

Item den xxixsten septembris schoot myn heer van Luyck te Cueringhen op dy bergen dry schoet met den voetboege ende ginck te Lenarts van Herkenroy bancketeeren.
Prima octobris op eenen densdach trock myn heer van Bueren van Cueringhen met vrou Mari den coninck van Vranckryck besoeken met xv hondert peerdt.

Sint Truyen

Septima octobris op eenen maendach ontfinck ons alder genedichste biscop van Luyck, her Cornelis van Sevenberghen Sint Truyen, ende in dy incoempst van myn heer stroeyde myn heer gelt, want een keyserlycke stadt is, item dy van Sinttruyen schenckden myn heer een stuck wyns van vi aemen, dy aem costen xx brabants gulden.

Borchloen ende Tongeren

Nona octobris op Sinte Dyonysdach ontfinck myn heer van Luyck Borchloen ende Tongeren, dy van Tongeren hadden op dy merckt gemaect vii bergen, te weeten Mons Syon,Mons Tabor, Mons Calvarie ende dy van Tongeren hadden groten prys van myn heer.

fol. 81 [recto]
Hoey

Decima octobris ontfinck ons genedighe heer Hoey.
Item der coninck van Vrankryck heeft vrou Mari ende myn heer van Bueren ende myn heer van Esselsteyn zeer grote chier aengedaen ende ontfinckse met groter lieffde ende triumphen, het cosde den coninck van Vranckryck deese besueckinge

3 Munters, *Dagboek van gebeurtenissen*, 95–98.

alle daech iiii hondertich duysent ducaten ende het doerde xxv daegen.

Decima tertia octobris op eenen sondach woert te Zuylre een hersteken.

Den xxii octobris galt corn tot Hasselt xiii st. i ort.

fol. 81 vo.
xii novembris galt corn tot Hasselt xiiii st. i ort.

Op den dach voersc. heeft der stathelder van Diepenbeeck eenen hersteken dy myns heeren van Gaveren bastart dochter had ende hy was principael stathelder, sy waeren allen beyde te peerde.

Item deese weeck is te Diepenbeeck een knecht gestorven den syn moder alsoe geslaegen had dat hy daervan sterff, ende sy suster hiel hem, ende dit quam by om eens verkens wil, deese knecht bedroech synder moder ende synder suster in syn doot.

Item deese weeck is by Antwerpen een van Borchloen doot gevallen van synen peerde.

Int Haspegouw syn deesen saettyt soe veel muys geweest dat dy wennen vanden coern moesten dwater met waegelen vueren in dy velden om dy muysen te verdrencken, ende dy muys hedden theel coern affgeten wt dy velden soe dat dy wennen geen coern en vonden.

fol. 82 [recto]
Maeseyck
Decimaseptima novembris op een sondach ontfinck ons genedighe heer Maeseyck ende dy van Maeseyck hadden grote eer van myns heeren genaede.

Op den dach voersc. woert te Tongeren een hersteken.

fol. 82 vo.
Brie
Octava decembris ipsa die conceptionis dive Marie semper Virginis que erat dies dominica ontfinck ons alder genedichste heer Brie.

Het oester coern

In deese maent van december quam in tlant van Luyck veel oester coerns daert volck zeer aff verblyt was, want het coern vanden lande van Luyck zeer qualyck te crygen was doer den dieren tyt.

Appendix 5. Weekly price of grain as recorded by Justus Billet (volumes 2-12)

Date	Wheat min in stivers per meuken	Wheat max in stivers per meuken	Rye min in stivers per meuken	Rye max in stivers per meuken	Buckwheat in *schellingen* per *'sack'*
09-09-1661	33	35	20	21	13
16-09-1661	36	37	21	22	14
23-09-1661	38	40	21,5	22,5	15
30-09-1661	38	40	20	22	15
07-10-1661	36	38,5	19,5	21	15
14-10-1661	35	37	19	21	15
21-10-1661	36	38	20,5	21,5	16
29-10-1661	37	39	23,5	24,5	18
04-11-1661	38	40	21,5	22,5	18
11-11-1661			19,5	21	16
18-11-1661			20	21,5	18
25-11-1661			21,5	22,5	18
02-12-1661			22	23	18
09-12-1661			23	24	18
16-12-1661			23,5	24,5	19
23-12-1661	34	36	23	25	19
30-12-1661	35	39	25	26,5	
07-01-1662			22	23,5	21
13-01-1662	33	35	23	23	20
20-01-1662	33	38	23	24	21
27-01-1662	33	36	22	23,5	22
03-02-1662	33	37	21,5	23,5	21
10-02-1662			21	22,5	23
17-02-1662			23,5	24,5	23
25-02-1662			22	25	23
03-03-1662			22	25	23
10-03-1662	35	37	23,5	24,5	24
17-03-1662	39	40	25	25	24
24-03-1662	39	40	24,5	25,5	
31-03-1662	39	40	25	26,5	23
07-04-1662	39	42	26	27	24
14-04-1662	41	44	32	33	26
21-04-1662	37		27,5	28	25
28-04-1662			27	29	25
05-05-1662			28	28	26
12-05-1662			26,5	27,5	26
26-05-1662	34	35	27	27,5	
02-06-1662	34	35	28	28	
09-06-1662	33	37	29,5	30	24
16-06-1662	33	37	29,5	30	24
23-06-1662	33	37	29,5	30	24
30-06-1662			32,5	33	24

Date	Wheat min in stivers per meuken	Wheat max in stivers per meuken	Rye min in stivers per meuken	Rye max in stivers per meuken	Buckwheat in *schellingen* per *'sack'*
07-07-1662			25	26	24
14-07-1662	33	38	28	29	
21-07-1662	38	40	26	26	27
28-07-1662	37	41	25	26	
04-08-1662	38	39	25	25	28
11-08-1662	29	30	19	20	
18-08-1662	30	33	17	18	19
25-08-1662	28	32	19	19,5	
01-09-1662	28	33	18	19	16
19-01-1663	24	27	17	18	
26-01-1663	24	27	17	18	
03-02-1663	24	26	16,5	17,5	
13-02-1663	24	26	16,5	17,5	
21-02-1663					
02-03-1663					
09-03-1663	24	26	16,5	17,5	
23-03-1663	23	28	15	16	
06-04-1663			15,5	16	
13-04-1663					
27-04-1663			16	16,5	
04-05-1663			16	17	
11-05-1663			19,5	20	
25-05-1663	24	27	16,5	17,5	
01-06-1663	24	27	17	17,5	
08-06-1663	24	27	17	17,5	
22-06-1663	25	30	18	19	
30-06-1663	25	29	18,5	19,5	
06-07-1663	25	29	18	19	
20-07-1663	25	29	18	19	
27-07-1663	25	29	16,5	16,5	14
03-08-1663			18	18	
10-08-1663	27	30	14	14,5	
17-08-1663	30	31	14,5	15	
25-08-1663	27	29	13,5	14,5	
31-08-1663	23	26	13	13,5	14
07-09-1663	23	26	12,5	14	14
14-09-1663	25	29	13	14	
22-09-1663	22	27	15	15	13
28-09-1663	22	27	14	15	
05-10-1663	23	27	14,5	15	
12-10-1663	28	29	15	15	
19-10-1663	28	29	15	16	
26-10-1663	27	28	16	17	
02-11-1663	29	29	15,5	16	13

Date	Wheat min in stivers per meuken	Wheat max in stivers per meuken	Rye min in stivers per meuken	Rye max in stivers per meuken	Buckwheat in *schellingen* per *'sack'*
09-11-1663	27	27	15	15	
16-11-1663	25	29	15	15	14
01-12-1663	25	29	15	15	
07-12-1663					
14-12-1663	27	31	15	15	
22-12-1663					
29-12-1664			15	15	
04-01-1664			15	15	15,5
11-01-1664			15	15	15
18-01-1664					
25-01-1664					14
01-02-1664	23	26	13	13	
08-02-1664			14	14	
22-02-1664			13	13,5	
07-03-1664	22	26	13	13	
14-03-1664	22	26	12	13	
21-03-1664	22	26	13	13	
28-03-1664			13,5	14	
04-04-1664	22	28	13	13,5	
11-04-1664	22	28	13	13,5	
18-04-1664					
16-05-1664	24	28	14,5	15	
23-05-1664			14,5	14,5	
30-05-1664			13,5	14	
06-06-1664	23	27	13,5	14	
13-06-1664	23	27	13	13,5	
20-06-1664					
27-06-1664	25	27	12	12	
04-07-1664	21	26	11	11	13
11-07-1664	21	26	11	11	13
18-07-1664	22	27	11,5	12	
26-07-1664	25	26	12	12,5	
01-08-1664	24	25	11	11	
08-08-1664	23	24	10	10,5	
16-08-1664	24	25	11	11	
29-08-1664	20	24	10	10	
05-09-1664	20	24	10	10	
12-09-1664	20	24	10	10,5	
19-09-1664	25	26	11	11	
26-09-1664	20	25	10	11	
03-10-1664	18	26	8	8,5	10
10-10-1664	17	26	10	11	10
17-10-1664	21	25	10	11	
24-10-1664	18	19	10	10	

Date	Wheat min in stivers per meuken	Wheat max in stivers per meuken	Rye min in stivers per meuken	Rye max in stivers per meuken	Buckwheat in *schellingen* per *'sack'*
07-11-1664	17	24	11	11	
14-11-1664	17	24	11	11	
21-11-1664	16	20	9	9,5	
28-11-1664			10	11	
05-12-1664	17	20	10	10	
19-12-1664	19	22	10	10	
16-01-1665	19	20,5	11	11	12
23-01-1665	18	18			
30-01-1665	18	18			
06-02-1665	17	20	10	10	11
13-02-1665	18	21	9	9,5	11
20-02-1665	18	21	9	9,5	11
27-02-1665	18	21	9	9,5	11
06-03-1665	20	23	10	10,5	
13-03-1665	20	21	9	10	
20-03-1665	16	18	10	10	
27-03-1665	18	22	11	11	
03-04-1665	18	22	9	9,5	12
10-04-1665	20	24	10	10	12
17-04-1665	20	24	10	10	12
24-04-1665	19	24	9	10	12
02-05-1665	20	24	11	11	
08-05-1665	20	24	11	11	
15-05-1665	20	25	11	11,5	
22-05-1665	20	26	11	12	
29-05-1665	21	25	9	10	
05-06-1665	20	25	11,5	12	
12-06-1665	20	25	12	12,5	
19-06-1665	20	25	12	12,5	
26-06-1665	22	26	12	12	
03-07-1665	25	26	10	10,5	
10-07-1665	24	25	9	9,5	
17-07-1665	23	24	9,5	10,25	12
24-07-1665			10	10,5	12
31-07-1665	24	26	10	10,5	
07-08-1665	22	22,5	12	12	
14-08-1665	21	25	11	11	13
21-08-1665	19	23	9	9	
28-08-1665					
04-09-1665	16	21	9	10	10
11-09-1665	17	22	10	10,5	11
18-09-1665	17	22	11	11,5	9
20-09-1665	19	23	11	12	10
02-10-1665	17	22	11	11,5	10

Date	Wheat min in stivers per meuken	Wheat max in stivers per meuken	Rye min in stivers per meuken	Rye max in stivers per meuken	Buckwheat in *schellingen* per *'sack'*
09-10-1665	17	22	11	11	10
18-10-1665	17	22	10	11	10
23-10-1665	18	23	10	11	
30-10-1665	17	20	10	11,25	6
06-11-1665					
13-11-1665	17	21	10,5	11	
20-11-1665	17	21	9	9,5	9
04-12-1665					
11-12-1665					
18-12-1665	16	21	10	10,5	10
24-12-1665	14	20	10	10	10
02-01-1666	15	20	10	11	11
08-01-1666	14	19	10	10	11
15-01-1666					11
22-01-1666	15	19	10	10,5	11
29-01-1666	15	19	10	10	
05-02-1666	14,5	19	10	10	11
12-02-1666					
19-02-1666	14	18	10	10	11
26-02-1666	14	18	9,5	10	10
12-03-1666	14	18	9,5	10	10
19-03-1666	14	18	9,5	10	10
26-03-1666	14	18	9,5	10	10
02-04-1666	14,5	18	9	10	
09-04-1666	13,5	18	9,5	10	
16-04-1666	14	18	9,5	10	12
23-04-1666	14	18	9,5	10	12
03-05-1666					
07-05-1666					12
13-05-1666	14	19	9,5	10	13
21-05-1666	14	19	9,5	10	14
28-05-1666	14	19	9,5	10	
11-06-1666	14	17	9,5	10	12
26-06-1666	14	18	9	9,5	12
02-07-1666	14	17	8	8,5	12
09-07-1666	13,5	17	8,25	8,5	11
16-07-1666	14	18	8,5	8,5	
23-07-1666	14	17,5	9	9	
06-08-1666	14	17	8,5	9	11
13-08-1666	14	17,5	8,5	8,5	
20-08-1666	14	18	8	8,5	11
27-08-1666	13	16	7,5	8	11
02-09-1666	14	15	7	7,5	12
10-09-1666	13	17	7	7,5	11

Date	Wheat min in stivers per meuken	Wheat max in stivers per meuken	Rye min in stivers per meuken	Rye max in stivers per meuken	Buckwheat in *schellingen* per *'sack'*
17-09-1666	13	17	8	9	10
24-09-1666	13	17	9,5	10	10
01-10-1666	13	17	9	10	
08-10-1666	14	18	9	10	10
15-10-1666	15	18	8	9	10
22-10-1666	15	17	9	9	10
29-10-1666	14,5	18	9	9	10
05-11-1666	14,5	18	8,5	9	10
12-11-1666	13	17	8,5	9	11
19-11-1666	16	17	8	8,5	
26-11-1666	14	15	9	9	10
03-12-1666	13	17	8	8,5	10
10-12-1666					
17-12-1666	14,5	17	9		11

Appendix 6. Search terms: Meteorology

* The asterisk is a wildcard that allows for searching for all possible suffixes following the prefix.

aardbeving*, aardbeeving*, aerdbeving*, aerdbeeving*, comeet*, comet, Komeet*, staart*, staert*, sterre*, Bliksem*, Blix*, Blikz*, Donder, Donderbu*, dondersla*, donderde*, Regen, Wind*, hagel*, storm*, lucht*, lugt, lugth, lugten, locht, vorst, warm*, winter*, lente*, sneeuw, somer*, zomer*, semer, seemer, herfst*, koud*, coud*, sturm*, reeyn, blyxie, heet*, donre, blyxy, reghen, caude, wint, *eclips*, ghesneeut, drooch, sneeuwe, eerdtbevinghe, eclipsiale, gedondert, gheblixomt, wijnt, eertbevinghe, aertbevinghen, eertbevingh*, stertsterren, tempeest, couwe, geblixemt, gesneeuwt, werlijchte, snuwen, regennen, doenderdedt, werlijchtet, wienter, onweer, Cometen, Comete, sprinck, droochte, reegen, starre, ecclips, Aard-beving, Commeet, Orcaan, orkaan, aerdt bevinge, aerdtbevinge, regende, aartbeginge, aartbevinge, Aartbevinge, aertbeving, aartbevingh, lugtverscheinsel, gevrooren, gevroren, geweerligt, geregend, geesel, nasomer, soomer, weeder, droogte, springvloed*, ramp*, clypsis, springvloet, innundeer*, guur weer, zneeuw, eertbeevinge, Commete, gereegent, stromwindt, ijssel, vierpijl, vriesen, watervloedt, verduystering, vriest, Weerligt, Baromeeter, barometer, manomeeter, Barrom*, Termometer, Manomr, weerligt, Star, aerd beving, Watervloeden, haegelsteenen, gedonderd, gehageld, regenachtig, gevrosen, overstrooming*, weerglazen, nevel, overstroming*, Waterberoert*, Aerbeving*, Waeterberoert*, vroor, wolke-breuk, regen*, *regens, waternood, vloed, deinzig, borometr, onweder, Gurig, Watervloed, Vriez*, Vloeden, Weerlicht, mist, regen*, sneuw, artbevinghe, haeghel, aertbevinghe, orcaen*, storemwint, tempest, aertbeving*, misachtig, onweeder, Farehenheit, onderweder, Roumuer, aertbeveynge, weyntter, kalt, kalde, herbevynghe, vuurige kloot, *verduistering, Noorderlicht, Mars, luchtverschijnsel, wolkbreuk, Regulus, planet*, Venus, Jupiter, natuurverschijnzel, geëclipseerd, meteoor, weerlichten, donderen, sprinckvloet, Reghen*, haghel, ghereghent, aerd'bevinghe, ghehaegelt, geregent, aerdebevinghe, haegel, Reaumur, *winden, vuurbal, stert sterre, ligtigheit, vloedt, springtydt, voorst, snee, donre, blyxhye, aertbevinge, steere, borometr

Appendix 7. Meteorological Phenomena

Meteorological phenomena	Entries
Lightning & Storms	773
Cold Winter	590
(Extreme) rain	251
(Strong) wind	235
Drought	190
Comets	160
Earthquakes	156
Flood & Spring tide	100
Snow	88
Other	74
Hail	60
Abnormal seasons	59
Eclipse	53
Good weather	44
Signs in the Sky	39
Aurora	31
Hurricane	27
Total	**2930**

Appendix 8. Search terms: Epidemics

* The asterisk is a wildcard that allows for searching for all possible suffixes following the prefix.

Pest, Siec*, *Ziec*, *ziek*, Siek*, Pokken*, Koorts*, Koortz*, Besmet*, sect*, cranc*, *pock*, contasieus*, sickt*, cholera, geesel, Contagieuse, sieckte, besmettelijke, siekte, pestsiekte, ongebeterde, kindersiekte, medicamenten, buijckloop, heete Cortse, rundvee, sterfte, Curiergijn, podegra, geswel, koors, gal, geinflameert, inflamatie, verstikt, bewaanthijt, ontsteeking, verderfinge, ijle koors, Bloetspuiging, Curiergijn, Seer Heete, Blus koors, besmettelyke, *koorts*, ader, Chirurgijn, runt-vee, verkoudheyt, coorsen, beroerte, cholera, medicinal*, remedie*, sterft*, Macharius, oculist, Corts*, Sterf*, Starf*, Storf*, Steerf*, Staerf, syckheyt, louppenden buyck, plage, syeckheyt, poeck*, syeck*, perstylencietyt, pleurit*, haestelyck, vlime, *pokjen*, *pocxken*, Medicijn, Medecijn, stroowis*, Stroewich, cancker*, fledercijn*, smettelic*, roemelesoen, coers, zycte*, perste, rootmelos*, bloetloop, plerensis, *melisoen*, bloetgan*, krankte, galsiekte, Jigt, Watersugt, waater sugt, Teering, pleuris, aaderlatinge, medisijne, waatersugt, rode loop, rotkoortz*, catharal*, inflamatoir*, roode loop, galkoort*, influenz*, geelzigt, waterzugt, dysentaria, roodvon*, borstkwa*, buikwee, Roodvonk, Rochus, Infectie, roo loop, Pluris*, Stikzingen, Galkoor*, Roodhond*, rotte kortse, dyssenterie, Contagiense, grip, griep, scheurbuijk, verkaudhijd, buykloop, rooden loop, inent*, vacci*, kinderpoekxkens, kinderpokskens, Kinderpocxkens, Kinderpokjens, roodenloop, kortsen, Dysenteria, Rooije Loop, Grauwe Loop, pokskens, buikloop, Colera, Epidemi*, kinderpokken, schorbut, scheurbuik, waterkanker, kinkhoest, verkoudheid, tongblaar, gevaccineerd, Fluensa, Grijp, geinfecteert, longzu*, bloed-sug*, melizoen, inocu*, Epidimike, perste, Medicijn, Medecijn, contagieuse, Remedie, Secten, camerganch

Appendix 9. Search terms: Roman Numerals

* The asterisk is a wildcard that allows for searching for all possible suffixes following the prefix.

*vi, *xv*, *iii*, *mc*, iv*, vii, *xl*, *xi*, ix, *xxx*, lx*, *ccc*

Appendix 10. Subset annotated corpus of chronicles

Period per 30 years	Number of chronicles
(1500-1530)	2
(1530-1560)	1
(1560-1590)	15
(1590-1620)	5
(1620-1650)	9
(1650-1680)	8
(1680-1710)	5
(1710-1740)	7
(1740-1770)	15
(1770-1800)	20
(1800-1830)	20
(1830-1860)	10
Total	**117**

Bibliography

Chronicles Corpus

This is an overview of the entire corpus. Because we were still transcribing at the time of writing, I could not use all the chronicles. An 'x' stands for the chronicles I have studied. A highlighted '**X**' means that there were also results that I analysed for chapters 1, 2 and 3. For chapter 4, the 'x' means that I used them calculate the relative frequency of Arabic numerals in the chronicles. The highlighted '**X**' means that I also used them to investigate whether Roman or Arabic numerals were used.

Chronicles (308 volumes)	Ch.1	Ch.2	Ch.3	Ch.4
Anonymous. 'Aenteeckeningen van de Waere ende Naeckte Beschryvinge van de Troubels ende beroertens voorgevallen binnen de Princelijk stadt Brussel, beginnende met den jaere 1717 ende eyndigende met den jaere 1719, waerin gehandelt wort van de droeve ende lanckbeclachde doodt van Franciscus Anneessens Borger ende Deken der voors. Stadt'. Stadsarchief Brussel. ASB Archives historiques, Registre 3350.		**X**	**X**	
———. Antwerpsch chronykje, in het welk zeer veele en elders te vergeefsch gezogte geschiedenissen sedert den jare 1500 tot het jaar 1574 zoo in die toen ... vermaarde koopstad als de andere steden van Nederland. Edited by Frans van Mieris and Gerard van Loon. Leiden, 1743. DBNL.	**X**	**X**	**X**	
———. 'Antwerpsche Kronijk, 1685-1721'. Felixarchief, Antwerpen. Pk. 119.	**X**	**X**	**X**	**X**
———. 'Beschrijvinge van de opkomste, gelegentheyt en den naem. van den lande van Waes'. Koninklijke Bibliotheek België, Brussels. Hs II. 3617.				
———. 'Beschrivinge van Vlissinge - uijt verscheide Schrivers bij een - vergaderd'. Private, Roelof van Gelder.	**X**	**X**	**X**	
———. 'Beschryvinge der stad Rotterdam mitsgaders geschiedenissen zoo binnen de stad als elders voorgevallen, van den jare 1426 tot den jare 1690". Stadsarchief Rotterdam. 33.01. Afschrift uit het einde der 17e eeuw'. Handschriftenverzameling inv.no. 1577.	**X**	**X**	**X**	**X**
———. 'Chronijk der landen van Overmaas en aangrenzende gewesten door eenen inwoner van Beek'. Edited by Jos Habets. *Publications de la Société Historique et Archéologique dans le Limbourg*, 1870, 11–197.	**X**	**X**	**X**	**X**
———. 'Chronijk van Maestricht tot 1719'. Historisch Centrum Limburg, Maastricht. 18.A Handschriftencollectie (voormalig) Rijksarchief Limburg, 13e-20e eeuw, inv.no. 404.	**X**	**X**	**X**	**X**
———. 'Chronique de Bruxelles'. Koninklijke Bibliotheek België, Brussels, Ms 14896-98.				
———. 'Chronique d'Ypres, contenant le récit des évènements, qui s'y sont passés à l'époque des troubles religieux (1567- 1587)'. Koninklijke Bibliotheek België, Brussels. Merghelynck 140.	**X**	**X**	**X**	**X**
———. 'Chronycke van Waes, et le chiffre couronné de Léopold 1er'. Koninklijke Bibliotheek België, Brussels. Hs 19157.	**X**		**X**	
———. 'Chronyk van Maestrigt, 1750-1800'. Historisch Centrum Limburg, Maastricht. 22.001A. Handschriftencollectie GAM, inv.no. 653.	**X**	**X**	**X**	**X**
———. 'Chronyke van Bethanien'. Stadsarchief Mechelen. EE Kronieken en Jaarboeken XXVI 1.	**X**	**X**	**X**	**X**
———. 'Chronyken der principaelste geschiedenissen, voorgevallen tenteyde der fransche republieq'. Koninklijke Bibliotheek België, Brussels. Hs 5881.	**X**	**X**	**X**	**X**

Chronicles (308 volumes)	Ch.1	Ch.2	Ch.3	Ch.4
———. 'Cronijk van Brabant en Vlaenderen. II'. Stadsarchief Brussel. ASB Archives historiques, Registre 2925.	X	X	X	X
———. 'Dagverhaal'. Edited by Wim Knoops. *De Schatkamer*, 2011, 33.	X		X	X
———. 'Dagverhaal van de gebeurtenissen te Franeker'. Tresoar Leeuwarden. 332-04 Familie Telting. inv.no. 112.	X	X	X	
———. De kroniek van het St.-Geertruiklooster te 's-Hertogenbosch. Den Bosch, 1699. DBNL.	X	X	X	X
———. 'De vermaerde ende wonderlycke Geschiedenissen der prinselycke Stadt van Brussel'. Stadsarchief Brussel. ASB Archives historiques, Registre 3107.	X	X		X
———. 'Een cort begrijp van de fondatie ende oprichtinghe des Cloosters van Onse Lieve Vrouwe in Bethania, hoe dat eertijts is opgeboudt geweest, buyten de stadtvesten van Mechelen, tusschen Deghem poort ende dWinket; met noch lofweerdighen ghedenckenisse van allen Beneficien, gratien ende donatien van Godtvruchtighe persoonen t'selve Godtshuys uut besondere affectie ende liefde bewesen, ende daerbij oock waerachtighe verhalinghe van alle Prioors, Comissarissen, Rectoors, Priorinnen, Capellanen oft Socios, van alle Religieusen Nonnekens, ende Wercksusterkens met naem ende toenamen. Ende al wat daer tusschen bijden is gepasseert binnen den selven Convente soo van Ordonnatien, Statuten, Concessien, Previlegien, Visitatien, ende andere Veranderinghen, neerstelijck bij een vergadert doer de Religieusen van tselve Clooster, etc.' 3. Stadsarchief Mechelen. EE Kronieken en Jaarboeken XXIX 1.				
———. 'Een dagboek uit het "rampjaar" 1672'. Edited by J.F. Gebhard. *Bijdragen en mededeelingen van het Historisch Genootschap, (gevestigd te Utrecht)* 8 (1885): 45–116.	X	X	X	X
———. 'Een Zierikzeese kroniek (693-1473)'. Edited by J.G. Smit. *Kroniek van het land van de zeemeermin (Schouwen-Duiveland)* 16 (1991): 21–40.	X	X	X	
———. 'Historien oft kort verhael van eenige gedenckweirdige gebeurtenissen van 't beginsel des weirelts'. Stadsarchief Leuven. Oud Archief Ms. 50 bis.	X	X	X	X
———. 'Kroniek der stad Gent, 1569-1579'. Universiteitsbibliotheek Gent. Boekentoren, BHSL.HS.3344.				
———. 'Kroniek, getiteld: Memoriael, 1243 - 1776', Rijksarchief Hasselt. 581. Abdij van Rotem in Halen, inv.no. 2.	X			
———. 'Kroniek van Gent, 1301-1568'. Universiteitsbibliotheek Gent. Boekentoren, BHSL.HS.2489.	X			X
———. 'Kroniek van Gent, 1538-1542'. Universiteitsbibliotheek Gent. Boekentoren, BHSL.HS.2340.	X			X
———. 'Kroniek van het Sint-Elisabethsconvent te Huissen (1667-1752 en 1782-1801)'. Translated by Historische Kring Huessen. Huissen, DBNL	X	X	X	X
———. 'Kroniek van Ieper, 180-1695, met talrijke legendarische of anecdotische onderdelen'. Universiteitsbibliotheek Gent. Boekentoren, BHSL.HS.0616/ MICRO.				
———. 'Kroniek van Maastricht 1236-1758'. Historisch Centrum Limburg, Maastricht. 22.001A. Handschriftencollectie GAM, inv.no. 192.	X	X	X	X
———. Kroniekje van een Ommelander boer in de zestiende eeuw. Edited by W. Bergsma and E.H. Waterbolk. Groningen: Wolters-Noordhoff; Forsten, 1986. DBNL	X	X	X	X
———. 'Kroniekje van Groningen, uit de 16de eeuw'. Edited by W. Zuidema. *Bijdragen en Mededelingen van het Historisch Genootschap* 12 (1889): 93–181.	X	X	X	X
———. 'Kronijk van het jaar 1725'. Felixarchief, Antwerpen. PK 124.	X	X	X	X

Chronicles (308 volumes)	Ch.1	Ch.2	Ch.3	Ch.4
———. 'Kronijke van Gend waer by gevoegt is twee sermoenen op de sotheyt der weerelts den intre ende de dood der biscoppen van Gend ende eenige raetsels', vol. 1. Universiteitsbibliotheek Gent. Boekentoren, BIB.G.019834.	X	X	X	X
———. 'Kronijke van Gend waer by gevoegt is twee sermoenen op de sotheyt der weerelts den intre ende de dood der biscoppen van Gend ende eenige raetsels', vol. 2. Universiteitsbibliotheek Gent. Boekentoren, BIB.G.019834.	X	X	X	X
———. 'Memorye. Kroniek van godsdienstige en politieke twisten in Alkmaar, 1618-1621'. Translated by Transcriptiewerkgroep Regionaal Archief Alkmaar. DBNL.			X	X
———. 'Merkwaerdige geschiedenis van het land van Waes'. Koninklijke Bibliotheek België, Brussels. Hs II. 3616.				
———. 'Narratio rerum Silvaducessium'. Stadsarchief Den Bosch.	X	X	X	X
———. 'Opmerkingen van eenige zaeken in de stad Brussel voorgevallen'. Stadsarchief Brussel. ASB Archives historiques, Registre 3106.	X	X		
———. 'Oudtheden ofte Chronychsche jaerboek der prinselijcke Stadt Brussel bijeen vergaedert uijt verscheijde schrijvers der stadt Brussel door eenen liefhebber van het vaderlandt'. Stadsarchief Brussel. ASB Archives historiques, Registre 2959B.	X	X	X	X
———. 'Utrechtse kroniek over 1566-1576'. Edited by H. Brugmans. *Bijdragen en Mededelingen van het Historisch Genootschap* 25 (1904): 1–258.	X	X	X	X
———. 'Verhaal van het beleg van het kasteel Vredenburg te Utrecht in 1576, door eenen ooggetuige'. Edited by Samuel Fzn Muller. *Bijdragen en Mededelingen van het Historisch Genootschap* 6 (1883): 147–216.	X		X	X
———. 'Vervolg op de kroniek van Hoorn van D. Velius, tweede deel 1795-1806 en 1800-1838'. Translated by D.C.A. Abbing. Noord Hollands Archief, Haarlem. 176. Losse Aanwinsten (verkregen tot 1984) 1545.			X	
———, and Anonymous. 'Chronijk (van Maastricht)'. Historisch Centrum Limburg, Maastricht. 22.001A. Handschriftencollectie GAM, inv.no. 119.	X	X	X	X
———, and Ludovicus Loyens. 'Manuscripta wegens de stad Maestricht de anno 998 usque anno 1742'. Historisch Centrum Limburg, Maastricht. 22.001A. Handschriftencollectie GAM, inv.no. 197	X	X	X	X
———, P.T. Picolet, and Jan Gerritsz Waerschut. 'Kronijk, inhoudende den opgang en voortgang van de scheepryke wijdvermaarde Koopstad Rotterdam, beschreven door Jan Gerritsz. van Waarschut, bakker overleden int jaar 1623. Met een vervolgh tot het jaar 1663". Afschrift eerste kwart 18e eeuw'. Stadsarchief Rotterdam. 33.01. Handschriftenverzameling, inv.no. 1555.	X	X	X	X
———, and H. S. 'Vervolg op de kroniek van Hoorn van D. Velius, eerste deel tot 1794'. Translated by D.C.A. Abbing. Hoorn, 1794. Noord Hollands Archief, Haarlem. 176. Losse Aanwinsten (verkregen tot 1984) 1544.	X	X	X	X
Anonymous, and Philippus van de Maele. 'Chronycke van Cortryck'. Rijksarchief Kortrijk. Fonds Goethals-Vercruysse, ms. 215.	X	X	X	X
———, and Jan Gerritsz Waerschut. 'Kroniek van Rotterdam'. Stadsarchief Rotterdam. 33.01. Handschriftenverzameling inv.no. 1552.	X	X	X	X
Aarssen, Jan van. 'De principaelste geschiedenissen voorgevallen binnen Antwerpen sedert 1794, 15 maert tot 16 maert 1796, beschreven door Jan van Aarssen, stoofmaker en koperslager op de Steenhoudersvest te Antwerpen'. Felixarchief, Antwerpen. Pk. 123.	X	X	X	X

Chronicles (308 volumes)	Ch.1	Ch.2	Ch.3	Ch.4
Ackersdijk, Willem Cornelis. 'Kronyk der Hoofdstad 's Hertogenbosch. Inhoudende allerlei merkwaardige zaaken, binnen die stad en eenige in derselver meijerij voorgevallen, of daartoe betreklijk. Aanvang neemende met den jaare 1780. Ten tijde van derzelver gebeurtenis naaukeurig binnen voorzeide stad aan, geteekend door Mr. Willem. Corn: Ackersdijck. 1e stuk.' Universiteitsbibliotheek Tilburg. KHS D154.	X	X	X	
———. 'Kronyk der Hoofdstad 's Hertogenbosch. Inhoudende allerleie merkwaardige zaaken, binnen die stad en eenige in derzelver meijereij voorgevallen, of daartoe betrekkelijk aanvang neemende met den jaare 1790. Ten tijde van derzelver gebeurtenis naaukeurig binnen voorzeide stad aangeteekend door Mr Willem Corn: Ackersdijck. 2e stuk.' Universiteitsbibliotheek Tilburg. KHS D155.	X	X	X	
Alfen, H., ed. Kroniek eener kloosterzuster van het voormalig Bossche klooster 'Mariënburg' over de troebelen te 's-Hertogenbosch e.e. in de jaren 1566-1575. Uitgave van het Provinciaal Genootschap van Kunsten en Wetenschappen in Noord-Brabant. 's Hertogenbosch, 1931. DBNL.	X			X
Allertsz, Jan, and Jansz, Cornelis. Rotterdamse kroniek: aantekeningen van Rotterdamse stadssecretarissen, 1315-1499 (1570). Edited by H. ten Boom and J. van Herwaarden. 1981. DBNL.	X	X	X	X
Alting, Egbert. Diarium van Egbert Alting, 1553-1594. Edited by W.J. Formsma. Den Haag, 1964.	X	X	X	X
Baake, Nicolaas Johannes. 'Journaal van 1802 tot 1813 door N.J. Baake'. Gemeentearchief van 's-Gravenhage. Ov.Verz. H s. 373.	X	X	X	X
Baerntsz, Claes. 'Kort verhaal der gedenckwaerdijgste gheschiedenissen van Westvrieslant'. Noord Hollands Archief, Haarlem. 176. Losse Aanwinsten (verkregen tot 1984) 1530.			X	X
Bakker, Symon. 'Kroniek van Broek in Waterland over de jaren 1282-1818, samengesteld door Symon Bakker, 19e eeuw'. Noord Hollands Archief, Haarlem. 176. Collectie van losse Aanwinsten (verkregen tot 1984) van het Noord-Hollands Archief te Haarlem, 14.1.3.2, inv.no. 1534.	X	X	X	X
Barnaart junior, Jacobus. 'Dagverhaal van merkwaardige voorvallen aangetekend door Jacobus Barnaart Junior te Haarlem, 1747-49'. DBNL.	X	X	X	X
Baten, Guillame. 'Oudheden 1510-1643'. Felixarchief, Antwerpen. Pk. 113.	X	X	X	X
Beeftingh, Josua van. 'Een Rotterdamsch Gedenkschrift uit den patriottentijd en de dagen der revolutie'. *Bijdragen en Mededelingen van het Historisch Genootschap* 31, no. Lintum, C. te (1910): 97–231.	X	X	X	
Beer, Jan Baptist de. 'Kroniekje van Tilburg over 1774-1854'. Regionaal Archief Tilburg. 338. Collectie handschriften Tilburg, inv.no. 1.	X	X	X	X
Beer, J.G. de. 'Korte kronijk door Zacheus J.G. De Beer, 1739-1816'. Noord Hollands Archief, Haarlem. 3295. Archief Oudemannenhuis, inv.no. 45.	X	X	X	X
———. 'Kronyk van Spaarndam'. Noord Hollands Archief, Haarlem. 3295. Archief Oudemannenhuis, inv.no. 45.	X	X	X	
Beringen, Sebastiaan van. 'Kronijke der Stad Roermond beginnende met de komst van keizer Joseph II en eindigende met de troonsbeklimming van Leopold I, koning der Belgen (1781-1831)'. Edited by J. Habets. *Publications de la société historique et archéologique dans le Limbourg* 2 (1865): 370–416.	X			X
Betouw, Johannes in de. Vervolg der Kronijk van Nijmegen, tot den jare 1818. Edited by C.J. van (Nijmegen) Goor en zoon. Nijmegen: C.J. van Goor & zoon, 1818. DBNL.	X	X	X	X

Chronicles (308 volumes)	Ch.1	Ch.2	Ch.3	Ch.4
Biesten, Hendrik van. 'Anteykeningen, gedaen van Broer Hendrik van Biesten, Orateur van de Minnebroeders binnen Amsterdam, op de nijeuwe mare en geschiedenis, dat geschiet is binnen en omtrent Amsterdam, sedert den jaere 1534 tot den jaere 1567; getrouwelijc gecomponiert'. Edited by Joseph Alberdingh Thijm. *De Dietsche warande*, no. 7 (1866): 519–50.	X	X	X	X
Bikker, Jakob Raye. 'Notietie van het merkwaardigste meijn bekent dat in het jaar 1732 binnen Amsterdam is voorgevallen. 1733, 1734, 1735, 1736, 1737, 1738, 1739.' Stadsarchief Amsterdam. Bibliotheek 15030/3551.	X	X	X	X
Billet, Justus. 'De cleene ofte corte chronycke van Dhr. Justo Billet, begrypende in forme van eenen register … van saecken principalick gheschiet binnen de Stadt van Ghendt, midtgaders van eenighe steden van Vlaendren, van Duytslandt … tot den jaere 1564. In twee volumen, waer naer noch dry andere sullen volghen, eyndende met de jaere 1666, deel 1'. Stadsarchief Gent. 529. Bibliotheek 1LF2 and GSA1.	X	X	X	X
———. 'De cleene ofte corte chronycke van Dhr. Justo Billet, begrypende in forme van eenen register … van saecken principalick gheschiet binnen de Stadt van Ghendt, midtgaders van eenighe steden van Vlaendren, van Duytslandt … tot den jaere 1564. In twee volumen, waer naer noch dry andere sullen volghen, eyndende met de jaere 1666, deel 2'. Stadsarchief Gent. 529. Bibliotheek 1LF2 and GSA1.	X			X
———. 'De cleene ofte corte chronycke van Dhr. Justo Billet, begrypende in forme van eenen register … van saecken principalick gheschiet binnen de Stadt van Ghendt, midtgaders van eenighe steden van Vlaendren, van Duytslandt … tot den jaere 1564. In twee volumen, waer naer noch dry andere sullen volghen, eyndende met de jaere 1666, deel 3'. Stadsarchief Gent. 529. Bibliotheek 1LF2 and GSA1.	X			X
———. 'De cleene ofte corte chronycke van Dhr. Justo Billet, begrypende in forme van eenen register … van saecken principalick gheschiet binnen de Stadt van Ghendt, midtgaders van eenighe steden van Vlaendren, van Duytslandt … tot den jaere 1564. In twee volumen, waer naer noch dry andere sullen volghen, eyndende met de jaere 1666, deel 5'. Stadsarchief Gent. 529. Bibliotheek 1LF2 and GSA1.	X	X	X	X
———. 'De cleene ofte corte chronycke van Dhr. Justo Billet, begrypende in forme van eenen register … van saecken principalick gheschiet binnen de Stadt van Ghendt, midtgaders van eenighe steden van Vlaendren, van Duytslandt … tot den jaere 1564. In twee volumen, waer naer noch dry andere sullen volghen, eyndende met de jaere 1666, deel 6'. Stadsarchief Gent. 529. Bibliotheek 1LF2 and GSA1.	X			X
———. 'Den polytye boeck, … beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 1'. Stadsarchief Gent. 529. Bibliotheek 1LF2 and GSA1.	X			X
———. 'Den polytye boeck, … beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 2'. Stadsarchief Gent. 529. Bibliotheek 1LF2 and GSA1.	X	X	X	X
———. 'Den polytye boeck, … beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 3'. Stadsarchief Gent. 529. Bibliotheek 1LF2 and GSA1.	X			X
———. 'Den polytye boeck, … beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 4'. Stadsarchief Gent. 529. Bibliotheek 1LF2 and GSA1.	X	X	X	X
———. 'Den polytye boeck, … beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 5'. Stadsarchief Gent. 529. Bibliotheek 1LF2 and GSA1.	X	X	X	X
———. 'Den polytye boeck, … beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 6'. Stadsarchief Gent. 529. Bibliotheek 1LF2 and GSA1.	X			X

Chronicles (308 volumes)	Ch.1	Ch.2	Ch.3	Ch.4
———. 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 7'. Stadsarchief Gent. 529. Bibliotheek 1LF2 and GSA1.	X	X	X	X
———. 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 8'. Stadsarchief Gent. 529. Bibliotheek 1LF2 and GSA1.	X	X	X	X
———. 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 9'. Stadsarchief Gent. 529. Bibliotheek 1LF2 and GSA1.	X		X	X
———. 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 10'. Stadsarchief Gent. 529. Bibliotheek 1LF2 and GSA1.	X		X	X
———. 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 11'. Stadsarchief Gent. 529. Bibliotheek 1LF2 and GSA1.	X	X	X	X
———. 'Den polytye boeck, ... beginnende den 22sten augusto in tjaer ons heeren 1658 (1658-1668) deel 12'. Stadsarchief Gent. 529. Bibliotheek 1LF2 and GSA1.	X			X
Boer, Jan de. 'Chronologische Historie van het geen is Voorgevallen, by de komste van Willem Karel Hendrik Friso. Prince van Oranie &ct... Door den Schrijver dezes. Jan de Boer, 1747 en vervolg'. DBNL.			X	X
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Samenvatting

Historisch onderzoek naar de acceptatie van nieuwe kennis en technologie heeft zich voornamelijk gericht op 'experts'. Hoewel deze geleerden, uitvinders en ondernemers 'betere' kennis of technologie ontwikkelden, betekent dit niet dat dit door de rest van de samenleving zonder meer werd overgenomen. Het succes van nieuwe kennis en technologie hangt ook af van sociale en culturele factoren. Deze veranderen in de loop van de tijd en verschillen zowel tussen als binnen culturen. Dit proefschrift heeft als doel beter te begrijpen hoe dergelijke processen van culturele verandering werkten in de Lage Landen tussen 1500 en 1850.

De vroegmoderne Lage Landen vormen om verschillende redenen een interessante casestudy. Het gebied stond bekend om zijn sterke verstedelijking en hoge geletterdheid, waar veel kennis werd geproduceerd en geconsumeerd tijdens de 'informatierevolutie'. Bovendien ontwikkelde het gebied zich in twee afzonderlijke staten met elk een eigen politieke en religieuze signatuur. Hierdoor leent deze regio zich goed voor vergelijkend onderzoek en is het mogelijk de invloed van religie en politieke structuur op de acceptatie van nieuwe kennis en technologie te bestuderen.

Om te onderzoeken hoe nieuwe ideeën zich buiten de kring van experts verspreidden en onder welke voorwaarden ze door de samenleving werden geaccepteerd, heb ik de acceptatie van nieuwe kennis onder ‘niet-experts’ bestudeerd. Deze geletterde groep van (hogere) middenklasse mannen en enkele vrouwen gebruikte lokale kronieken om informatie te verzamelen en te 'archiveren' die zij zowel gedenkwaardig als relevant vonden. Dit manuscriptgenre was bedoeld om bruikbaar te zijn voor familieleden, buren, medeburgers en toekomstige generaties. Dit betekent dat een kroniek niet alleen een nuttige verzameling van kennis was voor de auteur, maar ook voor de bredere gemeenschap. Door 204 kronieken te vergelijken die zijn verzameld, gedigitaliseerd en getranscribeerd in het kader van het onderzoeksproject *Chronicling Novelty: New knowledge in the Netherlands, 1500-1850*, heb ik het genre als een lens gebruikt om verschillende sociaal-culturele aspecten van de midden- en hogere klasse van de vroegmoderne samenleving te bestuderen.

Door de bevindingen uit de kronieken te analyseren aan de hand van concepten uit de kennisgeschiedenis, antropologie en culturele evolutietheorie, onderzoekt dit proefschrift een nieuwe manier om de verspreiding en interactie van nieuwe kennis en technologie in de vroegmoderne periode te bestuderen. In plaats van te veronderstellen dat vooral het handelen van een intellectuele elite culturele verandering teweegbracht, geeft dit onderzoek ook een stem aan de midden- en hogere klasse van de samenleving. Het toont aan dat zij niet noodzakelijkerwijs in de voetsporen traden van een kleine minderheid – die ook wel ‘cultural entrepreneurs’ worden genoemd – wanneer nieuwe of 'betere' kennis beschikbaar kwam. Sterker nog, deze studie laat zien hoe kroniekschrijvers nadachten over nieuwe kennis en technologie, en onder welke voorwaarden zij geneigd waren deze te accepteren.

Dit wordt onderzocht door vier onderwerpen te bespreken die een significante impact hadden op het dagelijks leven van vroegmoderne mensen en waardoor kroniekschrijvers werden gestimuleerd om informatie over deze onderwerpen te verzamelen, patronen te ontdekken en kennis te produceren. Met uitzondering van politieke en religieuze gebeurtenissen zijn duurte, epidemieën en meteorologische fenomenen de drie onderwerpen waarover kroniekschrijvers het meest schreven.

Het eerste hoofdstuk bespreekt hoe en onder welke voorwaarden kroniekschrijvers begonnen met het verzamelen van prijzen en andere relevante informatie. Dit hoofdstuk heeft als doel mijn methodologie uiteen te zetten en aan te tonen dat kronieken meer zijn dan slechts een verzameling van alledaagse of gedenkwaardige gebeurtenissen. Het laat zien dat veel kroniekschrijvers hun kroniek gebruikten om op basis van de informatie die ze vastlegden patronen te ontdekken. Vervolgens kwamen zij tot nieuwe inzichten op basis van deze patronen en konden zij daaruit conclusies trekken. Bovendien toont dit hoofdstuk aan dat verklaringen voor duurte vrij stabiel bleven gedurende de vroegmoderne periode, maar dat er significante verschillen waren in de manier waarop kroniekschrijvers uit de Noordelijke en Zuidelijke Nederlanden over dit onderwerp schreven.

In de overige drie hoofdstukken onderzoek ik onder welke voorwaarden kroniekschrijvers nieuwe kennis accepteerden en hoe ze ermee omgingen. In hoofdstuk 2 wordt dit proces onderzocht aan de hand van verschillende meteorologische fenomenen. Enerzijds bevestigt dit hoofdstuk het beeld dat meteorologische verschijnselen steeds meer werden beschreven in termen van natuurlijke processen, in plaats van het resultaat van goddelijke interventie. Anderzijds betoog ik dat dit geen lineair proces was, maar dat dit proces zich voor elk meteorologisch fenomeen op een unieke wijze voltrok. Zo wordt verklaard waarom het verschijnen van kometen eerder als een natuurlijk fenomeen werd beschreven dan aardbevingen, afwijkende seizoenen en bliksem. Deze laatste categorie werd tenminste tot de tweede helft van de achttiende eeuw door kroniekschrijvers geïnterpreteerd als een teken van goddelijke interventie.

In hoofdstuk 3 wordt vervolgens besproken hoe kroniekschrijvers meerdere verklaringen naast elkaar gebruikten om epidemieën te verklaren. In tegenstelling tot sommige meteorologische fenomenen leidde de acceptatie van nieuwe kennis over epidemieën in deze periode niet tot het verdwijnen van traditionele verklaringen. Religieuze en verschillende soorten natuurlijke verklaringen werden niet alleen naast elkaar gebruikt, maar ook in combinatie. Dit hoofdstuk toont aan hoe kroniekschrijvers elementen uit verschillende kennissystemen tegelijk konden gebruiken door bijvoorbeeld religieuze verklaringen en gebruiken te combineren met elementen uit zowel de 'moderne' kiemtheorie als de 'traditionele' humorenleer van ziekte.

Het laatste hoofdstuk onderzoekt het gebruik van Romeinse en Arabische cijfers. Het bespreekt de verschillende motieven die niet-experts mogelijkerwijs hadden voor het

accepteren van een innovatie zoals een nieuw cijfersysteem, en toont aan dat Arabische cijfers in eerste instantie niet werden gebruikt vanwege hun unieke eigenschappen om complexe berekeningen uit te voeren. In de zestiende eeuw werden Romeinse cijfers in eerste instantie aangepast door kroniekschrijvers om ermee te kunnen rekenen. De opkomst van het kapitalisme, het gebruik van de drukpers en de toenemende geletterdheid speelden dan ook voor velen een belangrijkere rol bij de acceptatie van Arabische cijfers dan de manier waarop ermee gerekend kon worden.

In het tweede deel van dit hoofdstuk wordt besproken wat kroniekschrijvers vervolgens deden met deze 'nieuwe' Arabische cijfers. Hoewel het gebruik van getallen procentueel nauwelijks toenam, was er vanaf de jaren 1730 een groeiende interesse in het structureren van cijfers in de vorm van lijstjes en tabellen. Dit viel samen met het verschijnen van temperatuurmetingen, sterftecijfers en andere gezondheids- en bevolkingsstatistieken in gedrukte media. Kroniekschrijvers gebruikten deze data om nieuwe patronen te ontdekken, zoals de invloed van het klimaat, de seizoenen en het weer op de verspreiding van ziekten. Dit leidde overigens niet tot het verdwijnen van providentiële verklaringen; integendeel, deze cijfers stelden kroniekschrijvers in staat om nauwkeurigere vergelijkingen te maken tussen verschillende gebeurtenissen en fenomenen, waardoor ze een beter begrip kregen van goddelijke voorzienigheid.

Uit de vier hoofdstukken blijkt dat niet-experts veel kritischer stonden tegenover de acceptatie van nieuwe ideeën dan meestal wordt gedacht. Nieuwe ideeën werden niet vanzelfsprekend geaccepteerd omdat ze 'beter' waren. Bovendien volgden kroniekschrijvers niet blindelings de experts die het beter wisten. Voor de meeste onderwerpen die in dit proefschrift worden besproken, probeerden kroniekschrijvers zelf de nieuwe ideeën te begrijpen voordat ze deze accepteerden. In tegenstelling tot de acceptatie van nieuwe technologie, geldt dit met name voor nieuwe kennis die invloed had op culturele overtuigingen van de kroniekschrijver.

De adoptie van nieuwe kennis is dus geen eenvoudig proces dat kan worden verklaard op basis van een kleine groep 'experts'. De verspreiding ervan is een dynamisch proces dat wordt gevormd door voortdurende interactie op verschillende niveaus van de samenleving. Deze studie toont aan dat de culturele evolutietheorie de instrumenten biedt om culturele verandering op het niveau van de bredere samenleving te bestuderen, maar kan profiteren van de inzichten van kennishistorici om de circulatie van kennis in de samenleving te onderzoeken. Naast de wetenschappelijke bijdragen die dit proefschrift levert, biedt het ook een inkijk in hoe mensen uit verschillende lagen van de vroegmoderne samenleving crisissen ervoeren en daarmee probeerden om te gaan. Het zal geen antwoord bieden op de maatschappelijke uitdagingen van de eenentwintigste eeuw, maar kan wel een nieuw perspectief bieden op hoe de verklaringen van niet-experts kunnen worden geïnterpreteerd wanneer zij worden geconfronteerd met periodes van crisis, innovatie en een veranderende wereld.

Summary

Historical research on the acceptance of new knowledge and technology has focussed primarily on 'experts'. Although these scholars, practitioners, entrepreneurs, and engineers developed better or more accurate knowledge or technology, this does not mean that it was willingly appropriated by the rest of society. The success of new knowledge and technology also depends on socio-cultural factors, which change over time, and differ between cultures and groups within them. This dissertation aims to better understand how such processes of cultural change worked in the Low Countries between 1500 and 1850.

The early modern Low Countries are an interesting case study for various reasons. They were known as a highly urbanised and exceptionally literate hub for the production and consumption of new knowledge and technology during the 'information revolution'. Moreover, they evolved politically into states with quite different religious and political regimes, which means that they lend themselves to comparison, making it possible to study the impact of these changing regimes on the conditions on the acceptance of new knowledge and technology.

As a result, the early modern Low Countries offer a window to examine how new ideas spread beyond expert circles, and under which conditions they were accepted by society at large. In order to do so I have studied the spread of new knowledge among 'non-experts'. This literate group of (upper-) middle-class men, and some women, used local chronicles to collect and 'archive' information that they deemed both memorable and useful. This manuscript genre was designed to be useful to family members, neighbours, fellow citizens, and future generations. This means that chronicles were written about and usually for a wider community than the 'individualist self'. By comparing 204 chronicles that were collected, digitised, and transcribed in the context of a team project entitled, *Chronicling novelty. New knowledge in the Netherlands, 1500-1850*, it became possible to use the genre as a lens to study various socio-cultural aspects from the middle and upper class of early modern society.

By approaching the chronicles with the conceptual apparatus of the history of knowledge and anthropological theories about cultural evolution, this study explores a new way to study the circulation of, and engagement with, knowledge in the early modern period. Instead of arguing that the actions of an intellectual minority caused cultural change, this study also gives a voice and agency to the (upper-) middle-class of society. It demonstrates that they were not necessarily dragged along when new or 'better' knowledge became available. In fact, this study shows how chroniclers reflected upon new knowledge and technology, and under which conditions they were inclined to accept it.

It will do so by examining four topics that had a significant impact on people's daily lives and consequently encouraged chroniclers to collect information on these topics, to discover patterns and produce knowledge. With the exception of political and religious events, the first three topics chroniclers wrote about the most were dearth, epidemics,

meteorological phenomena, ensuring that as many chronicles as possible were used while making comparisons. The fourth topic concerned every chronicler and examines the new ways chroniclers used numerals in their lives.

The first chapter examines how and under which conditions chroniclers started to record prices and other relevant information. It aims to put my methodology into practice and to demonstrate that chronicles are more than just collections of 'trivial' data, or 'memorable' events. Many chroniclers used the information they recorded to discover patterns, to arrive at new insights based on these patterns and to draw conclusions from them. This chapter demonstrates that explanations for dearth remained fairly stable throughout the early modern period, yet there were significant differences in the way chroniclers from the Northern and Southern Netherlands wrote about dearth.

In the three subsequent chapters, I investigate under which conditions chroniclers accepted new knowledge, and how they engaged with it. In Chapter 2, this process is explored through various meteorological phenomena. It shows, characteristic to the early modern period, that meteorological phenomena were increasingly being described in terms of natural processes rather than as the result of divine intervention. Yet, it will argue that it occurred in a differentiated manner, and explains why earthquakes, seasonal anomalies and lightning were predominantly perceived as divine providence until the second half of the eighteenth century.

Chapter 3 focusses on how chroniclers used multiple explanations side by side to explain epidemics. Unlike the case of some meteorological phenomena, the acceptance of new knowledge on epidemics did not lead to the disappearance of traditional explanations. Religious and several types of natural explanations were used not only alongside each other, but also in combination. This chapter demonstrates how individuals could operate on different thought systems at the same time by combining for example religious explanations and measures with elements from both the 'modern' (i.e. germ) and 'traditional' (i.e. miasma) theory of disease.

The final chapter addresses the use of Roman and Hindu-Arabic numerals, and the replacement of the former by the latter. It discusses the different motives non-experts may have had for accepting an innovation such as a new numeral system, and demonstrates that in first instance Arabic numerals did not became dominant because of their unique properties to perform complex computations. In the sixteenth century, chroniclers initially adapted Roman numerals to calculate with them. For non-experts, not their unique properties, but external factors such as the rise of capitalism, the printing press, and growing literacy, explains why Arabic numerals became the new way to represent numbers.

The second half of this chapter demonstrates the consequences and possibilities the use of Arabic numerals offered. Although the use of numbers did not increase in relative terms, there was an increasing interest in systematic quantitative data in the

form of tables and lists from the 1730s onwards. This coincided with the publication of temperature measurements, mortality figures, and other health and population figures in printed media. Chroniclers used these quantitative data to observe new patterns, such as the influence of climate, seasons and weather on the spread of diseases. However, this did not cause providential explanations to disappear; on the contrary, these figures enabled chroniclers to make more accurate comparisons between different events and phenomena, thereby gaining a better understanding of divine providence.

From the four chapters it will appear that non-experts (e.g. chroniclers), were much more critical in their acceptance of new ideas than one might expect. New and 'superior' ideas were not automatically accepted just because they were 'better', nor did chroniclers blindly follow the 'experts' who knew better. In most of the topics discussed in this study, chroniclers evaluated new ideas themselves, before accepting them. Yet it seems that this was more applicable to new knowledge that had an impact on cultural beliefs, than for the acceptance of new technology.

In other words, the adoption of new knowledge is not a straightforward process that can be explained based on a small group of 'cultural entrepreneurs'. Its spread is a dynamic process shaped by continuous interaction at various levels of society. This study shows that cultural-evolution theory has the tools to study cultural change bottom up, but it can benefit from the insight of historians of knowledge to study the circulation of knowledge in society. Besides the scholarly contributions this dissertation has to offer, it also provides a glimpse of how people from many walks of life tried to understand the crises they encountered in the early modern period. It will not provide an answer to twenty-first century challenges, but it might offer a new perspective on how to interpret the explanations of non-experts facing, crises, new knowledge, and cultural change.

Curriculum Vitae

Theo Dekker was born in Bovenkarspel, the Netherlands, in 1992. He obtained his bachelor's degree in History at the University of Amsterdam in 2015. Subsequently, he pursued a Research Master's in History at the same university, followed by a Research Master's in History and Philosophy of Science at Utrecht University, and a Master's in Teaching Social Sciences and Humanities in Secondary Education—completing three Master's degrees between 2015 and 2019.

In September 2019, Theo began working as a PhD candidate on the project *Chronicling Novelty: New Knowledge in the Netherlands 1500–1850* at Leiden University. During his PhD trajectory, he was a member of the Huizinga Research Institute and Graduate School of Cultural History. He completed courses on Research into Cultural History and Scientific Integrity and served as chair and PhD representative for the Institute of History at Leiden University.

He presented his work at several conferences, including the Renaissance Society of America Conference, the European Association for Urban History, and the European Association for the History of Medicine and Health, where he received the Pieter van Foreest Student Prize for the best paper.

Since the summer of 2024, Theo has been working as a strategy consultant for various municipalities in the province of North Holland.