



# Calamitous knowledge: Disaster research in the British, French and Spanish Atlantic worlds, c.1605-1755

## Citation

Gerdelan, Louis Desmond. 2021. Calamitous knowledge: Disaster research in the British, French and Spanish Atlantic worlds, c.1605-1755. Doctoral dissertation, Harvard University Graduate School of Arts and Sciences.

## Permanent link

<https://nrs.harvard.edu/URN-3:HUL.INSTREPOS:37368515>

## Terms of Use

This article was downloaded from Harvard University's DASH repository, and is made available under the terms and conditions applicable to Other Posted Material, as set forth at <http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-of-use#LAA>

## Share Your Story

The Harvard community has made this article openly available.  
Please share how this access benefits you. [Submit a story](#).

[Accessibility](#)

HARVARD UNIVERSITY  
Graduate School of Arts and Sciences



DISSERTATION ACCEPTANCE CERTIFICATE

The undersigned, appointed by the

Department of History

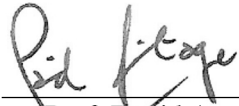
have examined a dissertation entitled

**Calamitous knowledge: Disaster research in the British, French and Spanish Atlantic worlds,  
c.1605-1755**

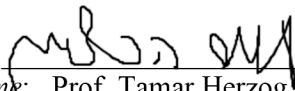
presented by

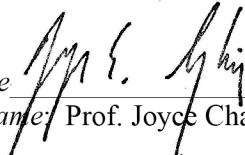
Louis Gerdelan


candidate for the degree of Doctor of Philosophy and hereby  
certify that it is worthy of acceptance.

Signature   
Typed name: Prof. David Armitage

Signature   
Typed name: Prof. Ann Blair

Signature   
Typed name: Prof. Tamar Herzog

Signature   
Typed Name: Prof. Joyce Chaplin

Signature   
Typed Name: Prof. Alexandra Walsham

April 9<sup>th</sup>, 2021

Calamitous knowledge: Disaster research in the British, French and Spanish Atlantic  
worlds, c.1605-1755

A dissertation presented

by

Louis Gerdelan

to

the Department of History

in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

in the subject of

History

Harvard University

Cambridge, Massachusetts

April 2021

© 2021 by Louis Gerdelan. All rights reserved.

Calamitous knowledge: Disaster research in the British, French and Spanish Atlantic worlds,  
c.1605-1755

**Abstract**

The period between 1605 and 1755 witnessed major transformations in the understanding of disasters in the Atlantic world. Rather than constituting stages in a secularising process, these developments consisted of changes to the shape of disaster knowledge. The key agents of epistemic change were disaster researchers — a diverse group of natural philosophers, physicians, clergy, journalists and astrologers, who recorded, collected, compiled and disseminated information about earthquakes, storms and epidemics. In the seventeenth century their techniques of information management gradually turned an extremely ambiguous category of misfortunes into coherent typologies and taxonomies. This process began in the first half of the century, when a small number of writers developed programmatic visions that distinguished calamities in the civil sphere (such as wars, rebellions and ecclesiastical schisms) from the impacts of elemental forces and illnesses. In the 1650s-60s, in the context of a sequence of devastating disasters on both sides of the Atlantic, a series of collaborative projects emerged to make the assembly of information ever more comprehensive and systematic.

Disaster researchers both benefited from and helped to drive the increasing circulation of news about catastrophes, but in the 1650s-80s their growing concerns about the credibility of the available information led to the construction of new standards of evidence and new means of proving testimonies. This trend encouraged experiments with the use of statistics, particularly in studying epidemic disease. Questions of credibility and credulity were also central to debates about the interpretation of eclipses and comets as portents of calamity. Those debates called into question the

utility and accuracy of astrological disaster prediction, driving both sceptical attacks and a series of projects to create a "rational astrology" on a more robust footing. As disaster researchers improved their means of collecting information they began to reach conclusions that challenged deep-rooted notions, including the idea that hazards could only affect limited spatial areas. In the 1680s-90s a sequence of large earthquakes inspired new theories of hazard transmission that encouraged thinking on a global scale about the deep structure of the earth, the nature of the atmosphere and the providential meaning of disasters.

In the first half of the eighteenth century, major collaborative projects of information collection emerged, with the ultimate goal of discovering the natural laws governing storms and epidemics. At the same time, the interaction of European expeditionaries to Peru with creole savants drove new ideas about the function of hazards within interconnected environments. In 1755, when a major earthquake devastated parts of the Iberian peninsula, disaster researchers responded by trying to integrate the catastrophe into ideas derived from experiences in South America. The massive informational surveys that appeared in the wake of the disaster represented the culmination of earlier trends: they were collaborative enterprises that aimed to compile large quantities of qualitative and quantitative data in systematic ways. At the same time, they signalled the division of natural and moral disaster interpretation into distinct discursive registers. Rather than declining, religious disaster discussion increased. However, scholars increasingly looked for new ways to articulate moral ideas about catastrophes that fitted within the changed epistemic environment of the mid-eighteenth century.

## Table of Contents:

<i>Title</i>	<u>i</u>
<i>Copyright</i>	<u>ii</u>
<i>Abstract</i>	<u>iii</u>
<i>Table of Contents</i>	<u>v</u>
<i>Acknowledgements</i>	<u>vi</u>
<i>List of Illustrations</i>	<u>x</u>
<i>Abbreviations</i>	<u>xi</u>
• Introduction	<u>1</u>
• Chapter 1: Ambiguity to taxonomy: Making sense of misfortune	<u>35</u>
• Chapter 2: Proof and prodigies: New evidentiary standards	<u>73</u>
• Chapter 3: Disaster astrology: Scepticism, reform and syncretism	<u>138</u>
• Chapter 4: Expanding the scale of disasters	<u>193</u>
• Chapter 5: Charting hazardous climates	<u>264</u>
• Chapter 6: The calamities of 1755 and the shape of disaster knowledge	<u>314</u>
• Conclusion	<u>367</u>
<i>Bibliography</i>	<u>374</u>

### Acknowledgements:

This dissertation has been a major undertaking, involving visits to archives and libraries in several countries as well as the exploration of a number of scholarly fields that were new to me when I started the project. I have been greatly assisted in these challenges by the advice, encouragement, suggestions and friendship of a number of people. Firstly, I would like to thank my advisor, David Armitage, for his expert guidance and tireless patience throughout this long process, and the members of my PhD committee, Ann Blair, Joyce Chaplin and Tamar Herzog, for all their help and advice. I also wish to express my deep thanks to Alexandra Walsham, not only for agreeing to examine the dissertation but also for her generous mentorship.

I have been the beneficiary of valuable conversations with Catherine Arnold, William Ashworth, Saptarishi Bandopadhyay, Conevery Bolton Valenčius, Jorge Cañizares-Esguerra, Pedro Cardim, Mackenzie Cooley, Devin Fitzgerald, Anthony Grafton, Eleanor Hubbard, Marie-Hélène Huet, Julia Irwin, Sheila Jasanoff, Hannah Marcus, Noah Millstone, Bruce Moran, Naomi Oreskes, Katherine Park, Marianne Potvin, Juan Pimentel, Eleonora Rohland, Fritz Sager, Simon Schaffer, Stuart Schwartz, Steven Shapin, Daniel Lord Smail, Heidi Tworek, Michael Tworek, Olivia Weisser and Carl Wennerlind. Domenico Cecere not only encouraged my interest in the circulation of disaster information but also gave me an excellent tour of Naples. I also benefited from Megan McDonie's deep expertise in the volcanic history of Guatemala and Mexico. I owe special thanks to Cornel Zwierlein for his unflagging interest and his helpful suggestions, and to Josh Ehrlich and Stuart McManus for their help throughout. I am grateful to Philip Morgan and Matthew Mulcahy for reading



some of my work on the earthquakes of 1692 and for sharing their own recent work, and to Monica Azzolini for her valuable advice and for meeting me in Bologna.

I might never have started the PhD without the encouragement of my MA advisors at the University of Auckland, Lindsay Diggelmann and Jonathan Scott. I am also grateful more generally to the history faculty in Auckland, including Maartje Abbenhuis, Ruth Barton and Kim Phillips. At Harvard, I benefited from the expertise of the faculty and staff of the History Department. In addition to those individuals already mentioned, I would like to thank James Hankins, Carla Heelan, Maya Jasanoff and Mary Lewis. Dan Bertwell's deft administrative management made the process smoother at every turn.

The Frank Knox Memorial Fellowship not only made my study at Harvard possible through generous financial assistance but was also a source of tremendous support, encouragement and enjoyment. The team at the Committee on General Scholarships — Dean Margot Gill, Dina Moakley, Lisa Bruzzese, and above all Rebecca Bauer Lock — went out of their way to help me with immense kindness and friendship. Their constant support, even in trying times, has meant a great deal to me. The Knox fellows provided both interdisciplinary discussions and great companionship.

I would also like to express my thanks for the generous financial support of the North American Conference on British Studies, the New England Regional Fellowship Consortium, the Consortium for the History of Science, Technology and Medicine, the Omohundro Institute and the Ella Burford Trust. Within Harvard, I received financial support from the Graduate School of Arts and Sciences, the Minda de Gunzburg Center for European Studies, the David Rockefeller Center for Latin American Studies, the E.J. Safra Center for Ethics, the John Clive Fellowship, the Jens Aubrey Westengard Fellowship and the Artemas Ward Fellowship. In 2015 a fellowship from the Folger Institute allowed me to

participate in the illuminating seminar “Transition, Scale, Catastrophe” led by Jeffrey Jerome Cohen.

I am grateful to the archivists and librarians at Harvard and of the many institutions I visited during the course of my research, and particularly those at which I spent time as part of my two consortium fellowships: in Boston, the Massachusetts Historical Society, the Boston Athenaeum and the Boston Public Library; in Philadelphia, the American Philosophical Society, the Library Company of Philadelphia and the Science History Institute; the Linda Hall Library in Kansas City, the Beinecke Library in New Haven and the Thomas Fisher Library in Toronto. I also want to thank Jordan Landes, now curator of the Friends Historical Library, for her extremely helpful research suggestions pertaining to seventeenth-century Quakers.

A special thanks is due to my writing partners Nate Aschenbrenner and Sonia Tycko, and also to the members of the Harvard “writing oasis” group, especially Stephanie Winkler. Nate, Sonia and Steffi helped to keep me on track and in good spirits even when the going was tough. I am also grateful to the faculty and graduate students who read and commented on my work in several fora: the Harvard-Princeton Early Modern Graduate Conference, the Harvard Atlantic History Workshop, The Center for European Studies workshop, The Center for History and Economics and the E.J. Safra Center. Vincent Brown and Mary Lewis gave me valuable feedback on several pieces of writing. I also thank Elettra Bietti, Jon Booth, John Gee, Sally Hayes, Joe La Hausse de Lalouvière, Ian Kumekawa, Jacob Moses and Gili Vidan for reading and commenting on a number of draft chapters.

I am also extremely grateful to many friends for their hospitality on my travels. When I first moved to Massachusetts the warm welcome of the Lehar family made me feel at home, and they have been a great source of support ever since. I thank Alisa Dolgova

and Matthew McCormick, Claire Filer and Jo Reilly for generously hosting me in London; Jessica Tearney-Pearce in Cambridge; Karen Hollewand in Oxford; Catherine Ballériaux and Steven Parfitt in Nottingham; Anton Gerdelan in Dublin; Christian Flow, Ingrid Ockert and William Theiss in Princeton; Elizabeth Cross in New Haven. I also thank those who kept me company during trips to various places, including Hannah Callaway, Kirsten Cooper, Claire Doussard, Sarah Grandin and Abby Lewis in Paris; Charo Prieto in Gijón and London; María Martínez Álvarez in Huelva; Elettra Bietti in Rome; Vikki Addona in Naples, Paris and Montreal; Ana Beskin and her family in New York City; Sofia Verba in Providence; and in Washington DC the Folger seminar participants, especially Ana Beskin, Jenny Bledsoe and Melissa Ridley Elmes. In Cambridge (UK) I had the excellent company of Clara Aranda, Tanya Filer, Anton Isopoussu, Jordan Ramsey and the Churchill College graduate students. I was fortunate to have the company of Kathryn Heintzman in Aix-en-Provence and Valencia, and of James Almeida and Sally Hayes in Lima. I am also very grateful to James Almeida, Joe La Hausse de Lalouvière and Jessica Tearney-Pearce for their generous help at the Archivo General de Indias, Archives Nationales d’Outre Mer and Cambridge University Library, respectively, with some documents that I realised I needed only *after* my visits to those institutions.

Finally, I want to express special thanks for the support of my friends Chloe Bordewich, Aimée Scorziello and Peter Sealy, and that of my family, especially my mother, Margaret Greer.

## List of Illustrations

Figure 1: Detail from Philippe Buache, *Planisphère physique où l'on voit du pôle septentrional ce que l'on connoit de terres et de mers, avec les grandes chaînes de montagnes qui traversent le globe*, 1756.

Source: Bibliothèque nationale de France, BNF GE D-12539. 338

Figure 2: Philippe Buache, *Planisphère physique où l'on voit du pôle septentrional ce que l'on connoit de terres et de mers, avec les grandes chaînes de montagnes qui traversent le globe*, 1756. Source:

Bibliothèque nationale de France, BNF GE D-12539. 339

Abbreviations:

AGI	Archivo General de Indias (Seville)
AGNP	Archivo General de la Nación del Perú (Lima)
AGS	Archivo General de Simancas
AHN	Archivo Histórico Nacional (Madrid)
AHNz	Archivo Histórico de la Nobleza (Toledo)
ANF	Archives Nationales de France (Paris)
ANOM	Archives Nationales d'Outre Mer (Aix-en-Provence)
APS	American Philosophical Society (Philadelphia)
AS	Académie des Sciences (Paris)
BA	Boston Athenaeum
BL	British Library (London)
Bodleian	Bodleian Library (Oxford University)
BNE	Biblioteca Nacional de España (Madrid)
BNF	Bibliothèque Nationale de France (Paris)
BPL	Boston Public Library
CUL	Cambridge University Library
FSL	Folger Shakespeare Library (Washington DC)
HF	Hooke Folio Online ( <a href="http://www.livesandletters.ac.uk/cell/Hooke/Hooke.html">http://www.livesandletters.ac.uk/cell/Hooke/Hooke.html</a> )
HL	Houghton Library (Harvard University)
HP	Hartlib Papers ( <a href="https://www.dhi.ac.uk/hartlib/">https://www.dhi.ac.uk/hartlib/</a> )
HSP	Historical Society of Pennsylvania (Philadelphia)
HUA	Harvard University Archives

MHS	Massachusetts Historical Society (Boston)
NA	National Archives (Kew)
NL	Newberry Library (Chicago)
NMM	National Maritime Museum (Greenwich)
NRS	National Records of Scotland (Edinburgh)
RAH	Real Academia de la Historia (Madrid)
RS	Royal Society (London)
UV BH	Universitat de València, Biblioteca Histórica
WL	Wellcome Library (London)
YU BL	Yale University Beinecke Library

## Introduction

Recent catastrophes, including the Coronavirus pandemic and record-breaking wildfires, storms, floods and droughts, have given ample evidence of the vast scale of the threat that disasters pose to contemporary society. Indeed, despite modern technological advantages, we continue to face many of the same challenges that early modern people dealt with in disaster situations. Just as they do today, for instance, seventeenth- and eighteenth-century governments struggled to counteract the spread of rumours, prophecies and conspiracy allegations with the potential to cause panic. Furthermore, debates about the causes of disasters raised questions about collective morality, political leadership, environmental systems, divine design and popular irrationality, all of which have again become objects of public discussion. Studying historical disasters can thus offer a useful avenue for understanding some of the persistent issues that mark our disaster experience. At the same time, it can also reveal and explain the distinctive shape of modern disaster knowledge. Indeed, historical investigation is an essential prerequisite for a critical understanding of our ways of thinking about disaster — both our modes of inquiry and our guiding assumptions. The intellectual activities that underpin our collective responses to disaster risk depend upon and take place within an intellectual environment that is not immutable or timeless but contingent and open to change. There is therefore a great deal at stake in mapping the contours of disaster knowledge and in uncovering their processes of formation. The key to understanding these processes lies above all in the study of the seventeenth and eighteenth centuries, because it was in this period that the most fundamental transformations in the epistemology of disaster took place. The following chapters chronicle this historical process by examining its core manifestation: the development of disaster research.

Broad intellectual changes are notoriously difficult to pin down; establishing the major transformations in knowledge about disaster thus requires a careful approach that recognises continuities as well as alterations and that emphasises contingency over teleology. We need to be particularly cautious in tracing the evolutions in ideas about calamity to a general shift in *mentalités* or to a broad decline in religiosity. The Coronavirus pandemic should finally dispel the illusion that we live in an age in which the social response to disasters is characterised chiefly by rational decision-making and a secular faith in science. Religious interpretations of catastrophe have changed over time in important ways but they have certainly not disappeared; indeed, belief in the power of providence to avert disaster has acquired a new visibility among publics. Paying attention to epistemic structures and environments, on the other hand, gives us the opportunity to uncover important changes in people's intellectual resources without overstating alterations in their basic beliefs.

In order to uncover how early modern people transformed the understanding of disaster we need to pay close attention to the evolving practices of early modern scholars concerned with the investigation of environmental hazards and their impacts. The differences between the intellectual ambit in which these scholars worked and the academic environment of our own time mean that there is no obvious term to denote their activity. “Science” (even in the more inclusive designation “vernacular science”)<sup>1</sup> does not adequately reflect the diverse backgrounds and idioms of the participants, who included not only naturalists (or “natural philosophers”) and physicians but also churchmen, journalists and astrologers. The actors themselves employed a range of terms, often implying an attempt to discover truths not visible to the layman: “to search after what our Maker has

---

1 Conevery Bolton Valencius, *The Lost History of the New Madrid Earthquakes* (Chicago; London: The University of Chicago Press, 2013), chap. 5.



[...] cover'd with a thin Veil of Natural Obscurity” seemed to necessitate “hidden & deepe inquiryes”.<sup>2</sup> The most apt term to describe their activity seems to be disaster “research” (which I have used in alternation with “investigation” and “inquiry”), which reflects this sense of the enterprise as a scholarly pursuit of obscure patterns by means of the careful sifting of available evidence.

Early modern disaster researchers worked variously with textual sources, instrumental readings, astronomical calculations, statistical computations and the evidence of the senses to determine the causes and nature of catastrophes.<sup>3</sup> They pieced together disaster data, often painstakingly, from all the resources available to them: their own journals of observations, networks of correspondents and informants, the printed reports of gazettes, newspapers, periodicals and newsheets, as well as many other kinds of texts, from printed reference compendia to the Bible. Uninhibited by modern disciplinary boundaries, they poured over the works of historians, the Church Fathers, astrologers, ancient and modern meteorologists and physicians in pursuit of relevant material. Direct heirs to “the Renaissance obsession with accumulating information”, disaster researchers shared the encyclopedic “info-lust” that drove other early modern collectors and compilers.<sup>4</sup> However, they also had the additional motive of helping their societies prevent, mitigate or even predict catastrophes. While inquiries into catastrophes possessed many points of intersection with other areas of scholarship, from geography to medicine, this sense that disaster research held the potential

---

2 CUL MS Dd.iii.64, f. 139r; Daniel Defoe, *The Storm; or, A Collection of the Most Remarkable Casualties and Disasters Which Happen'd in the Late Dreadful Tempest, Both by Sea and Land* (London: Printed for G Sawbridge, and sold by J Nutt, 1704), 8. In the former case “deepe inquiryes” referred specifically to the interpretation of prodigies.

3 This is not to say that all disaster researchers exploited all of these sources and methods all of the time. Indeed, the priorities and techniques of investigators evolved in significant ways over the period, as the following chapters demonstrate.

4 Ann Blair, *Too Much to Know: Managing Scholarly Information before the Modern Age* (New Haven: Yale University Press, 2010), 11–12.

to supply knowledge that could spare communities from destruction served to give it a distinct identity and even urgency.

The present study considers a very large geographical area — the British, French and Spanish Atlantic worlds — but it nevertheless presents a focus on Western Europe and its empires in the Americas that is not representative of the world as a whole. As an intellectual history of disaster it should thus be treated as a contribution to a much larger field of global or comparative inquiry, embracing many more cultural, religious and linguistic frameworks than can be covered here. However, as a study of a specific set of knowledge structures and practices a focus on Europe and the Americas is justifiable because it was principally in this area that they took shape. This development should be seen in part as a reflection of the limitations of early modern information networks: although these networks did occasionally convey news of disasters in other parts of the globe to Western scholars, and reports and scholarship from the Atlantic world also spread outwards, the circulation of information depended on the existence of nodes and relays which were particularly dense in Europe and between Europe and the Americas. The style of disaster research that emerged in the region has subsequently exerted a broader global influence, although we do not need to assume that it was or is the only type of disaster knowledge. It seems reasonable to expect that other knowledge structures and practices developed differently in different areas. Since to my knowledge the evolution of those epistemic traditions remains unexplored, however, a broader comparison will have to await future studies.

The increasingly widespread awareness of the importance of catastrophes in the contemporary world has helped to stimulate interest in the history of disasters. This is an area of study that

coalesced relatively recently as a coherent scholarly field, *sensu stricto*,<sup>5</sup> although the analysis of past disasters in the broader sense is as old as the study of history itself, dating back at least to Thucydides' account of the plague that devastated Athens in 430 BCE.<sup>6</sup> Despite the recent augmentation of interest, however, basic questions of definition remain unresolved, and as such it seems necessary to devote significantly more space to the conceptual issues than is customary in a historical study. There is currently no consensus among historians about the meaning of key terms such as "disaster" and "catastrophe", while "crisis" has long served as a flexible descriptor of all kinds of ruptures and critical moments in history.<sup>7</sup> The lack of terminological clarity among historians echoes a similar confusion in the social sciences, from which the historical field derives much of its theoretical framing. After a century of scholarly discussion, there is still no agreed-upon definition of "disaster" in the sociological literature.<sup>8</sup> Historians have fared no better than social scientists, but have proven to be more prepared to accept a high degree of conceptual ambiguity. According to one scholar, disaster is "one of those extraordinary phenomena that is ubiquitous yet

---

5 Several "state of the field" reviews offer useful summaries, though all are now in need of updating: Monica Juneja and Franz Mauelshagen, "Disasters and Pre-Industrial Societies: Historiographic Trends and Comparative Perspectives," *The Medieval History Journal* 10, no. 1–2 (2007): 1–31; Gerrit Jasper Schenk, "Historical Disaster Research. State of Research, Concepts, Methods and Case Studies," *Historical Social Research / Historische Sozialforschung* 32, no. 3 (121) (2007): 9–31; Jonathan Bergman, "Disaster: A Useful Category of Historical Analysis," *Historical Compass* 6, no. 3 (2008): 934–46; Mark Carey, "Latin American Environmental History: Current Trends, Interdisciplinary Insights, and Future Directions," *Environmental History* 14, no. 2 (2009): 235–37; Charles F. Walker, "Natural Disasters in Latin America: Introduction to the Dossier," *Revista de Historia Iberoamericana* 4, no. 1 (2011); Gerrit Jasper Schenk, "Common Grounds in Early Modern Disaster Experiences? Some Remarks on New Trends in Historical Disaster Research as Part of Environmental History and Climate History," in *An Environmental History of the Early Modern Period: Experiments and Perspectives*, ed. Martin Knoll and Reinhold Reith (Zürich; Berlin: Lit, 2014), 11–18.

6 Thucydides, *The Peloponnesian War*, II.47–55.

7 For one influential example in intellectual history, see Reinhart Koselleck, *Critique and Crisis: Enlightenment and the Pathogenesis of Modern Society* (Oxford; New York: Berg, 1988). Koselleck's entry on the term *Krise* in the *Geschichtliche Grundbegriffe* is also instructive: for an English translation see Reinhart Koselleck, "Crisis," trans. Michaela Richter, *Journal of the History of Ideas* 67, no. 2 (2006): 357–400.

8 See for instance the discussion in Wolf R. Dombrovsky, "Again and Again: Is a Disaster What We Call 'Disaster'? Some Conceptual Notes on Conceptualizing the Object of Disaster Sociology," *International Journal of Mass Emergencies and Disasters* 13, no. 3 (1995): 241–54; E. L. Quarantelli, ed., *What Is a Disaster? Perspectives on the Question* (London; New York: Routledge, 1998); Ronald W. Perry and E. L. Quarantelli, eds., *What Is a Disaster?: New Answers to Old Questions* (Philadelphia: Xlibris Corp., 2005).

indescribable”.<sup>9</sup> Another refers to it as something that “cannot be comprehended exactly”, “a hopelessly hybrid entity”.<sup>10</sup> On the whole, historians seem willing to abandon the search for a precise definition and instead rely on a common vocabulary and a shared interest in the societal response to episodes of destruction. This ambiguity makes identifying the precise limits of the field of study a particular challenge.

Most scholars now accept the observation (derived from ecology, environmental history and ecocriticism) that there can be no clear differentiation between “natural” and “human-made” disasters, in part because humans have so altered the environment that it now makes more sense to speak of hybrid human-natural systems than a group of completely autonomous natural forces.<sup>11</sup> In addition, humans have historically exacerbated the risk and impact of disaster. On the other hand, it does not make sense for scholars of premodern history to rely on social scientific definitions premised on the dangers and encroachments of modern industrialism. We therefore need two things: a general concept of disaster with both human and natural dimensions, *and* a vocabulary that allows us to talk about specific environmental phenomena. The latter can be achieved by invoking the concept of “hazard”, which among a broad community of social scientists, geoscientists and emergency planners connotes “an event, phenomenon, process, situation, or activity that may potentially be harmful to the affected population and damaging to the society and the environment”.<sup>12</sup> Early modern writers themselves sometimes used hazard (French *hasard*; Spanish

---

9 Bergman, “Disaster: A Useful Category of Historical Analysis,” 934.

10 Deborah R. Coen, *The Earthquake Observers: Disaster Science from Lisbon to Richter* (Chicago; London: The University of Chicago Press, 2013), 3.

11 Particularly influential works on this question are Bill McKibben, *The End of Nature* (New York: Random House, 1989); Richard White, *The Organic Machine: The Remaking of the Columbia River* (New York: Hill and Wang, 1995).

12 See the entry for “hazard” in Peter T. Bobrowsky, ed., *Encyclopedia of Natural Hazards* (Dordrecht: Springer Netherlands, 2013).

*azar*) to connote risk or danger.<sup>13</sup> A Massachusetts statute of 1668, for instance, required sailors not to abandon their ship unless there was an “apparent hazard”, such as a “tempest or other accident”, which would put their lives in imminent danger.<sup>14</sup> Seventeenth- and eighteenth-century fire insurance proposals also referred to the special fire dangers posed by “hazardous goods” and “hazardous trades”.<sup>15</sup> As a compromise between the modern and early modern semantic fields, the present study refers to hazardous or destructive phenomena, singling out in particular storms, earthquakes and epidemics. This selection allows for the consideration of three types of phenomena with completely separate causes and characters, which were nevertheless often connected by early modern writers.<sup>16</sup> It also bridges three separate historiographies, within the histories of meteorology, seismology and medicine.

To speak of environmental hazards or destructive natural phenomena in this sense is to invoke non-human processes that engage with the conditions of the human-environmental interface in ways that have the potential to generate instances of physical devastation. This concept presents its own problems of complexity, however it has the advantage of encompassing small-scale occurrences that do not fit into most modern definitions of “disaster” but which were nevertheless discussed by historical actors using the same discursive framing that they applied to more destructive episodes.<sup>17</sup> Secondly, it includes cases where actors perceived and articulated the potential for devastation that did not in fact occur, as in 1721-22, when Spanish and English writers feared that a plague outbreak

---

13 See for instance, the entry for “azar” in the *Diccionario de Autoridades* (1726). The same term could invoke both expected dangers and unexpected ones, in addition to more innocuous situations such as games of chance.

14 *Several Laws and Orders Made at the General Court, Held at Boston in New-England, October 14. 1668* (Cambridge, MA: Printed by Samuel Green, 1668), “Maritime Affaires”, s.26.

15 For instance, *Proposals by the Corporation of the London-Assurance, Established by His Majesty’s Royal Charter, for Assuring Houses and Other Buildings, Goods, Wares, and Merchandizes, from Loss or Damage by Fire*, 1734, articles I-II.

16 I have also referred to other types of hazard where necessary — particularly in considering the connections that early modern scholars drew to other kinds of phenomena.

17 “Hazard” thus accommodates the “micro-disasters” attendant on environmental disruptions at the village level, which, as Jerry Toner points out, were as consequential to those affected by them as larger-scale episodes. J. P. Toner, *Roman Disasters* (Cambridge, UK; Malden, MA: Polity Press, 2013), 7–8.

in Provence would spread to their own countries (something that did not eventuate).<sup>18</sup> A focus on non-human phenomena provides some boundaries to a large subject by ruling out military conflicts, rebellions and political revolutions, sectarian violence, massacres and persecutions, although all of these may be connected with environmental hazards in complex ways.<sup>19</sup>

Pinning down the other necessary element — a general concept of disaster — presents even more complex conceptual difficulties. One of the reasons disaster is so difficult to define as a term is that it is a category in flux: its current existence is subject to a gradual process of “domain expansion”, through which an increasing array of phenomena enter the category of the disastrous.<sup>20</sup> The ever-growing pool of referents now includes not only situations involving natural and industrial hazards and economic downturns, but also the complex global phenomenon of anthropogenic climate change. In this latter case what is “catastrophic” is simultaneously the unfolding process itself, the collective failure to address it adequately, its apocalyptic future outcomes, and the impact of the increasingly frequent and severe environmental phenomena — such as hurricanes, wildfires and droughts — that have already begun to flow from it. Even at the basic level of classification, therefore, the concept of disaster must confront an astounding “multidimensionality” both in the varied applications of the term (popular and scholarly) and the complex relationships that disaster events bear to other kinds of events and processes at the natural, social and cultural levels.<sup>21</sup>

---

18 Cindy Ermus, “The Spanish Plague That Never Was: Crisis and Exploitation in Cádiz during the *Peste* of Provence,” *Eighteenth-Century Studies* 49, no. 2 (2016): 167–93.

19 Contrast my approach here to historical works with more open-ended concepts of catastrophe or disaster, which have sometimes included or even prioritised human violence. See for instance Andrew Cunningham and Ole Peter Grell, *The Four Horsemen of the Apocalypse: Religion, War, Famine and Death in Reformation Europe* (Cambridge, UK; New York: Cambridge University Press, 2000); Peter Gray and Kendrick Oliver, eds., *The Memory of Catastrophe* (Manchester; New York: Manchester University Press, 2004); Jennifer Spinks and Charles Zika, eds., *Disaster, Death and the Emotions in the Shadow of the Apocalypse 1400-1700* (London: Palgrave Macmillan, 2016).

20 Frank Furedi, “The Changing Meaning of Disaster,” *Area* 39, no. 4 (2007): 486.

21 Anthony Oliver-Smith, “Global Changes and the Definition of Disaster,” in *What Is a Disaster? Perspectives on the Question*, ed. E. L. Quarantelli (London; New York: Routledge, 1998), 180.

In fact, the domain expansion of disaster is only a recent phase of the much longer series of alterations that have marked the shifting conceptual terrain of catastrophe. Indeed, part of the reason for the elusiveness of disaster as a concept is that modern scholars are attempting to build coherent fields of study upon a set of premodern terms that for most of their history incorporated a large amount of ambiguity. In retaining this nomenclature, scholars have inherited complex linguistic matrices with deep roots in both learned and “popular” culture that cannot be easily severed or circumvented. Modern attempts to create a new typological vocabulary that would reduce catastrophes to “the equivalent of the chemical table of elements” have foundered.<sup>22</sup> Rather than ignoring or effacing this historical semantic complexity, historians should embrace it and attempt to engage with the shifting domains of disaster. We therefore need to divide our general concept of disaster into two parts. Firstly, we require a minimal operational definition that is sufficiently basic to encompass both historical and modern applications. At the simplest level it is enough to refer broadly to the destruction in human societies arising from situations involving the hazards mentioned above (e.g. storms, earthquakes and epidemics).<sup>23</sup> Simultaneously, we need an awareness of the more elastic actor category of calamity, with its perpetually shifting historical domain. As my narrative demonstrates, this category was extremely ambiguous in scholarly writing in 1605 but had become much more precise by 1755.

The focus of the following chapters on early modern scholarship diverges markedly from the dominant concerns in the field of the history of disasters more broadly. Historians have been

---

22 E. L. Quarantelli, “What Should We Study? Questions and Suggestions for Researchers about the Concept of Disasters,” Disaster Research Center Preliminary Paper 119, 1986, 15–16. Here the author sets out a scheme by which each disaster will correspond to a “genotype” based on certain (not always obvious) characteristics: “Type A”, “Type B”, etc.

23 With due awareness of their distinct etymologies and historical nuances, I employ the terms “disaster”, “calamity” and “catastrophe” interchangeably. When referring to the environmental forces that contribute to disasters, I speak of “hazards” and of “hazardous” or “destructive” phenomena.

heavily influenced by a branch of sociological disaster research that flourished in the United States between the 1950s-80s, initially with close ties to the military and civil defence organisations.<sup>24</sup> During this period, the work of E.L. Quarantelli (the so-called “arch-druid of calamity”) and other scholars helped to shape a field of study that envisaged disasters as “social crisis occasions” rather than natural events, with the consequence that the focus of study became human organisations and social behaviour — the “social characteristics of responses in crisis occasions that are [themselves] part of social change”.<sup>25</sup> Characterising disasters as social rather than purely natural occurrences seemed to justify the attention of historians. In addition, sociologists provided a functionalist model for interpreting these events that remains at the core of much historical practice. Equally important for historians has been the emphasis in human ecology and geography that disasters are not unpredictable “accidents” — the opposite to the predictable stability of “normal” life — but rather essential facets of the interaction between humans and their environments.<sup>26</sup>

Confronted with the multidimensionality of disasters, scholars have become increasingly aware that disasters have an “event character” and a “process character”, which means that they can be studied both as discrete episodes and in terms of longer-term structural change.<sup>27</sup> Even though dissenting voices in the historical scholarship have at times warned of the danger of over-extending the (already difficult) concept of disaster beyond the study of singular events,<sup>28</sup> the discovery of —

---

24 For the relationship of the nascent disaster sociology to the Cold War, military funding and civil defence organisations, see Gary R. Webb, “The Sociology of Disaster,” in *21st Century Sociology: A Reference Handbook*, ed. Clifton D. Bryant and Dennis L. Peck (Thousand Oaks: SAGE Publications, 2007), 279–80; Scott Knowles, *The Disaster Experts: Mastering Risk in Modern America* (Philadelphia: University of Pennsylvania Press, 2011), chap. 6.

25 Quarantelli, “What Should We Study? Questions and Suggestions for Researchers about the Concept of Disasters”, 13.

26 Kenneth Hewitt, “The Idea of Calamity in a Technocratic Age,” in *Interpretations of Calamity from the Viewpoint of Human Ecology* (Winchester, MA: Allen & Unwin, 1983), 12, 22.

27 Franz Mauelshagen, “Defining Catastrophes,” in *Catastrophe and Catharsis: Perspectives on Disaster and Redemption in German Culture and Beyond*, ed. Katharina Gerstenberger and Tanja Nusser (Rochester, NY: Camden House, 2015), 175.

28 For instance, Jacques Berlioz, “En forme de conclusion,” *Hypothèses* 3 (1999): 66; Gray and Oliver, *The Memory of Catastrophe*, 7–8. Gray and Oliver, who define catastrophes as moments of rupture, explicitly exclude climate change



or rather, renewed emphasis upon — the processual and systemic aspects of disasters has proven transformational for historical research. The disaster event has not disappeared from view, but the accent has now shifted towards a deep contextualisation of the conditions that enable disaster — conditions whose threads can stretch back a century or more into the past.<sup>29</sup> The historical theory of disasters has thus gradually moved away from a focus on anomalous, temporary disruptions to an emphasis on integrating disasters into wider social and economic structures and processes.<sup>30</sup> Underpinning this shift is the widespread adoption of a concept of “vulnerability” that derived in the first place from natural hazards research, but which owes its more recent and politically radical connotations to influential work in ecology, political-economy, anthropology and critical theory.<sup>31</sup> Frameworks centered around vulnerability tend to accept that catastrophes manifest as social disruption, but diagnose that disruption as a symptom of societal weakness on a structural and ecological plane, rather than as a challenge eliciting community affirmation and solidarity (as earlier sociological research had suggested) or a mental and emotional response (such as in the psychiatric theory of post-traumatic stress).<sup>32</sup>

---

from their analysis because it takes place over an extended period of time and as such, in their view, cannot form the basis for memory (the focus of their volume). Other scholars have sought a compromise between event and system: Serge Briffaud called in 1993 for a “new” history of disasters that would link social systems and ecosystems by viewing catastrophes primarily as “structuring events” (*événement structurants*), to be analysed using the tools of *l’histoire événementielle*. Serge Briffaud, “Introduction. Vers une nouvelle histoire des catastrophes,” *Sources: revue de l’Association ‘Histoire au présent’* 33 (1993): 4.

29 As evidenced by the scope of recent work, for instance Andy Horowitz, *Katrina: A History, 1915–2015* (Cambridge, MA: Harvard University Press, 2020).

30 “Disasters come from within [...] [they] are less discrete events than they are contingent processes”. Horowitz, 3.

31 Especially influential for historians is the perspective expressed in Anthony Oliver-Smith, “Anthropological Research on Hazards and Disasters,” *Annual Review of Anthropology* 25, no. 1 (1996): 303–28; Anthony Oliver-Smith, “What Is a Disaster? Anthropological Perspectives on a Persistent Question,” in *The Angry Earth: Disaster in Anthropological Perspective*, ed. Anthony Oliver-Smith and Susannah M. Hoffman (New York: Routledge, 1999).

32 For the sociological findings on the “pro-social” responses of communities, see the summaries in E. L. Quarantelli, “Disaster Research: Sociohistory of the Field,” in *Encyclopedia of Sociology*, ed. Edgar F. Borgatta and Rhonda J. V. Montgomery, 2nd ed., vol. 1 (New York: Macmillan Reference USA, 2000); Webb, “The Sociology of Disaster.” On trauma and psychiatry, see Mark S. Micale and Paul Frederick Lerner, eds., *Traumatic Pasts: History, Psychiatry, and Trauma in the Modern Age, 1870-1930* (Cambridge, UK; New York: Cambridge University Press, 2001). For early

The shift from sudden event to protracted process has been particularly fruitful in the examination of disasters connected with climate change. Studies of the period of global cooling known as the Little Ice Age have shown how extreme climatic oscillations between the fourteenth and eighteenth centuries led to widespread suffering and demographic contraction, as well as the failure of colonisation projects, because they fatally undermined weak points in human systems such as provisioning networks.<sup>33</sup> The inverse side of vulnerability is resilience and adaptation: thus, one scholar argues that the innovative Dutch prospered during the Little Ice Age because of their willingness and ability to adapt to changing conditions, while their neighbours suffered.<sup>34</sup> In some ways these analyses evoke and problematise an older historiographical focus on “security”. Some scholars between the 1950s-70s thought it would be possible to construct a historical narrative about the progressive march of societies from powerlessness before environmental hazards — perhaps characterised by religious and magical superstition — to a position of greater security, through (amongst other things) the advance of science and technology, the growth of insurance and the emergence of “*l’esprit capitaliste*”.<sup>35</sup> By contrast, more recent scholarship proceeds from the

---

examples of the employment of anthropological and sociological frameworks in historical study, see Luz María Espinosa Cortés and Virginia García Acosta, eds., *Estudios históricos sobre desastres naturales en México: balance y perspectivas* (México, DF: Centro de Investigaciones y Estudios Superiores en Antropología Social, 1992); Virginia García Acosta, ed., *Historia y desastres en América Latina*, 3 vols., Publicaciones de la Casa Chata (Bogotá; México, DF: La RED/CIESAS: Tercer Mundo Editores, 1996).

33 For instance, Sam White, *The Climate of Rebellion in the Early Modern Ottoman Empire* (New York: Cambridge University Press, 2011); Sam White, *A Cold Welcome: The Little Ice Age and Europe’s Encounter with North America* (Cambridge: Harvard University Press, 2017).

34 Dagomar Degroot, *The Frigid Golden Age: Climate Change, the Little Ice Age, and the Dutch Republic, 1560–1720* (New York: Cambridge University Press, 2018). Resilience and adaptation are interrelated concepts but not synonyms; some scholars have preferred to focus on the latter. See for instance, Eleonora Rohland, “Adapting to Hurricanes. A Historical Perspective on New Orleans from Its Foundation to Hurricane Katrina, 1718-2005,” *Wiley Interdisciplinary Reviews. Climate Change* 9, no. 1 (2018); Eleonora Rohland, *Changes in the Air: Hurricanes in New Orleans from 1718 to the Present* (New York and Oxford: Berghahn Books, 2018).

35 Initially the focus was on security and insecurity as socio-economic dynamics: Jean Halpérin, “La notion de Sécurité dans l’histoire économique et sociale,” *Revue d’histoire Économique et Sociale* 30, no. 1 (1952): 7–25. A second approach identified a shift in mentalities from spiritual security to a secular understanding of events based on a capitalist spirit: Lucien Febvre, “Pour l’histoire d’un Sentiment: Le Besoin de Sécurité,” *Annales. Histoire, Sciences Sociales* 11, no. 2

assumption that the advent of technological and industrial “modernity” served not to increase security but to introduce a range of new risks.<sup>36</sup> A recent movement to revitalise research on security within a new field of *Sicherheitsgeschichte* (security history),<sup>37</sup> aims among other things to uncover the discursive construction of security in the early modern era, as well as practical efforts to control risk, for instance through the creation of fire, maritime and life insurance.<sup>38</sup> The counterpart to the study of security is therefore the study of risk, which has formed its own subfield, connecting research in disasters and mercantile capitalism, amongst other topics.<sup>39</sup>

Given these multifarious inflections, historians have increasingly found it valuable to emphasise the “entangled” nature of disasters rather than their singularity: viewing them as junctures that connect aspects of social structures, rather than moments that rupture or sever them, allows them to write the history of disaster into other kinds of social and environmental history.<sup>40</sup> Nevertheless, this flexibility comes at the cost of reduced coherence on the conceptual level: the re-envisioning of catastrophes as “totalising” currents that implicate “all dimensions of a social structural formation and the totality of its relations with the environment” raises the possibility that the concept of disaster may gradually be reduced to the status of a meta-historical ordering device, perhaps as a

---

(1956): 244–47. Both social and cultural aspects of the question are visible in Keith Thomas, *Religion and the Decline of Magic: Studies in Popular Beliefs in Sixteenth and Seventeenth Century England* (London: Weidenfeld and Nicolson, 1971).

36 As demonstrated by Ulrich Beck, *Risk Society: Towards a New Modernity* (London; Thousand Oaks, CA: Sage Publications, 1992).

37 Cornel Zwierlein and Rüdiger Graf, “The Production of ‘Human Security’ in Premodern and Contemporary History,” *Historical Social Research / Historische Sozialforschung* 35, no. 4 (134) (2010): 7–21; Gerrit Jasper Schenk, “‘Human Security’ in the Renaissance? ‘Securitas’, Infrastructure, Collective Goods and Natural Hazards in Tuscany and the Upper Rhine Valley,” *Historical Social Research / Historische Sozialforschung* 35, no. 4 (134) (2010): 209–33; Cornel Zwierlein, “Sicherheitsgeschichte. Ein neues Feld der Geschichtswissenschaften,” *Geschichte und Gesellschaft* 38, no. 3 (2012): 365–86.

38 See especially Cornel Zwierlein, *Prometheus Tamed: Fire, Security, and Modernities, 1400 to 1900* (Leiden; Boston: Brill, 2021). However, the historical study of insurance also includes work with different theoretical emphases. See, for instance, Geoffrey Wilson Clark, *Betting on Lives: The Culture of Life Insurance in England, 1695-1775* (Manchester; New York: Manchester University Press, 1999).

39 For instance, Uwe Luebken and Christof Mauch, “Uncertain Environments: Natural Hazards, Risk and Insurance in Historical Perspective,” *Environment and History* 17, no. 1 (2011): 1–12; Jonathan Levy, *Freaks of Fortune: The Emerging World of Capitalism and Risk in America* (Cambridge, MA: Harvard University Press, 2012).

40 Eleonora Rohland and Virginia García-Acosta, “Disaster,” in *The Routledge Handbook to the Political Economy and Governance of the Americas*, ed. Olaf Kaltmeier et al. (New York: Routledge, 2020), 350–61.

near-synonym to the ubiquitous term “crisis”, which, as Emmanuel Le Roy Ladurie once remarked, “has such a general meaning that it is becoming overworked — and as a result, losing its usefulness”.<sup>41</sup>

The migration of disaster theory from the social sciences to history has raised a number of perplexing and unresolved problems. It remains unclear at the theoretical level whether vulnerability is a temporally and spatially constrained phenomenon, possessing an individual history and identifiable timeline in every society — even if it is a history “centuries in the making” — or whether it is a fundamental social dynamic that is observable everywhere and at all times, in different proportions and guises.<sup>42</sup> If vulnerability is a bounded phenomenon in the former sense, it is a paradoxical one in that it both generates and is generated by disaster, since catastrophic occurrences frequently undermine built environments, while further reducing the ability of the least resilient social groups to absorb future shocks.<sup>43</sup> This recursive relationship between vulnerability and disaster would seem to lend catastrophes a self-reproducing and cyclical character. It also ties them to the socio-economic forces (especially capitalism) that drive the human settlement of precarious environments prone to certain kinds of hazard, as well as the over-exploitation of land and the production of industrial hazards.<sup>44</sup> On the other hand, both the social scientific and historical

---

41 Oliver-Smith, “Global Changes and the Definition of Disaster,” 180. The latter quote is in Emmanuel Le Roy Ladurie, *The Mind and Method of the Historian*, trans. Siân Reynolds (Brighton, UK: Harvester Press, 1981), 270. Even Koselleck, for whom crisis served as a foundational concept, observed that “there is virtually no area of life that has not been examined and interpreted through this concept [...] the concept remains as multi-layered and ambiguous as the emotions attached to it.” Koselleck and Richter, “Crisis,” 358.

42 The quotation is from Greg Bankoff, “Vulnerability as a Measure of Change in Society,” *International Journal of Mass Emergencies and Disasters* 21, no. 2 (2003): 20.

43 This is not to suggest that increased vulnerability would be the *only* consequence of disaster. According to the logic of adaptation, disasters may constitute “significant catalysts of change” that trigger useful and necessary adjustments. Bankoff, 20.

44 Ted Steinberg, “The Secret History of Natural Disasters,” *Environmental Hazards* 3 (2001): 31–35; Ted Steinberg, *Acts of God: The Unnatural History of Natural Disaster in America*, 2nd ed. (New York: Oxford University Press, 2006). This line of reasoning owes much to ecological critiques, particularly that of Donald Worster, *Dust Bowl: The Southern Plains in the 1930s* (New York: Oxford University Press, 1979).

scholarship have emphasised the exceptionally close links between vulnerability and social, economic, racial and gender inequalities. Bearing this in mind, disaster comes to seem less like a contingent event or process, resulting from a convergence of circumstances in historical time, than a general state of being or “enduring condition” that transcends time.<sup>45</sup> In this case, catastrophes are effectively extreme symptoms of a pre-existing condition (vulnerability), which exists as an intrinsic property of societies, regions, ecologies or social groups, with the consequence that “disaster ceases to possess any distinct features” in its own right.<sup>46</sup> As a result, the space of normality between extreme events is merely illusory; spectacular catastrophes must simply serve to punctuate the undramatic “slow violence” of environmental degradation and socio-economic misery, whose gradual accumulation in its turn fosters more such catastrophes.<sup>47</sup>

While these unresolved conceptual problems have not prevented historical research, the focus on structural developments in disaster-struck communities has tended to overshadow the intellectual and cultural aspects that are crucial for the historical understanding of disaster. Although the material effects of disasters are among their most striking features, catastrophes actually possess a “double dimension”, as “material-discursive processes”.<sup>48</sup> Anthropologists of disaster have emphasised the importance of culture to the production of vulnerability, but their sense of culture’s role tends to be very different to that imagined by cultural or intellectual historians, because in the

---

45 I have borrowed the quote from the discussion of the term “crisis” in Janet L. Roitman, *Anti-Crisis* (Durham: Duke University Press, 2014), 2.

46 Furedi, “The Changing Meaning of Disaster,” 487–88. Greg Bankoff has argued that the assignment of vulnerability as a characteristic of specific geographical regions (such as the Philippines) effectively reproduces a Western-centric developmental logic that is rooted in colonialism. Greg Bankoff, *Cultures of Disaster: Society and Natural Hazards in the Philippines* (New York: Routledge, 2002); Greg Bankoff, “‘Regions of Risk’: Western Discourses on Terrorism and the Significance of Islam,” in *Representing the Unimaginable: Narratives of Disaster*, ed. Angela Stock and Cornelia Stott (Frankfurt am Main; New York: Peter Lang, 2007).

47 For this concept see Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, MA: Harvard University Press, 2011).

48 Louise Bénat Tachot, “Présentation,” *e-Spania. Revue interdisciplinaire d’études hispaniques médiévales et modernes*, no. 12 (2011): 2; Catherine E. Rigby, *Dancing with Disaster: Environmental Histories, Narratives, and Ethics for Perilous Times* (Charlottesville; London: University of Virginia Press, 2015), 15.

anthropological view culture in this case operates primarily as a factor in determining a society's collective actions and attitudes with regard to its environment, conceived in terms of adaptations or maladaptations.<sup>49</sup> By contrast, historical research needs to emphasise the diversity and dynamism of past peoples' attitudes, rather than their uniformity, and to avoid a straightforwardly iterative interface between environmental change and cultural adjustment. This necessity of taking past attitudes on their own terms is evident in historical studies that analyse disasters with the techniques of the history of emotions; a body of work which originated from French studies of *mentalités* and the cultural history of risk.<sup>50</sup> Such studies now sit in an uneasy relationship with the dominant currents of historical disaster research, since the feeling and expression of fear and insecurity do not perform the same functional role as vulnerability on an ecological and structural level.<sup>51</sup> To give an extreme example, few cultural or intellectual historians would be comfortable analysing deep-rooted religious beliefs or popular customs in terms of irrational behaviours with the potential to undermine a society's ecological survival.<sup>52</sup> A few disaster historians continue to apply concepts of

---

49 Anthony Oliver-Smith, "Theorizing Disasters: Nature, Power, and Culture," in *Catastrophe & Culture: The Anthropology of Disaster*, ed. Susannah M. Hoffman and Anthony Oliver-Smith (Santa Fe: School of American Research Press; Oxford, 2002).

50 Among other work, see Jean Delumeau, *La peur en Occident, XIVe-XVIIIe siècles: une cité assiégée* (Paris: Fayard, 1978); William G. Naphy and Penny Roberts, eds., *Fear in Early Modern Society* (Manchester; New York: Manchester University Press, 1997); Joanna Bourke, *Fear: A Cultural History* (London: Virago, 2005), chap. 2; Susy M. Sánchez Rodríguez, "Del gran temblor a la monstruosa conspiración: dinámica y repercusiones del miedo limeño en el terremoto de 1746," in *El miedo en el Perú: siglos XVI al XX*, ed. Claudia Rosas Lauro (Lima: Pontificia Universidad Católica del Perú, Fondo Editorial, 2005); Bernard Lavallé, "Miedos terrenales, angustias escatológicas y pánicos en tiempos de terremotos a comienzos del siglo XVII en el Perú," in *Una historia de los usos del miedo*, ed. Pilar Gonzalbo, Anne Staples, and Valentina Torres Septién (México, DF: Colegio de México, 2009); Lydia Barnett, "Between Pleasure and Terror: Enlightenment Science and Maupertuis' Letter on the Comet," *Architectural Theory Review* 20, no. 1 (2015): 30–45; Spinks and Zika, *Disaster, Death and the Emotions in the Shadow of the Apocalypse 1400-1700*.

51 Nevertheless, there does not seem to be much awareness among historians of the dissonance between these very different approaches with their distinct disciplinary genealogies. Instead, the prevalent view appears to be that the specific priorities of cultural history can be easily slotted into the space assigned to culture by anthropologists of disaster. See for instance, Jennifer Spinks and Charles Zika, "Introduction: Rethinking Disaster and Emotions, 1400-1700," in *Disaster, Death and the Emotions in the Shadow of the Apocalypse 1400-1700*, ed. Jennifer Spinks and Charles Zika (London: Palgrave Macmillan, 2016), 2.

52 For the alleged role of beliefs and customs in promoting "ecocide", see Jared M. Diamond, *Collapse: How Societies Choose to Fail or Succeed* (New York: Viking, 2005), 432–34, 274–76. For a more nuanced assessment of the

trauma derived from psychiatry (with important contributions from literary studies), which lend past emotional expressions a greater sense of legitimacy and individuality.<sup>53</sup> Nevertheless, the theory of trauma is fraught with its own conceptual problems, and its relationship to the vulnerability framework is extremely unclear.<sup>54</sup>

Moreover, historians need to re-think the spatial scale on which we imagine disasters as phenomena. In studies of spatially delimited communities (including towns, islands and regions) it makes sense to apply concepts of adaptation, by examining how human inhabitants of an ecosystem learned through personal experience, collective memory or (in a colonial context) the instruction of indigenous peoples about the flood regimes of local rivers, the periodicity of hurricanes, and so on.<sup>55</sup> However, the transnational nature of disasters in the present — not least in modern pandemics — should remind us that hazardous phenomena often affect large areas, both directly and indirectly. Moreover, to make broad claims about overall changes to ideas and practices concerned with disasters requires a much larger unit than a single community.<sup>56</sup> In the case of the early modern world we need to think on a different order of magnitude altogether, in terms of intercontinental empires and ocean-spanning networks of remote correspondents. The period's environmental learning occurred not just in communities proximate to specific hazards but across great distances.

---

relationship between religious prescription and popular action, in the specific case of Ottoman responses to plague, see Yaron Ayalon, *Natural Disasters in the Ottoman Empire: Plague, Famine, and Other Misfortunes* (New York: Cambridge University Press, 2015), chap. 4.

53 For instance, Stephanie Trigg, "Samuel Pepys and the Great Fire of London: Trauma and Emotion, Private and Public," in *Disaster, Death and the Emotions in the Shadow of the Apocalypse 1400-1700*, ed. Jennifer Spinks and Charles Zika (London: Palgrave Macmillan, 2016).

54 Peter Gray and Kendrick Oliver, "Introduction," in *The Memory of Catastrophe*, 10–12. Just as with vulnerability, the boundaries of the concept are ambiguous: "[t]he danger of trauma theory is that it implicates us all in an undifferentiated world of hurt", so that "there may be few individuals who could not now lay claim to the status of trauma victim".

55 Michael Kempe, "'Mind the next Flood!' Memories of Natural Disasters in Northern Germany from the Sixteenth Century to the Present," *The Medieval History Journal* 10, no. 1–2 (2007): 327–54; Rohland, *Changes in the Air*.

56 This is a problem also noted in Cornel Zwielerlein, "Historicizing Environmental Security," *European Journal for Security Research* 3, no. 1 (2018): 2.

Some of the most important adaptive techniques of the era, such as the relocation of colonial settlements in Spanish America, occurred as the result of long-distance imperial communication and planning between local centres and the metropole.<sup>57</sup> In addition, the long-range inferences that early modern people made about disasters extended far beyond the question of practical adaptation, to speculations about the nature, causes and meaning of destructive environmental phenomena and the environmental systems in which they operated. Recent studies have shown the importance of large collaborative networks for the scientific study of earthquakes in the nineteenth and twentieth centuries,<sup>58</sup> but we still lack a clear picture of what preceded these practices in the seventeenth and eighteenth centuries. Scholarship in the history of science over the past two decades has revealed that long-distance collaboration was an integral part of early modern natural inquiries.<sup>59</sup> While national and urban histories are indispensable for drawing out the complex local contexts of disasters, we cannot hope to arrive at a satisfactory overview of the evolution of disaster ideas in this period without considering them in a very broad, trans-oceanic and inter-imperial theatre.

Taking advantage of the tools provided by the “international turn” in intellectual history, we should pay attention to the way that ideas and stories about disaster took on new characters as they migrated over physical space and between different contexts, in a fashion similar to the movements of political ideas and texts.<sup>60</sup> Applying international intellectual history to disasters entails an attention to the international dimensions of catastrophic events that have typically been treated by

---

57 Alain Musset, *Villes nomades du nouveau monde* (Paris: Editions de l'Ecole des Hautes Etudes en Sciences Sociales, 2002).

58 Coen, *The Earthquake Observers*; Bolton Valenčius, *The Lost History of the New Madrid Earthquakes*.

59 Pamela H. Smith and Paula Findlen, *Merchants & Marvels: Commerce, Science, and Art in Early Modern Europe* (New York: Routledge, 2002); Steven J. Harris, “Networks of Travel, Correspondence, and Exchange,” in *The Cambridge History of Science*, ed. Katharine Park and Lorraine Daston, vol. 3, Cambridge History of Science (New York, New York: Cambridge University Press, 2008); Paula Findlen, ed., *Empires of Knowledge: Scientific Networks in the Early Modern World* (Abingdon, UK; New York: Routledge, 2019).

60 For an example of the latter see David Armitage, *The Declaration of Independence: A Global History* (Cambridge, MA: Harvard University Press, 2007).



historians within a national or local context. It also involves uncovering the physical, spiritual and astral teleconnections that contemporaries perceived between events in distant places or between different kinds of hazardous phenomena. Moreover, the movement of researchers themselves between the Americas, the Caribbean and Europe also played a crucial role in driving the development of ideas about earthquakes, storms and epidemics. Finally, we need to draw attention to the nascent early modern recognition of catastrophes as part of planetary processes, a development that connects to other aspects of the pre-history of globalisation.<sup>61</sup> Early modern scholars' reconceptualisation of local destruction on a global scale entailed the creation of a new strand of planetary awareness, which helped to further the recognition of global connectedness emerging from several other types of activities, including voyages of circumnavigation and the operations of warfare, law and commerce.<sup>62</sup>

To support this project we need histories of disasters that examine the gathering, transmission and reception of information about catastrophes.<sup>63</sup> This requires attention to the ways in which news about disaster travelled.<sup>64</sup> Disaster researchers in the European metropolises relied heavily on informants not only in their own countries but also on the other side of the Atlantic: accounts of

---

61 On this type of history, see David Armitage, *Foundations of Modern International Thought* (Cambridge, UK; New York: Cambridge University Press, 2013), 36–37.

62 Lauren A. Benton, *Law and Colonial Cultures: Legal Regimes in World History, 1400-1900* (Cambridge, UK; New York: Cambridge University Press, 2002); Joyce E. Chaplin, *Round about the Earth: Circumnavigation from Magellan to Orbit* (New York: Simon & Schuster, 2012). Mark H. Danley and Patrick J. Speelman, *The Seven Years' War: Global Views* (Boston: Brill, 2012); Pim De Zwart, *The Origins of Globalization: World Trade in the Making of the Global Economy, 1500-1800* (Cambridge, UK; New York: Cambridge University Press, 2018). But see also the caveats in Jan De Vries, "The Limits of Globalization in the Early Modern World," *Economic History Review* 63, no. 3 (2010): 710–33.

63 For some initial steps towards histories of this kind, which may suggest directions for larger studies, see Louis Gerdelan, "The Royal Society, Port Royal and the Great Trans-Atlantic Earthquake of 1692," *Studi Storici* 4 (2019): 845–74; Domenico Cecere, "Introduzione: Disastri naturali e informazione negli imperi d'età moderna," *Studi Storici* 4 (2019): 773–79; Domenico Cecere, "'Subterranea conspiración'. Terremoti, comunicazione e politica nella monarchia di Carlo II," *Studi Storici* 4 (2019): 811–43.

64 For recent work on early modern news networks and catastrophes, see Henry Ettinghausen, *How the Press Began: The Pre-Periodical Printed News in Early Modern Europe* (A Coruña: SIELAE, Universidade da Coruña, 2015), chap. 6; Carlos H. Caracciolo, "Natural Disasters and the European Printed News Network," in *News Networks in Early Modern Europe*, ed. Joad Raymond and Noah Moxham (Brill, 2016).

Caribbean hurricanes and Andean earthquakes, for instance, were sought-after commodities. The traffic of information about such occurrences offered opportunities both to illuminate the mysteries of the New World and to reassess the nature of elemental phenomena in Europe. At the same time, early modern empires were “polycentric monarchies”, in which human, commercial and intellectual traffic flowed not merely in channels between metropole and periphery, but between major regional centres.<sup>65</sup> With this in mind, we need to draw attention to the importance of such places as Lima, Boston and Quebec City, both as local hubs for the collection of disaster information (with close connections to other regional hubs and to the metropolises) and as locations for the generation of ideas in their own right. Rather than the passive and belated recipients of European intellectual developments, such places generated a wealth of inquiries that exerted a major influence on ideas about disaster elsewhere.

In order to engage with the ways that researchers compiled and ordered disaster data we need to consider their activity as an example of information management.<sup>66</sup> This history also has a “transtemporal” aspect that requires attention,<sup>67</sup> since early modern efforts to understand disaster drew not only on contemporary informants and recent texts but also natural, civil and sacred histories stretching from early modernity through the Middle Ages into classical and biblical antiquity. In these endeavours, as in other areas of early modern intellectual inquiry, living researchers carried on a continuous conversation with long-dead writers, incorporating ancient observations and theoretical discussions, typically with little attention to the specificities of their

---

65 Pedro Cardim and Tamar Herzog, eds., *Polycentric Monarchies: How Did Early Modern Spain and Portugal Achieve and Maintain a Global Hegemony?* (Eastbourne, UK; Portland, OR: Sussex Academic Press, 2012).

66 The leading work in this field is Blair, *Too Much to Know*.

67 For this term, see Jo Guldi and David Armitage, *The History Manifesto* (Cambridge, UK: Cambridge University Press, 2014), 15.

historical contexts.<sup>68</sup> Thus, reports of earthquakes, storms and epidemics in the ancient and medieval Mediterranean could serve as reference points to contrast or accentuate current events, and became a part of a shared pool of data on which to found overarching analyses. To understand how these practices of historical reading and reflection informed discussions, it is necessary to examine how early modern writers employed specific case studies and passages from historical sources, following their reasoning back in time, often through several layers of accreted knowledge. In doing so we can glimpse how disaster researchers adapted to current debates reports of ancient and medieval occurrences such as a major Near-Eastern earthquake in the reign of the Roman emperor Tiberius or the fourteenth-century Black Death. Although some collectors of disaster information focused exclusively on retrieving accounts either of contemporary phenomena or historical occurrences, many tried to assemble both at the same time. The construction of informational “archives” enabled and encouraged the comparative analysis of catastrophes—a practice that proved central to the development of disaster ideas in the seventeenth and eighteenth centuries.<sup>69</sup> As investigators revealed the degree to which disasters were not unique events but manifestations of deep patterns in the world’s workings, it became possible and desirable to reassess and even reject basic assumptions, such as the conventional wisdom that earthquakes could only affect relatively small geographical zones.

Given the prevailing emphasis in the historical study of disaster on social and environmental vulnerability, adaptation and security, intellectual and cultural issues have formed only a matter of subsidiary interest for most scholars. Those studies that have attempted to identify major transformations in disaster ideas, beliefs or attitudes in the early modern era have tended to gather

---

68 Blair, *Too Much to Know*, 2; Lorraine Daston, “The Sciences of the Archive,” *Osiris* 27, no. 1 (2012): 174.

69 For the concept of the archive as a data repository for natural inquiries, see Daston, “The Sciences of the Archive.”

around two main questions:<sup>70</sup> the impact of the Reformation in the sixteenth and early seventeenth centuries and the origins of “modern” attitudes to disaster, typically with an emphasis on the seventeenth and eighteenth centuries. Studies of the former group have demonstrated that religious revolutions reshaped the understanding of disaster, both by cultivating a theology of divine providence that informed every level of religious expression (including the emotions), and by stimulating new phases of apocalyptic expectancy.<sup>71</sup> Meanwhile, medieval historians have further complicated the picture by showing that those patterns emerged out of a cultural environment characterised by a high degree of intellectual pluralism, in which religious interpretations of disaster coexisted with natural philosophical ideas and practical technologies for mitigation and prevention.<sup>72</sup>

---

70 I put to one side here works about individual disasters that do not attempt to derive general trends, scholarship on specific issues in the history of science and medicine, and the distinct but overlapping historiographies concerned with prodigies and astrology.

71 See for instance, Cunningham and Grell, *The Four Horsemen of the Apocalypse*; Elaine Fulton and Penny Roberts, “The Wrath of God: Explanations of Crisis and Natural Disaster in Pre-Modern Europe,” in *History at the End of the World? History, Climate Change and the Possibility of Closure* (Penrith: HEB Humanities Ebooks, 2010); Spinks and Zika, *Disaster, Death and the Emotions in the Shadow of the Apocalypse 1400-1700*; Alexandra Walsham, “The Happiness of Suffering: Adversity, Providence, and Agency in Early Modern England,” in *Suffering and Happiness in England 1550-1850: Narratives and Representations: A Collection to Honour Paul Slack*, ed. M. J. Braddick and Joanna Innes (Oxford: Oxford University Press, 2017); Robert E. Bjork, ed., *Catastrophes and the Apocalyptic in the Middle Ages and Renaissance* (Turnhout: Brepols, 2019).

72 Among other works, see Bartolomé Bennassar, ed., *Les catastrophes naturelles dans l'Europe médiévale et moderne: actes des XV<sup>e</sup> Journées internationales d'histoire de l'Abbaye de Flaran, 10, 11 et 12 septembre 1993* (Toulouse: Presses universitaires du Mirail, 1996); Jacques Berlioz, *Catastrophes naturelles et calamités au Moyen Âge* (Firenze: Sismel, 1998); Jussi Hanska, *Strategies of Sanity and Survival: Religious Responses to Natural Disasters in the Middle Ages* (Helsinki: Finnish Literature Society, 2002); Christian Rohr, “Man and Natural Disaster in the Late Middle Ages: The Earthquake in Carinthia and Northern Italy on 25 January 1348 and Its Perception,” *Environment and History* 9, no. 2 (2003): 127–49; Christian Rohr, “Writing a Catastrophe. Describing and Constructing Disaster Perception in Narrative Sources from the Late Middle Ages,” *Historical Social Research / Historische Sozialforschung* 32, no. 3 (121) (2007): 88–102; Anna Akasoy, “Islamic Attitudes to Disasters in the Middle Ages: A Comparison of Earthquakes and Plagues,” *The Medieval History Journal* 10, no. 1–2 (2007): 387–410; Gerrit Jasper Schenk, “Dis-astri: modelli interpretativi delle calamità naturali dal Medioevo al Rinascimento,” in *Le calamità ambientali nel tardo Medioevo europeo: realtà, percezioni, reazioni: atti del XII convegno del Centro studi sul la civiltà del tardo Medioevo* (Florence: Firenze University Press, 2010); Thomas Labbé, *Les catastrophes naturelles au Moyen Âge: XIIIe-XVe siècle* (Paris: CNRS éditions, 2017).

Despite the existence of a few *longue durée* studies,<sup>73</sup> there is a noticeable gulf in the historiography between works concerned with the earlier and later periods.

The unfortunate consequence of this bifurcation is that the sophisticated approach to religion present in the first half of the scholarship has not yet carried over into work on the seventeenth and eighteenth centuries. By contrast, studies of the eighteenth century in particular have continued to postulate a linear shift “from divine punishment to natural disaster”.<sup>74</sup> One line of argument suggests that this transformation occurred as a result of the gradual accumulation of experience of specific types of hazards: British colonists in the Caribbean, for instance, eventually built up a store of experiential knowledge about hurricanes and earthquakes that allegedly evaporated the supernatural wonder attached to these phenomena.<sup>75</sup> Other arguments place the accent on changes in scientific practice. According to one study, the increasingly meticulous attention of English weather observers to mundane meteorological details rather than spectacular phenomena reduced the weather to regular patterns and therefore deprived storms of their association with divine punishment and apocalypticism.<sup>76</sup> Finally, some scholars have connected sweeping transformations in attitudes to disaster to the putative emergence of nation-states in the early modern era, suggesting

---

73 Delumeau and Lequin, *Les malheurs des temps*; François Walter, *Catastrophes: une histoire culturelle, XVIe-XXIe siècle* (Paris: Seuil, 2008); Ayalon, *Natural Disasters in the Ottoman Empire*; Emanuela Guidoboni and Jean-Paul Poirier, *Storia culturale del terremoto: Dal mondo antico a oggi* (Soveria Mannelli (It.): Rubbettino Editore, 2019).

74 Anne-Marie Mercier-Faivre and Chantal Thomas, eds., *L'invention de la catastrophe au XVIIIe siècle: du châtement divin au désastre naturel* (Genève: Droz, 2008).

75 Matthew Mulcahy, *Hurricanes and Society in the British Greater Caribbean, 1624-1783* (Baltimore: Johns Hopkins University Press, 2006); Matthew Mulcahy, “The Port Royal Earthquake and the World of Wonders in Seventeenth-Century Jamaica,” *Early American Studies: An Interdisciplinary Journal* 6, no. 2 (2008): 391–421.

76 Jan Golinski, *British Weather and the Climate of Enlightenment* (Chicago: The University of Chicago Press, 2007), xii–xiii, 3–4. However, Golinski also emphasises (at pp. xiii–xiv) “the incompleteness of the process of enlightenment” in meteorology.

for instance that “the moral economy of divine punishment” disappeared as states began to assume more responsibility for protecting their citizens from hazards.<sup>77</sup>

The shadow of the Lisbon Earthquake of 1755 looms large over the grand narratives of a transition in disaster attitudes from religious pre-modernity to secular modernity. Historians have long regarded this catastrophe as a turning-point in mentalities, particularly since the work of Paul Hazard and Thomas Kendrick in the 1930s-50s.<sup>78</sup> In following this line of interpretation historians have joined many scholars of literature as well as philosophers and social scientists in perpetuating the mythical status of the earthquake as signalling the end of a premodern attitude, not only to disasters but to such vast themes as the truth of religion, the harmony of nature, and the nature of evil.<sup>79</sup> According to one influential formulation, the Lisbon Earthquake was “the first modern disaster”.<sup>80</sup> Arguments for the inception of disaster “modernity” at this juncture generally consist of three aspects: the Portuguese government’s practical measures in the disaster response and reconstruction, the philosophical debate about why God allows evil in the world (especially in terms of the “theodicy” of Gottfried Wilhelm Leibniz and Alexander Pope), and the efflorescence of discussion about the physical causes of earthquakes (epitomised in the work of Immanuel Kant). The philosophical aspect in particular has exerted a magnetic pull on scholars, in part because the debates about theodicy drew in some of the chief luminaries of the Enlightenment, including

---

77 Franz Mauelshagen, “Natural Disasters and Legal Solutions in the History of State Power,” *Solutions* 4, no. 1 (2013).

78 P. Hazard, “Esquisse d’une histoire tragique du Portugal devant l’opinion publique du dix-huitième siècle,” *Revue de Littérature Comparée* 18 (1938): 59-68; Paul Hazard, “Le problème du mal dans la conscience européenne du XVIIIe siècle,” *Romanic Review* 32, no. 2 (1941): 147; T. D. Kendrick, *The Lisbon Earthquake* (London: Methuen, 1956).

79 Among many other works, see Clarence J. Glacken, *Traces on the Rhodian Shore: Nature and Culture in Western Thought from the Ancient Times to the End of the Eighteenth Century* (Berkeley: University of California Press, 1967), 521–24; Susan Neiman, *Evil in Modern Thought: An Alternative History of Philosophy* (Princeton, NJ: Princeton University Press, 2002), chap. 4.

80 Russell Dynes, “The Lisbon Earthquake in 1755: Contested Meanings in the First Modern Disaster,” Disaster Research Center Preliminary Paper 255, 1997; Russell Dynes, “The Lisbon Earthquake in 1755: The First Modern Disaster,” Disaster Research Center Preliminary Paper 333, 2003. This theme has been recapitulated recently in Gaspar Mairal, *A Pre-Modern Cultural History of Risk: Imagining the Future* (London; New York: Taylor and Francis, 2020), chap. 7.

Voltaire and Rousseau. The classic depiction, still influential among historians and other scholars, is that Voltaire's attack on philosophical optimism helped to provoke "a significant revolution of thought".<sup>81</sup> This revolution allegedly vanquished a metaphysical Old Regime that had insisted on God's benevolent use of catastrophes, by extension challenging the theological interpretation of calamity *tout court*. According to a major recent study of the earthquake, "[w]hat did slowly pass away in the wake of the Lisbon disaster was the belief, still so common in 1755, that earthquakes were acts of God sent to punish mankind [...] earthquakes would eventually be drained of their supernatural significance for the majority of people in the West".<sup>82</sup> Some scholars detect the roots of a secular approach to disasters in the scientific debates about earthquakes that followed the catastrophe,<sup>83</sup> although recent work has problematised the status of Kant as the law-giver of scientific modernity and postponed the disappearance of earthquakes' "apocalyptic associations" to the nineteenth century.<sup>84</sup> Other interpretations of the Lisbon Earthquake as "a founding date of European consciousness" suggest that it transformed disasters from manifestations of providence to risks that were subject to laws of probability, tied to new forms of scientific investigation and discussion, which ultimately produced "a secularised vision of 'natural' disasters".<sup>85</sup> More cautious

---

81 Kendrick, *The Lisbon Earthquake*, 209–10.

82 Mark Molesky, *This Gulf of Fire: The Destruction of Lisbon, or Apocalypse in the Age of Science and Reason* (New York: Knopf Publishing Group, 2015), 356–57. Confusingly, Molesky also hedges his bets by suggesting that "the shift may not have definitively occurred until sometime late in the nineteenth century".

83 Martin Stuber, "Divine Punishment or Object of Research? The Resonance of Earthquakes, Floods, Epidemics and Famine in the Correspondence Network of Albrecht von Haller," *Environment and History* 9, no. 2 (2003): 173–93; Agustín Udías, "Earthquakes as God's Punishment in 17th- and 18th-Century Spain," *Geological Society, London, Special Publications* 310, no. 1 (2009): 41–48.

84 Coen, *The Earthquake Observers*, 2, 7–8.

85 Grégory Quenet, "When Geology Encounters a Real Catastrophe: From Theoretical Earthquakes to the Lisbon Disaster," in *Histoires de La Terre: Earth Sciences and French Culture 1740-1940*, ed. Louise Lyle and David McCallam (Amsterdam; New York, NY: Rodopi, 2008), 42, 51, 55; Grégory Quenet, "Earthquakes in Early Modern France: From the Old Regime to the Birth of a New Risk," in *Historical Disasters in Context: Science, Religion, and Politics*, ed. Andrea Janku, Gerrit J. Schenk, and Franz Mauelshagen (New York: Routledge, 2012), 94–95, 109–10. Note, however, the slightly different picture that emerges from the longer chronology and more detailed treatment in Grégory Quenet, *Les tremblements de terre aux XVIIe et XVIIIe siècles: la naissance d'un risque* (Seysssel: Champ Vallon; Paris Diffusion, Presses universitaires de France, 2005).

assessments have questioned assumptions about the Enlightenment's supposedly confident rationalism by drawing attention to the persistence of a sense of fragility and powerlessness in the face of disasters throughout the eighteenth century.<sup>86</sup> However, reimagining the Enlightenment as the genesis of a new regime of industrial risks, insecurity and trauma has merely exchanged one genealogy of modernity for another.

There are two main problems besetting the narratives of a seventeenth- or eighteenth-century disenchantment of disasters. Firstly, although the documentary evidence suggests that important changes took place during this period in how people understood catastrophes, it also points to a good deal of continuity. It is not difficult to find examples of providential disaster interpretation at the end of the eighteenth century or, for that matter, in the nineteenth and twentieth.<sup>87</sup> Arguments based on a revolution in disaster beliefs in 1755 or on slower processes of secularisation in the seventeenth and eighteenth centuries often struggle to account for the remarkable persistence of this kind of religious commentary. If we accept, for instance, that “the providential interpretation of disease has waned steadily” from the early eighteenth century,<sup>88</sup> its continual reappearance in direct defiance of that trend begins to seem nothing short of a supernatural mystery. On the one hand, historians of disaster need to take note of recent scholarship that has sought to draw attention to the continuing importance of religion in the Enlightenment.<sup>89</sup> On the other hand, we may also need to

---

86 Alessa Johns, “Introduction,” in *Dreadful Visitations: Confronting Natural Catastrophe in the Age of Enlightenment*, ed. Alessa Johns (New York: Routledge, 1999), xv–xvi; Marie-Hélène Huet, *The Culture of Disaster* (Chicago: The University of Chicago Press, 2012), 6–7.

87 As for instance in the response of farmers to a drought in the northeastern United States in the 1960s: Ted Steinberg, “What Is a Natural Disaster?,” *Literature and Medicine* 15, no. 1 (1996): 33–47.

88 Françoise Deconinck-Brossard, “Acts of God, Acts of Men: Providence in Seventeenth- and Eighteenth-Century England and France,” in *Signs, Wonders, Miracles: Representations of Divine Power in the Life of the Church: Papers Read at the 2003 Summer Meeting and the 2004 Winter Meeting of the Ecclesiastical History Society*, ed. Kate Cooper and Jeremy Gregory (Woodbridge ; Rochester, NY: Published for the Ecclesiastical History Society by the Boydell Press, 2005), 370.

89 *Inter alia*: J. G. A. Pocock, *Barbarism and Religion* (Cambridge, UK; New York: Cambridge University Press, 1999), vol. 1; Jonathan Sheehan, *The Enlightenment Bible: Translation, Scholarship, Culture* (Princeton, NJ: Princeton University Press, 2005); William J. Bulman, ed., *God in the Enlightenment* (New York: Oxford University Press, 2016).



re-examine some of our assumptions about what a “modern” attitude to disasters looks like. The Coronavirus pandemic has provided a clear lesson that beyond academic circles deeply religious and even apocalyptic interpretations of disaster remain very powerful in many parts of the world.<sup>90</sup> This may well suggest that a more accurate depiction of the history of religious disaster analysis should eschew a linear narrative of decline altogether.

Furthermore, while acknowledging the complexity of some recent scholarly interpretations, many narratives about the secularisation of disaster continue to reflect assumptions about the intrinsic antagonism of early modern science and religion that have long been rejected by historians in both areas of study.<sup>91</sup> Many scholars of disaster have been surprisingly slow to recognise that the growth of early modern natural philosophy did not entail a concomitant decline in religious belief. In fact, one case study of southern Italy has found precisely the opposite trend: despite the accumulation of important natural studies of earthquakes and volcanic activity between 1631 and 1688, the interpretative emphasis on divine punishment actually increased in pamphlet literature over this time.<sup>92</sup> What we need is a reassessment of religious views in the seventeenth and eighteenth centuries that incorporates the more nuanced approaches to religion demonstrated by scholars of medieval and sixteenth-century disaster culture. Above all, we have to stop treating early modern religion as a monolithic, static entity and recognise that it was both multilayered and constantly evolving.

---

90 Similar evidence about earlier episodes is discussed in David K. Chester, “Theology and Disaster Studies: The Need for Dialogue,” *Journal of Volcanology and Geothermal Research* 146, no. 4 (2005): 319–28.

91 See the overviews in Ann Blair, “Science and Religion,” in *The Cambridge History of Christianity*, ed. R. Po-Chia Hsia, vol. 6 (Cambridge, UK: Cambridge University Press, 2007); Margaret J. Osler, “Religion and the Changing Historiography of the Scientific Revolution,” in *Science and Religion: New Historical Perspectives*, ed. Thomas Dixon, G. N. Cantor, and Stephen Pumfrey (Cambridge, UK; New York: Cambridge University Press, 2010).

92 Domenico Cecere, “Moralising Pamphlets: Calamities, Information and Propaganda in Seventeenth-Century Naples,” in *Disaster Narratives in Early Modern Naples: Politics, Communication and Culture*, ed. Domenico Cecere et al. (Roma: Viella, 2018), 145.

A critical aspect of this reassessment will consist of an emphasis on the interplay between the various branches of the contemporary understanding of disasters — particularly religious disaster interpretation, natural philosophy, medicine and astrology — that takes each of them seriously, on their own terms, rather than as the progenitors of something more recognisably modern. We can best achieve this by reorienting attention away from changes in beliefs and outlooks, which are extremely difficult to access on an evidentiary level and notoriously difficult to gauge on an analytical level. A more promising avenue of inquiry is to focus on changes to epistemic frameworks and knowledge practices. First of all, this entails an examination of how disasters fitted into the early modern tapestry of knowledge. Secondly, it necessitates a new attention to the ways in which people concerned to investigate destructive phenomena acquired their information, analysed it and ordered it into classificatory systems. Thirdly, it should consider the means by which researchers tried to produce valid knowledge and distinguish it from invalid forms — including attestations deemed false, “vulgar” or “superstitious”. It is in charting changes to these knowledge practices that we can best arrive at conclusions about the major intellectual transformations concerning disasters in this period.

In order to connect the disaster experience of Europe with other parts of the world, the present study encompasses not only Britain, France and Spain but also their colonial empires in the Americas and the Caribbean. One of the reasons for this is to give a broader contextual picture for events and developments that are often examined in one country alone. Without contradicting the validity and usefulness of more tightly bounded studies, we can only hope to produce a representative picture of early modern disaster knowledge and its transformations by examining a very broad geographical area over a long time period. A further important motive for the inclusion of Latin America is to reinforce the movement in the history of science to bring scholars and

practices from the early modern Hispanic world — long excluded from narratives of the “Scientific Revolution” — to the centre of events.<sup>93</sup> Finally, an Atlantic framework brings into relief the importance of the intra- and inter-imperial movement of people and ideas for the production of disaster knowledge.

Chronologically, the present study offers an alternative view of the intellectual transformations of disaster in the seventeenth century and the first half of the eighteenth — the period most often identified as a watershed in understandings of catastrophe. More specifically, it begins in 1605 — the year when Francis Bacon published *The Advancement of Learning* — in order to demonstrate the importance of early challenges to an older epistemic framework of calamities. Bringing the study to a close around 1755 offers the opportunity of reassessing the importance of the debates around the Lisbon Earthquake by putting them into the longer context of 150 years of disaster discussion. The purpose here is neither to reaffirm the mythical status of the destruction of Lisbon as a revolutionary moment nor to deprive it of importance, but rather to provide a more nuanced overview of the state of disaster research at this point and the impact of the events of 1755 upon it.

The first chapter begins by giving an outline of the basic epistemic armature that underpinned the knowledge of disasters before the middle of the seventeenth century. This was a framework characterised above all by ambiguity and eclecticism. The concept of calamity encompassed a vast range of phenomena, from individual afflictions to public catastrophes, and it made few meaningful distinctions between crises in the civil sphere (such as rebellions, wars and the deaths of monarchs), elemental phenomena such as storms and earthquakes, and other problems such as epidemic disease and crop pests. This amorphous assembly was grounded on Scripture, Greco-Roman texts and

---

<sup>93</sup> Jorge Canizares-Esguerra, “Iberian Science in the Renaissance: Ignored How Much Longer?,” *Perspectives on Science* 12, no. 1 (2004): 86–124.

patristic authorities, and it pervaded all areas of scholarship, from meteorology to architecture. The habit of clustering phenomena also lay at the core of doctrinal Christian interpretations of disasters. However, in the first half of the seventeenth century new ideas began to emerge about how to order the various types of calamity in more systematic ways. Firstly, encyclopedic reference works fragmented the unified category of adversities into potentially infinite topics of investigation. Secondly, the programmatic visions of Francis Bacon and Pierre Gassendi suggested divisions of knowledge that would deal separately with natural phenomena and civil events. These projects also emphasised the importance of collecting and ordering information about terrestrial phenomena. Although they did not by themselves effect a sweeping transformation of knowledge, these new frameworks for disaster research paved the way for the more far-reaching changes of the 1650s-90s.

Those decades form the chronological focus for the following two chapters. Chapter 2 makes the case for an extensive transformation in the scholarly approach to disasters in this period. Three concurrent trends encouraged this change. Firstly, a particularly intense phase of catastrophes between 1646 and 1666, including parallel epidemics in Europe and the Americas and a sequence of seismic disasters, spurred reflections on the nature and causes of destructive phenomena. Secondly, the expansion of the various means of communication increased the circulation of information about disasters. Finally, this growth in reporting was accompanied by mounting concern about the reliability of disaster news, expressed in an elevated level of scepticism about testimonies of extraordinary events and prophecies of doom. The combined influence of these three factors gave rise to a new style of disaster research dedicated to the collection of information about earthquakes, storms, epidemics and other hazards according to robust evidentiary standards. The fields in which these research activities emerged included the traditionally heterogeneous areas of prodigy and

judgement compilation. By the 1680s, investigators had developed methods for obtaining, vetting and ordering both qualitative testimonies and quantitative data.

Chapter 3 addresses the specific case of astrological prediction of disasters. The widespread prediction of massive calamities attending a series of eclipses and comets between the 1650s and the 1690s generated both popular panic and major sceptical attacks on the legitimacy of astrological disaster prediction. Sceptics pointed both to the inaccuracy of such predictions, the public disorder they produced, and the association of astral disaster ideas with foreign “vulgarity”. Some critics, most notably Pierre Bayle, attempted to prove that comets did not herald disasters by compiling lists of “misfortunes” that did not correspond to comet sightings, and, by contrast, of the fortunate events that followed comets. The impact of these attacks was not to destroy astrological understandings of disaster, but to place increasing emphasis on standards of credibility. This proved to be a propitious moment for the emergence of various kinds of intellectual projects that emphasised the comparative analysis of disasters, both from contemporary and historical sources. This trend not only informed the work of astral sceptics like Bayle but also encouraged the development of various kinds of “reformed” astrology, which developed differently in England, New England, New Spain and Peru.

In the last decades of the seventeenth century, a series of disasters encouraged contemporaries to think more deeply about the large geographical scales on which calamitous events could occur. Chapter 4 engages with commentary on a series of earthquakes in Quebec, Spain, Peru, Jamaica, England, Italy and France. Employing the techniques of information collection developed in the preceding decades, both natural philosophical and clerical writers challenged long-standing preconceptions about the spatial limits of earthquake impact. A new set of ideas about earthquake transmission emerged that envisioned the trans-Atlantic conveyance of calamity. As a result, the

attention of disaster investigators shifted from a local to a global scale, premised upon a reconsideration of geological and atmospheric processes. Finally, Daniel Defoe's response to the Great Storm of 1703 indicates the extent to which the coalescence of new techniques of information collection and a new global outlook had coloured investigations of disaster in general.

The global reimagining of disaster depended upon trans-Atlantic flows of information. Chapter 5, which covers the first half of the eighteenth century, begins by considering the new collaborative projects of meteorological inquiry. Based in the London and Paris academies, these programmes drew participants from Canada to Peru. Among other objectives, these projects sought to reduce storms to regular, predictable patterns, thus enabling accurate weather forecasting. Although researchers failed to achieve these lofty ambitions, they nevertheless introduced models of quantitative, collaborative data collection that became central to disaster investigation. Physicians in Europe, the Caribbean and the American colonies applied these techniques in an effort to identify the relationship between weather conditions and diseases. Inspired in part by the widespread discussion of the Marseille plague of 1720-22 and the decades-long debates over smallpox inoculation, medical researchers constructed new ideas about disease evolution and the relationship between epidemics and God's governorship of the world. The cumulative result of medical and meteorological inquiry into disaster was a powerful emphasis on climatic and geographic systems. These systems came to be seen as distinct regional units within an overarching global frame. American and Caribbean environments, informants and investigators were crucial to the development of these new templates. French and Spanish expeditionaries to South America brought with them European methods and ideas about earthquakes and storms, but they also relied heavily on local assistance. Creole scholars conducted their own investigations, influenced both by recent European trends and by the local syncretism of astro-meteorological and providential

traditions. The joint product of the work of these researchers and the European travellers was a vision of American environments characterised by the close interconnection of hazards with other aspects of the natural world, including mountains, tides, rainfall and soil fertility.

The massive earthquake and tsunami of November 1755 that devastated Lisbon and other parts of the Iberian peninsula, as well as North Africa, was an important moment for the investigation of disaster in several ways. As the final chapter shows, the events of 1755 signalled the apogee of early modern disaster research by inspiring unprecedented projects of data collection, including a Spanish bureaucratic inquiry that assembled thousands of pages of documentary evidence. The case study of Cádiz shows how the Spanish inquiry was able to draw upon not only local officials and engineers but also expertise on similar catastrophes in South America, including the earthquake-tsunamis of 1746 and 1751. However, the November disasters also challenged the dominance of American environmental research because the conditions in Lisbon and southern Spain did not match the topographical conclusions that scholars had reached about the role of mountain ranges in producing earthquakes. A key intervention by the French geographer Philippe Buache provided a possible solution by reorienting attention towards global marine topography.

Although important in its own right, the Lisbon Earthquake was not the grand intellectual turning-point that many scholars of disasters and of the Enlightenment have maintained. The intellectual responses to it were not the product of rapid and revolutionary change but the culmination of a century of investigative practices. Perhaps most importantly, the catastrophes of 1755 did not, as has been repeatedly suggested, signal the end of the belief that disasters were part of a providential order. In fact, they stimulated a reinvigoration of religious disaster interpretation on an enormous and trans-Atlantic scale. However, spiritual interpretations also transformed in the eighteenth century. Providential commentary came to occupy one of several distinct discursive

registers, which contemporaries could navigate between as the occasion demanded. Partly in response to this development, preachers and tract writers came up with new *raisons d'être* for providential interpretation, which emphasised the practical usefulness of religion, especially in its provision of solace to disaster victims. The characterisation of disasters as divine judgements remained a feature of sermons and tracts throughout the period, but the condemnation of sin gradually conceded space to a less doctrinal morality that took aim at illegal behaviour such as looting, while encouraging charity and benevolence. Religious disaster investigators also attempted to trace sequences of calamitous occurrences that showed a divine intelligence at work behind ostensibly natural phenomena. With hindsight we can see that eighteenth-century developments laid the foundations for a quieter, less stern religious attitude to disasters. However, in the middle of the century this was not the only possible trajectory, and an examination of two Guatemalan texts reveals an alternative path in which a syncretic blend of miracles, meteorology and even astrology could anchor an approach to disaster investigation that combined recent trends with older traditions.



## Chapter 1: Ambiguity to taxonomy: Making sense of misfortune

Prior to the middle of the seventeenth century, knowledge about disasters occupied a nebulous position in the scholarly world. Although writers frequently referred to earthquakes, epidemics and storms, they tended to assign them ultimately to a highly eclectic category of calamities or misfortunes, which included every imaginable form of mishap, both personal and collective. Founded equally on Scripture and classical authorities, this ambiguous framework proved both pervasive and resilient. However, although preachers found its vagueness and dogmatic associations useful, as seventeenth-century scholars tried to expand the sum of knowledge about destructive phenomena it became increasingly apparent that new and clearer forms of classification would be needed. Nevertheless, it is possible to find hints in works from the first half of the century for what a new epistemology of disasters might look like: a systematic arrangement of knowledge into categories that emphasised the physical characteristics of destructive phenomena and that distinguished elemental forces from turmoil in the civil sphere.

The inhabitants of Western Europe and its empires in the seventeenth century inherited a rich legacy of discussion about disaster that embraced diverse scholarly subjects, including theology, astrology, natural philosophy, medicine and architecture. Over time this diverse intellectual environment had contributed novel ideas about the nature of disasters as well as practical technologies for their prevention and mitigation, including hydrological engineering and building regulations.<sup>1</sup> Despite these innovations, the fundamental epistemic structure of disaster that

---

1 Fire regulations in medieval and early modern London are discussed in Derek Keene, "Fire in London: destruction and reconstruction, A.D. 982-1676," in *Stadtzerstörung und Wiederaufbau*, ed. Martin Körner, Niklaus Bartlome, and Erika Flückiger (Bern: P Haupt, 1999), 196–97. For flood control measures, see Raingard Eßer, "Fear of Water and Floods in the Low Countries," in *Fear in Early Modern Society*, ed. William G. Naphy and Penny Roberts (Manchester; New York: Manchester University Press, 1997), 62–77; Tim Soens, "Floods and Money: Funding Drainage and Flood

underlay all scholarly writing remained remarkably resilient and stable between the Middle Ages and the early seventeenth century. As a result, writers in the first half of the seventeenth century continued to follow assumptions about the fundamental classification of disasters that had their origins in the ancient world. The hallmark of this deep-rooted epistemic framework was the location of negative occurrences within an ambiguous category of “misfortunes”, in which earthquakes and storms shared space with rebellions and wars, religious schisms, personal afflictions and the prodigies of nature. This heterogeneous category was modified and complicated by the existence of many kinds of knowledge and experience, including natural philosophical, astrological and medical traditions, but the fundamental idea that disasters were inherently linked to other kinds of negative occurrence remained consistent. In the medical context, many common terms for disease (illness, *malum*, *mal*, *malaise*) continued to reflect a straightforward bipolar distinction between good and bad, which translated into the opposition between health and sickness as basic states of being. The consequence of this bipartite structure was that major environmental disruptions shared the same epistemic place as every other kind of negative occurrence, from a military defeat to a personal mishap.

Early modern nomenclature reflected this heterogeneity. “Disaster” (*désastre*, *desastre*) derived from astrology (via the intermediary Italian term *disastro*), and connoted a very broad range of misfortunes.<sup>2</sup> “Misfortune” itself (*malheur*, *infortunio*) could also apply to an extremely wide range of

---

Control in Coastal Flanders from the Thirteenth to the Sixteenth Centuries,” *Continuity and Change* 26, no. 3 (2011): 333–65.

2 For instance: “We cannot but take notice how the Lord hath been pleased to crosse our proseedings, and caused many disasters to befall us therein. I conceive the only reason to be, we, or many of us, aimed at other ends then Gods glorie; but now I hope that cause is taken away [...]” William Bradford, *History of Plymouth Plantation*, ed. Charles Deane (Boston: Privately Printed, 1856), 229–30. “*Désastre*”: “Misfortune, desolation, unfortunate occurrence” (“*Malheur*; desolation; accident funeste”); “*Désastreux*”: “Archaic word, which formerly signified unfortunate” (“*Vieux mot, qui signifioit autrefois, infortuné; malheureux.*”) Antoine Furetiere, *Dictionnaire Universel: Contenant Generalement Tous Les Mots François...* (La Haye: Chez Pierre Husson, et al, 1727). “*Desastre*”: “Tragedy, misfortune, unfortunate and lamentable

occurrences, from a cart accident to a massive earthquake.<sup>3</sup> A whole range of words expressed a similar sense of ill luck, such as the Spanish *desdicha*.<sup>4</sup> “Catastrophe”, originating in Greek drama, was a novel introduction to this linguistic context from the late seventeenth century.<sup>5</sup> Some words expressed divine judgement: punishment, correction or scourge (*châtiment, castigo, fléau, azote*), tribulation (*tribulation, tribulación*).<sup>6</sup> Beyond all these, the term most widely used in the period was “calamity” (*calamité, calamidad*), derived from the Latin *calamitas*.<sup>7</sup> A highly flexible term, it could be used to refer to individual mishaps or events that affected a whole community or kingdom. These latter cases were sometimes called “public” or “general” calamities to emphasise their societal

---

occurrence” (“Desgracia, desdicha, successo infeliz y lamentable”), *Diccionario de Autoridades*, Tomo III (1732). See also the discussion in Franz Mauelshagen, “Defining Catastrophes,” in *Catastrophe and Catharsis: Perspectives on Disaster and Redemption in German Culture and Beyond*, ed. Katharina Gerstenberger and Tanja Nusser (Rochester, NY: Camden House, 2015), 173; Gerrit J. Schenk, “Disastro, Catastrophe, and Divine Judgement: Words, Concepts and Images for ‘natural’ Threats to Social Order in the Middle Ages and Renaissance,” in *Disaster, Death and the Emotions in the Shadow of the Apocalypse 1400-1700*, ed. Jennifer Spinks and Charles Zika (London: Palgrave Macmillan, 2016), 55–56.

3 Sebastián Crespo, *Relacion de la tormenta que padeciò la capitana real, en que me ballè, como piloto, al tiempo que passò el mismo infortunio lo restante de las naos de la real armada ...* (Cadiz: por Juan Vejarano, 1672); Anon., *Les Malheurs des Anglois dans la Jamaïque. A Bord du Vaisseau l’Industrie, devant la Baye des Ruines de Port Royal dans la Iamaïque, le 30. Iuin & 10. Iuillet 1692* (n.p.: n.p., 1692). “Remarks of the misfortunes that Befell his majestys Ship Litchfeild [sic] [...]”, 1758, NMM JOD/7.

4 e.g. “tanta desdicha”, in Anon., *Breve relacion del borroso incendio: que ha padecido la ciudad de Londres, desde Domingo 12 de Septiembre, hasta Iueves 16 del mesmo mes, de este año 1666* (En Sevilla: Por Iuan Gomez de Blas, su impressor mayor, 1666), A1r.

5 An early English application of the term to disaster appears in connection with a storm, in Robert Harrison, *A Strange Relation of the Suddain and Violent Tempest, Which Happened at Oxford May 31, Anno Domini 1682: Together with an Enquiry into the Probable Cause and Usual Consequents of Such like Tempests and Storms* (n.p.: Printed for Richard Sherlock, 1682), 12. For French usage from the early eighteenth century, see Michael O’Dea, “Le mot ‘catastrophe,’” in *L’invention de la catastrophe au XVIIIe siècle: du châtiment divin au désastre naturel*, ed. Anne-Marie Mercier-Faivre and Chantal Thomas (Genève: Droz, 2008). More broadly, see Olaf Briese and Timo Günther, “Katastrophe: terminologische Vergangenheit, Gegenwart und Zukunft,” *Archiv für Begriffsgeschichte*, 2009, 155–95; Mauelshagen, “Defining Catastrophes,” 174; Schenk, “Disastro, Catastrophe, and Divine Judgement: Words, Concepts and Images for ‘natural’ Threats to Social Order in the Middle Ages and Renaissance,” 57–59.

6 “Azote de Dios”: “public calamities, and punishments which Divine Justice uses as warnings [...] like plague, famine, and war”. (“[...] las calamidades públicas, y castigos con que la Justicia Divina suele avisar [...] como peste, hambre, y guerra.”), *Diccionario de Autoridades*, tomo I (1726); “Mais Dieu nous châtia par un autre fleau [...]”. Mère Juchereau de St-Ignace, *Histoire de l’Hôtel-Dieu de Québec* (A Montauban [France]: Chez Jerome Legier, et se vend à Paris, chez Claude-Jean-Baptiste Herissant, libraire, 1751), 461. “[...] absolviendonos en semejante tribulacion [...]”, AGI, Lima, 304, f. 3r.

7 “calamité”: “Misfortune, misery, trouble. It is most commonly used for general misfortunes”. (“Malheur; misere; trouble; infortune. Il se dit plus ordinairement des malheurs generaux.”) Furetiere, *Dictionnaire Universel: Contenant Generalement Tous Les Mots François...* The *Diccionario de Autoridades* (Tomo II, 1729), defined “calamidad” as an “event or misfortune that makes somebody miserable and greatly troubled”. (“El accidente o infortunio, que hace infeliz y llena de trabajos a algún hombre.”)

importance. Although not intrinsically religious, the concept of calamity could be easily connected to providential doctrine. The eighteenth-century Spanish *Diccionario de Autoridades* illustrated its definition of *calamidad* with a quote from Juan Márquez' *Gobernador Christiano* (1612) to the effect that "Plagues and public calamities are effects of the wrath of God, provoked by our disorders".<sup>8</sup>

The habit of clustering phenomena is clearly visible in ecumenical Christian doctrine, where a diffuse association of destructive phenomena formed a core part of teachings about Biblical history, God's government of the world and the Apocalypse. The Hebrew Bible frequently lumped afflictions with quite different symptoms together, sometimes in groupings of numbers with mystical significance: the three arrows of God (famine, plague and war), the Four Horsemen of the Apocalypse and the ten plagues of Egypt. In Jeremiah 24:10 God threatened to send "the sword, the famine, and the pestilence", while Matthew 24:7 prophesied "famines, and pestilences, and earthquakes". On the other hand, God's mercy also promised deliverance from the same ambiguous grouping of ills: in 2 Chronicles 6:28, the Lord undertook to deliver the suppliant righteous of Israel, "If there be dearth in the land, if there be pestilence, if there be blasting, or mildew, locusts, or caterpillars; if their enemies besiege them in the cities of their land; whatsoever sore or whatsoever sickness there be".

Theologians of every confession accepted the amorphous quality of these Scriptural lists of adversities. Since God's omnipotence could turn every part of the natural and human world against the wicked, there was little reason to examine the components of the category of adversities in great detail. In addition, early modern clergy and historians, much like the writers of the early Church, realised that combining calamities heightened the sense of wonder and mystery in a narrative and

---

<sup>8</sup> "Las pestes y calamidades públicas son efectos de la ira de Dios, provocada de nuestros desconciertos." *Diccionario de Autoridades*, Tomo II, 1729.

added weight to allegations of divine judgements or warnings. Furthermore, the Church Fathers had cemented the essential interrelationship of the diverse calamities of the Bible. Placing the message in Matthew 24:7 in the context of the Roman siege of Jerusalem of 70 CE, John Chrysostom tersely commented, “if thou art minded to learn these things more distinctly, I mean, the famines, the pestilences, the earthquakes, the other calamities, peruse the history about these things composed by Josephus, and thou wilt know all accurately”.<sup>9</sup> “Learning” and “knowing” about calamities meant absorbing a narrative account of events (in this case, Josephus’ *Judean War*), which showed how one event foreshadowed another, rather than considering the phenomenal relationship between the disparate occurrences. Moreover, patristic writers fused the Scriptural account of the tribulations of the Hebrews and their neighbouring peoples with the similarly ambiguous concept of misfortune in the Greco-Roman world. In seeking to exculpate the Christians from blame for the Visigoths’ sack of Rome in 410 CE, Augustine of Hippo expounded upon the “countless and in a few cases even unbelievable misfortunes” that had been suffered by the pagan Romans before the birth of Christ, including “famine, disease, war, pillage, captivity, slaughter and similar calamities”.<sup>10</sup> The Roman histories in early modern libraries similarly clustered adversities together. Tacitus began his *Histories* by describing Italy in 69 CE as beset by calamity (*clades*) in the form of earthquakes, great fires, wars, massacres, the proliferation of informants and civil turmoil.<sup>11</sup> Medieval chronicles continued this habit of listing diverse troubles together. Discussing calamities at fifth-century Constantinople, the Venerable Bede grouped together famine, plague, the depredations of the Huns and the collapse of

---

9 John Chrysostom, *The Homilies of S. John Chrysostom on the Gospel of St. Matthew*, ed. Charles Marriott, trans. George Prevost (Oxford: John Henry Parker; F and J Rivington, 1851-79), vol. 3, p. 1001.

10 Augustine of Hippo, *City of God*, trans. William M. Green, vol. 7 (Cambridge, MA: Harvard University Press, 2014), III.1.

11 Tacitus, *Histories*, I.i-iii.

the city's walls.<sup>12</sup> Furthermore, medieval and early modern writers followed the example of ancient authorities in connecting these miscellaneous disorders to a bewildering array of frightening portents, from the birth of animals with deformities to visions of armies, weapons and ships in the sky.<sup>13</sup>

Ancient historical and philosophical works also provided another way to conceive of destructive events, as part of an endless cycle of fortune and misfortune. Stoic philosophy encouraged the grouping of all harmful occurrences within a single category of adversities, suggesting that individuals should steel themselves for misfortune by keeping in view all the possible travails and mishaps that could afflict them. Adapted by the Christian writer Boethius in the sixth century, the motif of Fortune's wheel became an influential part of medieval and early modern art and literature. Petrarch's fourteenth-century *De remediis utriusque fortune* (*On the remedies for both sorts of fortune*), widely translated and reprinted in the early modern era, included essays designed to fortify readers against over one hundred troubles, from earthquakes and plagues to torture, insomnia, stubborn sons and disloyal friends.<sup>14</sup> In the sixteenth and seventeenth centuries, the idea of the cyclical fluctuation of states of prosperity and misery gave rise to an important spiritual genre of *consolatio* writings, which

---

12 Bede, *Bede's Ecclesiastical History of England; a Revised Translation with Introduction, Life, and Notes by A.M. Sellar* (England: G Bell and sons, 1907), I.xiii.

13 Katharine Park and Lorraine Daston, "Unnatural Conceptions: The Study of Monsters in Sixteenth- and Seventeenth-Century France and England," *Past & Present* 92, no. 1 (1981): 20–54; Jean Céard, *La nature et les prodiges: l'insolite au XVIe siècle*, 2nd éd. rev. et aug. (Genève: Droz, 1996); Lorraine Daston and Katharine Park, *Wonders and the Order of Nature, 1150-1750* (New York: Zone Books ; Cambridge, Mass., 1998); Alexandra Walsham, "Vox Piscis: Or The Book-Fish: Providence and the Uses of the Reformation Past in Caroline Cambridge," *The English Historical Review* 114, no. 457 (1999): 574–606; Alexandra Walsham, *Providence in Early Modern England* (Oxford; New York: Oxford University Press, 1999).

14 Francesco Petrarca, *Petrarch's Remedies for Fortune Fair and Foul: A Modern English Translation of De Remediis Utriusque Fortune, with a Commentary*, trans. Conrad H. Rawski (Bloomington: Indiana University Press, 1991), vol. 3. Vernacular translations included Francesco Petrarca, *De los remedios contra prospera y adversa fortuna* (Caragoça: por Georgi Coci, 1523); *Messire Francois petracque des remedes de lune & lautre fortune: prospere & aduerse: nouvellement imprime a Paris* (On le vend a Paris: rue Saint Jacques par honneste homme Pierre Cousin, 1534); *Phisicke against Fortune, Aswell Prosperous, as Adverse: Conteyned in Two Bookes...*, trans. Thomas Twyne (London: Printed by Thomas Dawson for Richard Watkyns, 1579).

reaffirmed the tendency to unite troubles into a single category. Thomas More began his *Dialogue of comfort against tribulation* (1534) by pointing out that “[i]f the whole life of man be a continual warfare upon earth, as Gods owne word doth wnesse [...] how great nede have we, to provide some good armour and weapon in this our long warfare” against “the sundrie sorowes and woes that appertaine to eche state”.<sup>15</sup> The sixteenth-century *devotio moderna* movement further evolved the Stoic principle of preparedness into a doctrine of Christian patience in tribulations, as an avenue to mystical union with Christ.<sup>16</sup> Although Protestant reformers in England denied the salvific functions that Catholics attached to the endurance of tribulation, they created a religious identity based on suffering and oppression that magnified the pious benefits of adversities in general.<sup>17</sup>

The eclecticism of the category of calamities was also underpinned by Christian ideas of the inherent dangers of the natural world. In the Book of Genesis (3:17-19), when God banished Adam and Eve from Eden, He simultaneously cursed the earth. Formerly a lush and fertile garden, it would henceforth yield crops only with great toil, while thistles and thorns would perpetually hamper Adam’s attempts at cultivation. In his gloss on this episode, Augustine drew out the earth’s sudden transformation from verdant cornucopia to stubborn adversary. In his view, humans after the Fall were constantly punished for the original sin in their mortal lives by having to struggle against an unhelpful nature that was difficult and dangerous by design, and which spontaneously produced poisonous and prickly plants to admonish Adam and Eve’s descendants.<sup>18</sup> In *The City of*

---

15 Thomas More, *A Dialogue of Cumfort against Tribulation, Made by the Right Vertuous, Wise and Learned Man, Sir Thomas More, Sometime L. Chancellor of England, Which He Wrote in the Tower of London, An. 1534...*, (Antuerpie: Apud Iohannem Foulherum, Anglum, 1573), \*iiii.

16 Alexandra Walsham, “The Happiness of Suffering”, 47.

17 Walsham, 47, 51–52.

18 Augustine of Hippo, “On Genesis: A Refutation of the Manichees,” in *The Works of Saint Augustine: A Translation for the 21st Century*, ed. John E. Rotelle, trans. Edmund Hill (Hyde Park, NY: New City Press, 2002), 51.

God he elaborated on the miseries that humans can expect from the environment thanks to original sin:

What fear there is of the countless accidents [*innumeris casibus*] that threaten the body from without—of heat and cold, storms, rain, floods, lightning, thunder, hail, the bolt that strikes, earthquakes and chasms in the earth, of being crushed by falling buildings, or run down by frightened or even by vicious domestic animals, of the numerous poisons in shrubs, bodies of water, currents of air, and animals, of the merely painful or even deadly bites of wild beasts [...] What ills sailors endure, and those who travel by land! Who goes anywhere and is not liable to unexpected accidents?<sup>19</sup>

The proliferation of perils after the Fall attained a new importance in the early Reformation. Martin Luther's commentary on Genesis portrayed humanity in the figure of a gardener or farmer besieged by endlessly multiplying hordes of natural enemies. Only constant assiduous labour could keep at bay the "pernicious plants", invasive insects and ravenous vermin that had first begun to infest the earth at the Fall, and which became even worse after the Deluge, when God magnified the curse: "How many kinds of damage and how many diseases affect the crops, the plants and the trees, and finally everything, that the earth produces! How much harm is done to the vegetables by harmful insects!" Furthermore, since the Bible did not mention them as occurring in Eden, Luther understood the curse to have set in motion a whole range of hazards, including "frosts, lightning bolts, injurious dews, storms, overflowing rivers, settling of the ground, [and] earthquakes". The physical phenomena, plants and creatures that wreaked such harm on humanity were to be taken collectively as preachers of a physical sermon, reminding sufferers of the depravity of man and the

---

19 Augustine of Hippo, *City of God*, 7:XXII.22, pp. 310–11.



ills it had wrought.<sup>20</sup> Luther thus portrayed these adversities as the product of a general shift in God's activity after the Fall, from acts of creation to the penal work of correction and rehabilitation.

Thomistic theology took a different but complementary route, by emphasising the rational capacities of humans on the one hand and the irrationality of nature on the other. Glossators since the time of Augustine had struggled to make sense of the justice of God's curse in view of the innocence of the earth and its flora and fauna. Thomas Aquinas explained that irrational animals, plants and features of the landscape "are not competent subjects either of guilt or of punishment", since they contain nothing but God-created nature. Since they could not therefore be cursed for themselves, the Fall did not distort the moral character of natural things by making them malevolent. Instead, God began to use nature as a tool to punish mankind through active "ministration".<sup>21</sup> This line of reasoning allowed seventeenth-century Catholic preachers to suggest simultaneously that hazards were morally neutral parts of an area's character and that God wielded and exacerbated them in divine judgements. After the Lima earthquake of 1687, Fray Nicolás de León pointed out to his congregants that punishments for sin were inevitably far greater in a country, like Peru, that experienced frequent earthquakes.<sup>22</sup> However, Catholics writers also drew upon the view that the harmful forces of nature unleashed after the Fall and the Deluge offered a perpetual threat to human civilisation. Using urban imagery that offered a remarkable parallel to Luther's besieged farmer, the

---

20 Martin Luther, "Lectures on Genesis Chapters 1-5," in *Luther's Works*, ed. Jaroslav Pelikan, trans. George V. Schick (Saint Louis: Concordia, 1958), 204–6.

21 Thomas Aquinas, *Summa theologiae*, Q.76, art. 2. English translation from *The "Summa Theologica" of St. Thomas Aquinas*, trans. Fathers of the English Dominican Province (New York: Benziger Brothers, 1918), 312.

22 Josephe de Mugaburu, *Chronicle of Colonial Lima: The Diary of Josephe and Francisco Mugaburu, 1640-1697*, trans. Robert Ryal Miller (Norman: University of Oklahoma Press, 1975), 319.

architectural writer Leon Battista Alberti described the constant assault on the built environment of floods, heat, mould and wind.<sup>23</sup>

The ancient approach to clustering calamities retained its basic integrity amidst the upheavals of the late Middle Ages and the Reformation because it was deeply entwined with fundamental assumptions about the relationship between the natural and human worlds and between God and the Creation. Sixteenth- and early seventeenth-century testimonies about prodigious natural phenomena reflected the ingrained belief that “the physical environment was morally sensitive and responsive to human fortunes and transgressions, a mirror and cipher of the spiritual sphere”.<sup>24</sup> Extraordinary natural events were frequently read as portents for civil turmoil, while major political events were understood to precede natural disturbances. Describing the storm that accompanied the death of Oliver Cromwell in 1658, the poet Andrew Marvell explained that “A secret cause does sure those signs ordain / Foreboding princes’ falls, and seldom vain”.<sup>25</sup> Such concordances discouraged a consistent separation between environmental disruptions and the turbulent affairs of humans, since each reflected the other and both were manifestations of God’s power. This conceptual fluidity found linguistic expression in the free exchange of metaphors throughout the early modern era between discussions of dangerous natural phenomena, politics and religion. In his *Pensées*, Blaise Pascal explicitly compared the persecutions of the Church (and by extension, of Jansenism) with the experience of being in a ship during a storm.<sup>26</sup> The Boston congregationalist preacher Increase Mather spoke of earthquakes as prognostics “of State-quakes, of Church-quakes,

---

23 Leon Battista Alberti, *De re aedificatoria*, I.4. Alberti’s complex attitude to the Fall is considered in Caspar Pearson, *Humanism and the Urban World: Leon Battista Alberti and the Renaissance City* (University Park, PA: Pennsylvania State University Press, 2011), chap. 1.

24 Alexandra Walsham, “Vox Piscis,” 577.

25 Andrew Marvell, “A Poem upon the Death of His Late Highness the Lord Protector,” in *The Poems of Andrew Marvell*, ed. Nigel Smith (London: Pearson Longman, 2003), l.s 101-102.

26 Blaise Pascal, *Pensées and Other Writings*, trans. Honor Levi (Oxford; New York: Oxford University Press, 1995), No. 617.

of Kingdom-quakes, of Province-quakes”, simultaneously reading Scriptural references to “Great Changes and *Revolutions*” as physical upheavals of the earth and comparing “a sudden and very astonishing Change of affairs” in the political realm to a great earthquake.<sup>27</sup> The porosity of the linguistic and conceptual boundaries meant that even beyond the realm of conscious metaphor, natural philosophical and political vocabularies shared some of the same technical vocabulary: “revolution” could thus describe seismic and planetary motion as well as political change.<sup>28</sup>

Retaining the ambiguity of the ancient category of calamity was useful for theologians and preachers because it meant that the Church was prepared to deal with — and even draw advantage from — every possible adversity. The clergy effectively presented themselves as experts on calamity, able to explain and suggest remedies for even the most mysterious of events. Their central resource was the ecumenical Christian teaching that God used earthquakes, storms, fires and other calamities to punish errant humans for their sins, to admonish them to find the path of righteousness (and thereby avoid eternal damnation), or to test the faith of the pious. This doctrine of castigation constituted a subset of the broader logic of providentialism.<sup>29</sup> According to this doctrine, God could act on the world either through direct intervention (“special” or “direct” providence), which often entailed bending the laws of nature, or by using regular natural phenomena as His instruments (“general” or “indirect” providence). Those phenomena were then described as “secondary” causes, as distinct from the “primary” cause of God’s will. Early modern writers sometimes described

---

27 Increase Mather, *A Discourse Concerning Earthquakes: Occasioned by the Earthquakes Which Were in New-England, in the Province of Massachusetts-Bay, June 16. and in Conecticut-Colony, June 22. 1705...* (Boston: Printed by Timothy Green, for Benjamin Eliot, at his shop under the west end of the Exchange, 1706), 13–14.

28 Schenk, “Dis-astrì: modelli interpretativi delle calamità naturali dal Medioevo al Rinascimento,” 67; Mary Ashburn Miller, *A Natural History of Revolution: Violence and Nature in the French Revolutionary Imagination, 1789-1794* (Ithaca, NY: Cornell University Press, 2011); Mauelshagen, “Defining Catastrophes,” 174.

29 The best guide to early modern providentialism is Walsham, *Providence in Early Modern England*. See also David D. Hall, *Worlds of Wonder, Days of Judgment: Popular Religious Belief in Early New England* (New York: Knopf, 1989); Jerome Friedman, *The Battle of the Frogs and Fairford’s Flies: Miracles and the Pulp Press during the English Revolution* (New York: St Martin’s Press, 1993); Michael P. Winship, *Seers of God: Puritan Providentialism in the Restoration and Early Enlightenment* (Baltimore, MD: Johns Hopkins University Press, 1996).

divine judgements in the symbolism of Matthew 3:12, in which God is described as separating out the wheat and burning the chaff. As one writer put it after a destructive storm in the Spanish town of Lorca in 1674, “just as someone who grows plants and roots in his garden tears up the useless ones that don’t bear fruit and flings them into the fire, so the Lord God does with human plants: those that do not bear forth the fruit of good works he condemns to the fire”.<sup>30</sup> On the other hand, the religious fear that catastrophes inspired provided clergymen with an apparently heaven-sent opportunity for conversion and reformation. The pouring of frightened people into Churches after disasters was often described positively as a “harvest” of souls: an “*admirable fruto*”, in the words of one Spanish writer.<sup>31</sup> After an earthquake in 1687, the archbishop of Lima expected that “the fruit of this tribulation has to be a very bountiful harvest of reformation”.<sup>32</sup>

If preachers seized on disasters as occasions for shoring up the faith of their congregants, missionaries and polemicists recognised in it a powerful resource for converting pagans. Since providentialism supposedly offered an explanation and a remedy for the full ambit of fearful afflictions, it provided Christian clerics and missionaries with a tool to discredit other belief systems. In the early centuries of Christianity, evangelists had taken advantage of catastrophes as opportunities to win adherents, battle rival sects and excoriate pagan opponents.<sup>33</sup> Missionaries in the early modern Atlantic world followed this example, founding their authority among indigenous peoples partly on their claim to know the secrets behind disasters. In doing so they assumed a

---

30 “como el que cultiva las plantas, y raizes de su huerta, a las inutiles, y que no dàn fruto, las arranca, y echa en el fuego; assi la Magestad de Dios, a las plantas humanas, que no dàn fruto de buenas obras las condena al fuego”. Anon., *Copia de una carta escrita por un Cavallero de la Ciudad de Lorca á otro de esta Corte, avisandole del gran terremoto, y Uracan que hubo en dicha Ciudad, desde el dia de San Lorenzo, hasta el dia de la Degollacion de San Iuan, que es á 29. de Agosto de 1674* (Madrid: Ioseph del Espiritu Santo, n.d.), BNE VE/26/55.

31 AGI, Indiferente General, 1991, f. 6r.

32 “el fruto desta tribulacion ha de ser muy copiossa cosecha de reformation”, Melchor Liñan de Cisneros to Carlos II, 3 December 1687, AGI, Lima, 304, f. 14v.

33 Toner, *Roman Disasters*, 80–86.

quasi-magical role, gaining new responsibilities that did not always sit comfortably alongside Church doctrine: one French Jesuit complained that, as a missionary in Canada, “you are responsible for the sterility or fecundity of the earth, under penalty of your life; you are the cause of droughts; if you cannot make rain, they speak of nothing less than making away with you”.<sup>34</sup> By extension, some Huron attributed the terrible diseases that afflicted them in the 1630s to Jesuit sorcery, and they reportedly believed that the French were responsible for sending out the thunder bird that caused storms.<sup>35</sup>

Catholic writers also emphasised the remarkable power of ecclesiastical rites over dangerous natural phenomena. Gonzalo Fernández de Oviedo’s natural history of the Indies (1526) claimed that the mere celebration of Holy Communion had diminished the frequency and destructiveness of hurricanes in the New World.<sup>36</sup> In his treatise on superstitions of 1529, Martín de Castañega advised priests that displaying relics and holding mass should help to avert a storm; if that failed another effective measure was to have the congregation go outside and confront the storm clouds, reciting the litany of saints while the priest thrust his cross against the sky.<sup>37</sup> The most influential model for placating God’s wrath was that established by Pope Gregory I (“the Great”) in the late sixth century. Gregory had famously averted plague in Rome by organising processions of the clergy and people, who prayed, sang psalms, chanted the *Kyrie eleison*, and emitted laments and groans to attract divine pity.<sup>38</sup> An example of how closely some early communities followed this model can be seen in the

---

34 Cited in Alan Taylor, *American Colonies: The Settling of North America* (New York: Viking, 2001), 110.

35 Laurent Bordelon, *Remarques ou reflexions critiques, morales et historiques, sur les plus belles & les plus agreables pensées, qui se trouvent dans les ouvrages des auteurs anciens & modernes* (A Paris: chez Arnoul Seneuse, ruë de la Harpe, vis-à-vis la ruë des Mathurins, à la Sphere, 1690), 103; Taylor, *American Colonies*, 110.

36 Gonzalo Fernández de Oviedo y Valdés, *De la natural hystoria de las Indias* (Toledo: n.p., 1526), f. 15v.

37 Martín de Castañega, *Tratado de las supersticiones y hechizerias y de la posibilidad y remedio dellas (1529)*, ed. Juan Robert Muro Abad, 3. ed. (Logroño: Gobierno de La Rioja; Instituto de Estudios Riojanos, 1994), 63.

38 Gregory of Tours, *The History of the Franks*, trans. Lewis Thorpe (Harmondsworth, UK; Baltimore: Penguin, 1974), X.1.

response of the Monastery of Santa María de Guadalupe in Extremadura (one of Spain's most renowned shrines) to a plague outbreak in 1682. The printed account of the ceremonies described how "[i]n imitation of the Roman People [...] in a general plague that they suffered in the time of the holy Pope Gregory", the populace filed through the town bearing the image of the Virgin of Guadalupe, invoking heavenly aid through song and prayers (said out loud), "the eyes of each person being a sea of tears". That very day, according to the pamphlet, the sickness began to abate: the combination of the rituals and the renowned power of the Black Madonna had successfully inclined God from punishment to mercy. While the image had been particularly successful at combating plague — merely turning the cedar image to face Seville had supposedly cured that city of the contagion — the author pointed out that the holy image was equally efficacious in dealing with "the four elements" and "the rigours of every type of sickness".<sup>39</sup> Catholic ceremonial did possess features that targeted certain phenomena, including the invocation of particular saints: Saint Rosa (the first American saint) was said to protect Lima against earthquakes, for instance, while Saint Anthony supposedly preserved Santiago de Chile from floods.<sup>40</sup> However, saints were also generally capable of interceding with God in numerous kinds of affliction. Each region had its constellation of patron and tutelary saints, who were understood to discharge protective functions against an array

---

39 "Letanias, Missas, processiones, limosnas, disciplinas, ayunos, y lagrimas"; "à imitacion del Pueblo Romano, que en una peste general, que padeciò en tiempo del santo Pontifice Gregorio"; "siendo los ojos de cada uno un mar de lagrimas"; "no tan solamente [sic] los quatro elementos, sino es [sic] el rigor de toda diversidad de enfermedades". Anon., *Relacion breve, en que se da noticia como se sacò en procession, por la peste, la Milagrosissima Imagen de Guadalupe al portico de su Santo Templo, el dia 19. de Julio de este año de 1682. y los muchos beneficios que los Fieles han recibido de su Santissima Mano* (Madrid: por Iulian de Paredes, 1682).

40 Gaspar de Villarroel, *Gobierno eclesiastico-pacifico y union de los dos cuchillos Pontificio y Regio* (Madrid: en la oficina de Antonio Marin, 1738), 574; Charles F. Walker, *Shaky Colonialism: The 1746 Earthquake-Tsunami in Lima, Peru, and Its Long Aftermath* (Durham: Duke University Press, 2008), 25–27.

of external threats.<sup>41</sup> Above all, Catholics directed appeals in disaster situations to Jesus and Mary, who acted as the chief intercessors in all adversities.

In place of the Catholic processions and invocation of saints, Protestants employed a combination of fasts, sermons and prayers. There were both public and private aspects to these devotions. Mary Rich, Countess of Warwick, kept an annual fast in her chapel on the anniversary of the Great Fire of London of 1666, “having taken a resolution to keep it as long as I lived”.<sup>42</sup> Secular authorities proclaimed special “Days of Humiliation” during public calamities, which involved supercharged disaster sermons and general fasts. After a great fire in Edinburgh in 1700, the Scottish politician Sir John Clerk of Penicuik took part in a “solemn fast” and attended two sermons by different preachers: one on Deuteronomy 29:24 (“Even all nations shall say, Wherefore hath the Lord done thus unto this land?”) and another on Deuteronomy 32:18-19 (“Of the Rock that begat thee thou art unmindful, and hast forgotten God that formed thee [...]”).<sup>43</sup> The chief model for both Protestant and Catholic practices of communal humiliation was the Biblical description of the preservation of Nineveh in Jonah 3:1-10. Heeding the timely warning of Jonah, the residents of Nineveh had saved their city from destruction by humbly dressing in sackcloth and ashes and holding a general fast. Early modern people tried to follow this example as literally as possible. One late seventeenth-century English writer exclaimed, “oh what *Energy*, what *prevalency* might a sincere *Ninivitical* Humiliation have against the *Powers* of Heaven! How might it wrest and extort Mercy

---

41 On the role of the saints, see Simon Ditchfield, “Thinking with Saints: Sanctity and Society in the Early Modern World,” *Critical Inquiry* 35, no. 3 (2009): 552–84; Monica Azzolini, “Coping with Catastrophe. St Filippo Neri as Patron Saint of Earthquakes,” *Quaderni Storici* 52, no. 3 (2017): 727–50.

42 Diary of Mary Rich, Countess of Warwick, September 2, 1668, BL Add MS 27351-27355; Mary Rich Warwick, *Memoir of Lady Warwick: Also Her Diary, from A.D. 1666 to 1672, Now First Published: To Which Are Added, Extracts from Her Other Writings*, ed. Anthony Walker (London: Religious Tract Society, 1847), 166–67. I am grateful to Olivia Weisser for referring me to this source.

43 John Clerk of Penicuik, spiritual journal, February 22, 1700, 1708, NRS GD18/2092.

from God, and avert these impending *Catastrophies!*”<sup>44</sup> After an earthquake in 1678, the archbishop of Lima drew a similarly emotive lesson: “knowing the Value in which God holds tears, and that these made Him revoke the death sentence of Nineveh, the People garbed themselves in tears [...] in copious profusion”.<sup>45</sup> The lesson from the sparing of Nineveh was that God’s judgements could be averted by humiliation and repentance, regardless of the nature of the threat to the community.

The flexibility of Christian doctrine on tribulations gave it considerable explanatory power: it could account for any kind of affliction. However, the adaptability and range of this providential framework of calamity came at the cost of specificity, which meant that as an analytic category it was typically characterised by an *a priori* certainty of causes and effects that tended to obviate detailed inquiry. This was not merely a religious but an epistemic issue, since the tendency to cluster calamities was reproduced in every intellectual tradition. Astrology, for instance, favoured undifferentiated groupings of misfortunes whose causes were literally determined beforehand by well-established celestial mechanics. The appearance of a comet could simultaneously portend earthquakes, storms, shipwrecks, plagues and floods, along with the deaths of kings, the eruption of rebellions, the emergence of new heresies, schisms in the Church and bloody conflicts.<sup>46</sup> As such, the entire area of knowledge concerned with disasters lacked conceptual clarity. Despite its accessibility, consistency and usefulness in evangelising, the multifarious concept of calamity posed problems for detailed scholarly inquiries. When early modern writers desired to investigate one aspect or other of the panoply of negative and destructive events, the prevailing conceptual ambiguity made their task very difficult. Even if they wanted to study only one type of destructive

---

44 Harrison, *A Strange Relation of the Suddain and Violent Tempest, Which Happened at Oxford May 31, Anno Domini 1682*, 12.

45 “conociendo el Pueblo el Valor que tienen con Dios las lagrimas y que le hicieron revocar la sentencia capital de Ninive las Vestieron en presencias de su Mag.d divina en copiosisima proffusion” , AGI, Lima, 78, no. 3, ff. 2r-v.

46 See the discussion in ch. 3.



phenomenon, such as earthquakes, the confusion of causative theories meant that any comprehensive discussion needed to cover not only seismic shaking but also volcanism and avalanches, winds, fires, airs, the movement of waters and the actions of planets.

The ambiguity of the idea of calamity and its close association with the equally capacious field of portents made it most amenable to scholarly approaches that emphasised heterogeneity. Sixteenth-century prodigy compilations like Pierre Boaistuau's *Histoires prodigienses* (1560) and Ambroise Paré's *Des monstres et prodiges* (four editions up to 1585) classed disastrous phenomena alongside the other strange things of the natural and human world, such as monstrous births, rains of toads or blood, sea monsters, parhelia and visions of armies fighting in the air.<sup>47</sup> Paré, for instance, covered volcanic eruptions after discussing strange, exotic creatures and “*monstres célestes*” (apparitions in the sky).<sup>48</sup> The genre of sixteenth and seventeenth-century compilations of divine judgements, on the other hand, considered great storms alongside mysterious and sudden deaths, disfigurements, and even talking trees.<sup>49</sup> Although focused on the divine punishment of individuals, Thomas Beard's hugely popular *Theatre of God's judgements* (1597) noted that God also corrected people “in a heap: sometimes by stormes and tempests, both by sea and land; other times by lightning, haile, and deluge of waters, often by overflowing and breaking out of rivers, and of the sea also: and not seldome by remedillesse and sudden fires, heaven and earth, and all the elements being armed with an invincible force, to take vengeance upon such as are traytors and rebels against God”.<sup>50</sup>

---

47 Pierre Boaistuau, *Histoires prodigienses les plus memorables qui ayent esté observées, depuis la nativité de Iesus Christ, iusques à nostres siecle: Extraictes de plusieurs fameux auteurs, Grecz, & Latins, sacrez & prophanes: mises en nostre langue par P. Boaistuau surnommee Launay, natif de Bretagne, avec les pourtraictz & figures* (Paris: Pour Jean Longis & Robert le magnier libraires..., 1560); Ambroise Paré, *Des monstres et prodiges*, ed. Michel Jeanneret (Paris: Gallimard, 2015).

48 Paré, *Des monstres et prodiges*, chap. XXXVIII.

49 This genre is discussed in detail in Walsham, *Providence in Early Modern England*.

50 Thomas Beard, *The Theatre of Gods Judgements: Wherein Is Represented the Admirable Justice of God against All Notorious Sinners...*, The fourth Edition, With Additions (London: Printed by SI & MH and are to be sold by Richard Whitaker at the signe of the Kings Armes in St Pauls Churchyard, 1648), 409–10.

Similar panoplies of destructive events lay at the heart of other kinds of writing, including local histories. Antoine Froment, a lawyer at the Parlement of Dauphiné, published in 1639 a collection of extraordinary occurrences in the vicinity of Briançon in the French Alps.<sup>51</sup> The main focus of the work was a lengthy account of devastating fires in Briançon, to which Froment appended chapters on earthquakes, wolves, plagues, famines, floods and avalanches. Although he clearly perceived some underlying relationship between these kinds of misfortune, Froment did not articulate any identifiable ordering of disastrous phenomena, instead referring to them with the ambiguous terms *adversités*, *mal-beurs*, *singularitez* and *curiosités*. As adversities and misfortunes, they corresponded to the old sphere of negative occurrences; as singularities and curiosities they fitted alongside other miscellaneous notable events, such as the passage of the French king through the region, in the process losing even the unique aspect of destructiveness. Later antiquarians rediscovering Froment (whose work quickly slipped into obscurity) remarked on the lack of a clear organising principle in the *Essais*.<sup>52</sup> Even the nineteenth-century editor in charge of a reprinting of Froment's work, whose preface sought to rehabilitate the text, conceded that “[o]ne is in the right [...] to reproach Froment for the lack of order and method”, since “[t]he facts present themselves in a singular muddle, and it is only with some labour that the reader can himself introduce some kind of sequence in the account”.<sup>53</sup>

---

51 Antoine Froment, *Essais d'Antoine Froment avocat au parlement du Dauphiné, sur l'incendie de sa patrie, les singularitez des Alpes en la Principauté du Briançonois; Avec plusieurs autre curieuses remarques sur le passage du Roy aux Italies, ravage des loups, pestes, famines, Avalanches, & embrasemens de plusieurs Villages, y survenus de suite* (Grenoble: Par Pierre Verdier, Imprimeur du Roy, en la sale du Palais, 1639).

52 An overview of these critiques may be found in the preface to Antoine Froment, *Essais d'Antoine Froment, avocat au parlement de Dauphiné*, ed. Aristide Albert (Grenoble: Imprimerie Édouard Allier, 1868).

53 “On est en droit [...] de reprocher à Froment le défaut d'ordre et de méthode. Les faits se présentent dans un singulier pêle-mêle, et ce n'est que par un certain travail que le lecteur peut introduire lui-même quelque enchaînement dans le récit”. Froment, 1868, viii.

Natural philosophical treatises on earthquakes and volcanic eruptions presented an important alternative to the compilations of monsters and judgements by focusing on a single type of phenomenon. Although there were earlier examples, two sets of events served as particular catalysts for writing in this genre before the mid-seventeenth century: a series of earthquakes in Ferrara in the 1570s and the eruption of Vesuvius in 1631.<sup>54</sup> While such works sometimes contributed personal observations and contemporary reports, the core of this tradition consisted in the glossing of ancient authorities, particularly Aristotle's *Meteorologica*, Seneca's *Naturales Quaestiones* and Pliny's *Historia Naturalis*. Renaissance commentaries on these works endlessly reproduced the essential structure of ancient meteorology, with its eclectic discussion of the causes of storms, floods, earthquakes, eruptions and epidemics alongside rainbows, parhelia and comets. Key departures from the main corpus of classical theory tended to be envisioned not as radical innovations but rather as conservative readings of ancient authorities. The most significant of these departures — the idea that earthquakes were caused by subterranean fires rather than winds or exhalations — was the product of a reliance on works wrongly attributed to Aristotle (*De proprietatibus elementorum*, *Problemata* and to a lesser extent *De mundo*) and an amplification of an obscure passage in the *Meteorologica*.<sup>55</sup> Furthermore, the persistent importance of theological reasoning in scholarly accounts of disasters, such as the widely-discussed 1631 eruption, kept the old diverse category of divine judgements in view.<sup>56</sup> The question of teleology — the ultimate function and purpose of natural phenomena — tended to draw Renaissance natural philosophical writing on earthquakes and storms towards

---

54 Craig Martin, *Renaissance Meteorology: Pomponazzi to Descartes* (Baltimore: Johns Hopkins University Press, 2011), chap. 3; Sean Cocco, *Watching Vesuvius: A History of Science and Culture in Early Modern Italy* (Chicago: The University of Chicago Press, 2013), ch.s 1-2.

55 Rienk Vermij, "Subterranean Fire. Changing Theories of the Earth during the Renaissance," *Early Science and Medicine* 3, no. 4 (1998): 323–47.

56 Jane E. Everson, "The Melting Pot of Science and Belief: Studying Vesuvius in Seventeenth-century Naples," *Renaissance Studies* 26, no. 5 (2012): 691–727; Cecere, "Moralising Pamphlets: Calamities, Information and Propaganda in Seventeenth-Century Naples".

theology on the one hand (especially outside the Italian universities) and the heterogeneous concerns of Aristotelian meteorology on the other.<sup>57</sup> The French lawyer Louis du Thoum's treatise on earthquakes (1616) offered both a summary of ancient natural explanations and chapters on divine causes, portents and spiritual remedies. The preface indicated du Thoum's desire to link his work with the achievements of classical scholarship, which had elucidated for mankind "war, fire, plague, the assaults of the weather, & earthquakes".<sup>58</sup>

Whereas natural studies of earthquakes and volcanic eruptions retained many residual connections with the indiscriminate combinations of phenomena in theology and classical meteorology, another type of contemporary writing about nature tended toward the total fragmentation of these heterogeneous categories. The authors of encyclopedic "theatres" or "treasuries" of nature, building on the model of large sixteenth-century reference works, including Jean Bodin's *Universae naturae theatrum* ("Theatre of all of nature", 1596), aspired to the comprehensive cataloguing of natural phenomena.<sup>59</sup> Writers working according to this pattern reduced earthquakes, storms, fires and plagues to isolated topics within an all-encompassing conversation about the world. The huge *Essay des merveilles de nature, et des plus nobles artifices*, which appeared in over twenty editions between 1621 and 1657, set disastrous phenomena alongside an incredible mélange of topics.<sup>60</sup> The author of the *Essay* was the Jesuit preacher Étienne Binet,

---

57 Craig Martin, "The Ends of Weather: Teleology in Renaissance Meteorology," *Journal of the History of Philosophy*; *Baltimore* 48, no. 3 (2010): 259–82.

58 "[...] la guerre, le feu, la peste, l'injure du temps, & le tremblement de terre [...]" Louis du Thoum, *Le tremblement de terre ou sont contenus ses causes, signes, effets & remedes* (Bordeaux: Par Gilbert Vernoy, 1616), 2.

59 Ann Blair, *The Theater of Nature: Jean Bodin and Renaissance Science* (Princeton, NJ: Princeton University Press, 1997); Blair, *Too Much to Know*, chap. 3.

60 René François [Étienne Binet], *Essay des merveilles de nature et des plus nobles artifices, pièce très-nécessaire à tous ceux qui font profession d'éloquence...*, 12th ed. (Paris: Chez Jean Poquet, 1657).

writing under the pseudonym René François.<sup>61</sup> In his encyclopedic collection Binet used the expansive term “marvel” (*merveille*) to cover not only the extraordinary monsters and prodigies of sixteenth-century teratological compilations, but virtually anything that seemed worthy of discussion — “all the rarities of Nature & of Art”.<sup>62</sup> Here a chapter on “Tempeste” is sandwiched between others on “Remora” and “War”. This choice of organisation indicated a very expansive conception of natural wonders that removed them from the providential domain and set them beside the quotidian aspects of the world. According to Binet’s overall conception, not only anomalies but *all* parts of nature could be marvellous, and disasters were no more intrinsically wondrous than honey or fish. However, in the actual discussion of disasters — identified conventionally in the text as “misfortunes” (*malheurs*) — the rhetoric remained providential, as befitted Binet’s ecclesiastical position. Storms, shipwrecks and earthquakes were divine punishments, and their timely cessation was the result of divine mercy, within the well-established framework of heavenly justice.<sup>63</sup> Nevertheless, the effect of the *Essay*, as with other similar works, was to abstract these occurrences from the theological context that invested them with specific meaning. If compilations of monsters, prodigies and judgements ostensibly provided edifying proof of God’s direct engagement with humanity, the *theatrum naturae* genre instead allowed readers to attain and display a knowledge of everything in the natural world for their own advantage. The subtitle and prefatory epistle of Binet’s *Essay* assured potential readers that the book would be indispensable for those who pursued eloquence — indicating that a diffuse coverage of topics best suited the needs of refined conversation and sociability. A similar formula is evident in the widely-read *Thaumotographia naturalis*

---

61 For his authorship, see “Binet, Étienne”, J. Balteau et al., eds., *Dictionnaire de biographie française* (Paris: Letouzey et Ané, 1933-2018), vol. 6, p. 494.

62 “toutes les raretez de Nature & de l’Art” Binet, *Essay Des Merveilles de Nature*, A3r.

63 Binet, 131.

(1632) of John Jonston (or Joannes Jonstonus), a Polish scholar of Scottish descent who wrote most of the work in London.<sup>64</sup> Jonston conventionally located earthquakes and storms within the discipline of meteorology, but the work as a whole touched on everything from butterflies to sex, and from giants to drunkenness. His understanding of earthquake causation, which involved exhalations and winds trapped beneath the earth, derived entirely from Aristotle, Seneca and Pliny. Jonston substantiated this theory with several observations drawn from classical histories, which he remarked “are full of these calamities”, as well as a few anecdotes from the recent past. As with Binet, Jonston’s natural focus did not preclude conventional religious ideas. His perusal of history left him in no doubt that every earthquake was a portent, since “*Rome* had never any Earth-quake that did not foreshew, some future event”, and he affirmed that the primary cause of such occurrences was the will of God.<sup>65</sup>

Jonston and Binet’s brand of encyclopedism shared with other works an intellectual trajectory leading to comprehensiveness as opposed to distinctiveness in ontological or epistemological classification. Writers working in this vein did not explicitly connect earthquakes to plagues and wars within a single category of calamities, but they offered no clear alternative, other than to situate them within the ancient classes of natural knowledge, which were themselves highly diffuse. By describing earthquakes as “meteors” Jonston recalled their association in classical meteorology with rain, comets, noxious vapours, rainbows and weird celestial apparitions. This made good sense if one accepted the Aristotelian proposition that the underlying physical cause of all these things was the emanation of exhalations from the earth, but it presented little opportunity to make sense of the

---

64 Joannes Jonstonus, *Iob. Iohnstoni thauatographia naturalis, in decem classes distincta...* (Amsterdam: Apud Guilielmum Blaeu, 1632). Translated into English as Joannes Jonstonus, *An History of the Wonderful Things of Nature: Set Forth in Ten Severall Classes...*, trans. John Rowland (London: Printed by John Streater, 1657).

65 Jonstonus, *An History of the Wonderful Things of Nature*, 83–84. The inference on Roman earthquakes was not original but rather derived from Pliny, *Historia naturalis*, II.lxxxvi.

relationships between various hazardous phenomena or of humans to natural upheavals. On the other hand, encyclopedic writers did not necessarily want to efface the deeper significance of these phenomena. For Jonston what was most interesting about earthquakes and powerful storms was not their supposed connection to invisible exhalations, but the astonishing destruction they visited on human civilisation, with all of the moral overtones that came with it. Quoting Seneca's *Naturales Quaestiones*, Jonston urged readers to contemplate not only the workmanship of nature but "the threatenings of Heaven; [...] when the World is all on fire".<sup>66</sup> The encyclopedism of the *theatrum naturae* genre shattered the unity of the category of calamities by fragmenting it into a thousand separate pieces, but insofar as destructive phenomena were concerned it offered no coherent and consistent alternative to the old epistemic order. As a result, even as they dismantled the traditional categories, authors like Jonston and Binet found themselves reaching back to the more meaningful world of Heaven's judgements.

The practice of placing earthquakes and storms alongside all the other marvels of nature reflected the all-embracing curiosity about the natural world visible in "cabinets of curiosity" or *Wunderkammern*.<sup>67</sup> This drive to collect curiosities was particularly apparent in the discussions of the Bureau d'Adresse, an early French scientific society led by the physician Théophraste Renaudot that gathered from 1633 to 1642, and whose proceedings appeared in print in five volumes between 1634 and 1655.<sup>68</sup> At each of the Bureau's regular meetings until 1636 the assembled company considered two unrelated issues in tandem — often a natural subject and one concerned with human artifice,

---

66 Jonstonus, 73.

67 Paula Findlen, *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy* (Berkeley: University of California Press, 1994). It is worth noting that the works of Binet, Jonston and others in the first half of the century seem to blur Findlen's distinction (at p. 27) between late sixteenth-century "encyclopedism" ("the indiscriminate inclusion of every natural object"), and mid seventeenth-century "exoticism" (focused on wonders and marvels).

68 Howard M. Solomon, *Public Welfare, Science, and Propaganda in Seventeenth Century France; the Innovations of Théophraste Renaudot* (Princeton, NJ: Princeton University Press, 1972), chap. 3.

morality or knowledge.<sup>69</sup> Earthquakes were thus considered alongside the vice of envy, while the causes of contagions were juxtaposed with a discussion of the art of secret writing.<sup>70</sup> The proceedings recorded each speaker’s distinct contribution, resulting in a discordant and eclectic sampling of some of the existing opinions on each subject. Thus, the conversation on earthquakes covered both Aristotelian and Stoic notions about subterranean exhalations and more recent views on the combustion of flammable minerals, as well as an original theory that identified tremors as periodic wobbles in the earth’s orbit.<sup>71</sup> The possibilities of direct divine causation, as well as astral influences, also remained in view.<sup>72</sup> If there was no consensus on the exact nature or causes of earthquakes, there was also no reason to connect them to other kinds of destructive phenomena (such as epidemics, which the Bureau discussed in the following year). Isolating each type of phenomenon while juxtaposing it to an unrelated topic echoed the emphasis on sociable erudition in Binet’s *Essay*, perhaps unsurprising for a club “directed to rhetorical ends, as much as to informational and scientific ends”.<sup>73</sup> The diverse tenor of the discussions at the Bureau offered a stark contrast to the closed world of contemporary Parisian literary clubs, but it never aspired to the elucidation of any kind of coherent intellectual framework for natural phenomena.

Rather than try to replace the traditional category of calamities, some scholars attempted to deepen it by providing a bridge between the developments in natural inquiries and the theology of divine justice. One way to do this was to accentuate the difference between private or personal calamities and public ones — those that affected cities or kingdoms. This was the strategy of the *Causa y remedio de los males públicos* (“Cause and remedy of public ills”, 1642) of Juan Eusebio

---

69 Solomon, 66.

70 Conferences of 16 April 1635 (no. 24) and 21 January 1636 (no. 49), in *Seconde Centurie des questions traitées ez conférences du Bureau d’adresse* (Paris: Au Bureau d’Adresse, 1636).

71 *Seconde Centurie des questions traitées ez conférences du Bureau d’adresse*, 186–90.

72 *Seconde Centurie des questions traitées ez conférences du Bureau d’adresse*, 186–87.

73 Solomon, *Public Welfare, Science, and Propaganda in Seventeenth Century France*, 66.



Nieremberg, a Jesuit scholar based at the Imperial College in Madrid.<sup>74</sup> Nieremberg's concept of calamity was sufficiently influential that the first official dictionary of the Real Academia Española drew an example from the *Causa y remedio* in its definition of *calamidad*.<sup>75</sup> As the title indicated, Nieremberg's objectives were to identify "public ills" (*males públicos*) or "misfortunes" (*desdichas*), locate their underlying causes and suggest solutions.<sup>76</sup> In the context of the enormous interlinked crises facing Spain in the 1640s, he was particularly concerned with military reverses in the war with France and the turmoil of the Catalan and Portuguese rebellions.<sup>77</sup> Nieremberg drew a direct analogy between the threats facing Spain and the destruction of the Roman empire by barbarians. Following the template of late antique authors such as the fifth-century Christian writer Salvian, he identified the cause of all collective calamities as the sins of the populace.<sup>78</sup> The corresponding remedy was therefore extensive moral reformation accompanied by displays of humility and repentance, to incline God away from punishment and towards deliverance.<sup>79</sup> While the *Causa y remedio* focused on the calamities occasioned by political and military events, in his natural historical work Nieremberg applied the same basic framework to environmental disturbances. On the authority of Pietro Martire d'Anghera's descriptions of the New World, Nieremberg declared that hurricanes had ceased to trouble the island of Hispaniola after the introduction of Catholicism; conversely, he asserted that the crocodiles of the Nile had proliferated since the spread of Islam to Egypt.<sup>80</sup> The ability to speak of hurricanes and crocodiles as if they were members of the same

---

74 Juan Eusebio Nieremberg, *Causa y remedio de los males publicos* (Madrid: Por Maria de Quiñones, 1642).

75 "Calamidad", *Diccionario de Autoridades*, tomo II, 1729.

76 For *desdicha*, see Nieremberg, *Causa y remedio de los males publicos*, 39.

77 See for instance, Nieremberg, 36.

78 Nieremberg, 24.

79 Nieremberg, 72, 95.

80 Juan Eusebio Nieremberg, *Curiosa filosofia y tesoro de maravillas de la naturaleza, examinadas en varias cuestiones naturales....* (En Madrid: En la Imprenta del Reyno, 1634), 15; Pietro Martire d'Anghera, *De Orbe Novo: The Eight Decades of*

essential category indicated a willingness to subordinate the visible differences between the things of the world in favour of a salvific message that lay hidden beneath them. Just as the military and political disorders of Spain were the direct products of moral deficiency, in Nieremberg's view, storms and ferocious beasts reflected the disordered state in which God had placed nature after the Deluge, so as to remind humans of their mortality and keep them from sinking into vice.<sup>81</sup> Indeed, disorder served as one of the key bridges between the natural and human worlds. Like other scholars of the time, Nieremberg used the techniques of theological exegesis to make intelligible these disorders, which amounted to vibrating threads in the sacred web that connected all the diverse things of the universe.<sup>82</sup>

If most early seventeenth-century scholarship either perpetuated the deep-rooted ambiguity of ancient and medieval writers on disaster or eschewed the established patterns without offering a clear replacement, we can nevertheless detect some important hints of alternative possibilities. In particular, Francis Bacon's programmatic vision for the layout of natural inquiries offered suggestions for new arrangements that redrew the epistemic map of disaster in important ways. A key feature of his vision for remaking natural knowledge was the priority he accorded to natural history as a precondition for natural philosophy — in other words, a new emphasis on the collection of facts or particulars to replace the welter of theoretical explanations in Aristotelian and scholastic learning.<sup>83</sup> In *The Advancement of Learning* (1605) Bacon sketched an overview of human knowledge and attempted to identify areas that required reform or had been left undeveloped. Here he divided

---

*Peter Martyr d'Anghera*, trans. Francis Augustus MacNutt (New York: GP Putnam's Sons, 1912), vol. 2, p. 309. The claim about the cessation of hurricanes ultimately derived from Oviedo y Valdés, *De la natural hystoria de las Indias*, f. 15v.

81 Nieremberg, *Curiosa filosofia y tesoro de maravillas de la naturaleza*, 14–15.

82 On exegesis, sympathies and correspondences in Nieremberg's worldview more generally, see Juan Pimentel, "Juan E. Nieremberg, American Wonders, and Preterimperial Natural History," in *Science in the Spanish and Portuguese Empires, 1500-1800*, ed. Daniela Bleichmar (Stanford, CA: Stanford University Press, 2009).

83 Daston and Park, *Wonders and the Order of Nature, 1150-1750*, 221.

natural history into three parts “nature in course” (the “history of creatures”), “nature erring or varying” (the “history of marvels”) and “nature altered or wrought” (the “history of arts”).<sup>84</sup> Casting aside the existing prodigy compilations as “frivolous impostures”, Bacon insisted that a reformed history of marvels should consist of “a substantial and severe collection of the Heteroclitics or Irregulars of nature, well examined and described [...] with due rejection of fables and popular errors”.<sup>85</sup> As with natural history, civil history and ecclesiastical history would contain three parts. Carefully sidestepping the question of whether judgement collections constituted legitimate histories, he nevertheless assigned one of the branches of ecclesiastical history to the “History of Providence”, which included “the notable events and examples of God’s judgments, chastisements, deliverances, and blessings”.<sup>86</sup>

In the *New Organon* (1620) Bacon took these suggestions further by attempting to replace Aristotelian syllogisms with a system that better corresponded with his vision of nature. The key to this new approach would be the compilation of a series of natural histories that could serve as the storehouse of facts for a reformed natural philosophy. At the end of the work Bacon appended a “Catalogue of Particular Histories” whose titles and arrangement gave an indication of how he thought natural inquiries should be ordered.<sup>87</sup> Although Bacon remained interested in all of the areas of traditional meteorology (including rainbows and parhelia), he dispensed with the Aristotelian ordering, instead separating meteorological study into two categories. Only the second of these had a label — “Histories of the Major Masses” — which included histories of the elements as substances: a “History of Fire and of Burning Things”, of air, water and earth. The other

---

84 Francis Bacon, “The Advancement of Learning,” in *Works*, ed. James Spedding, Robert Leslie Ellis, and Douglas Denon Heath (London: Longman, 1857), vol. 3, 330.

85 Bacon, 330–31.

86 Bacon, 341–42.

87 Francis Bacon, *The New Organon*, ed. Lisa Jardine, trans. Michael Silverthorne (Cambridge, UK: Cambridge University Press, 2000), 233–38.

(unnamed) grouping comprised twenty-one separate topics. Storms could have potentially figured in at least four of these: the histories “of Lightning, Thunderbolts, Thunder and Sheet-lightning”, “of Winds, and Sudden Blasts, and Waves of Air”, “of Normal Rain, Storms and Abnormal Rains” and “of the Weather or Temperatures of the Year [...] of Floods, Hot Spells, Droughts and so on”.<sup>88</sup> While histories of the weather and of winds perhaps suggested that storms should be considered only as extreme manifestations of general patterns, the inclusion of “Abnormal Rains” indicated a continuing interest in the rains of fire, blood, toads and wheat that were a staple of the literature on prodigies. On the other hand, earthquakes had a classification that entirely separated them from both the prodigy compilations and a dependence on Aristotelian exhalations — a choice that probably reflected the growing popularity of theories ascribing the earth’s shaking to subterranean fires rather than vapours. This new “History of the major Motions and Disturbances in Land and Sea” specifically covered “Earthquakes, Tremors and Fissures” as well as “Inundations and Floods” and “Eruptions of Fire from the Earth”, alongside the emergence of new islands and coastal erosion.<sup>89</sup> However, earthquakes also appeared in the *Historia ventorum* (History of the Winds, 1622), a work that combined several of the weather-oriented topics in the *New Organon*, offering a more detailed outline of what natural histories in this area should seek to record. Here Bacon postulated a special category of “extraordinary and prodigious winds”, with a distinction between extraordinary winds above ground (“fiery winds, whirlwinds, and hurricanes”) and those below ground — the “sulphureous” winds that “find vent in earthquakes, or burst out from volcanoes”.<sup>90</sup> As well as crafting specific categories for extreme phenomena, Bacon’s overview of knowledge in the *New Organon* completely distinguished the numerous types of natural history from another epistemic

---

88 Bacon, 233.

89 Bacon, 233–34.

90 Francis Bacon, “History of the Winds,” in *Works*, vol. 9, 384.

division entitled “the Histories of Man”, which was not concerned with civil history but rather with the arts and with phenomena that he specifically connected with humans.<sup>91</sup> In fact, Bacon explicitly signalled that human and natural histories were to be distinguished even in topics where they traditionally overlapped: the “Natural Geographical History”, for instance, would cover mountains, forests and rivers while “omitting Nations, Provinces, Cities and such Civil matters”.<sup>92</sup>

If the schematic overview of the *New Organon* set out divisions both between specific types of destructive phenomena and between natural and human spheres, a somewhat different vision appeared in *The Essayes, or Counsels, Civill and Morall*, a set of fifty-eight pieces that Bacon published in thirteen editions between 1597 and 1625. An essay “Of Vicissitude of Things” presented a view of the world and its workings that recalled the cyclical fluctuations of fortune and misfortune. Whereas *The Advancement of Learning* and the *New Organon* had called for strictly limited natural histories to precede natural philosophy, “Of Vicissitude of Things” turned to a much more speculative set of ideas about the rules that might govern “great Revolutions”, both in natural and human affairs.<sup>93</sup> The essay began by considering floods and earthquakes as “[t]he great Winding-sheets, that burie all Things in Oblivion”, alongside great fires and droughts that “dispeople, and destroy” and the “great Burnings by Lightnings” reported in the West Indies.<sup>94</sup> Following a hint in the Spanish writer José de Acosta’s *Historia natural y moral de las Indias* (published in 1589 in Latin and 1590 in Spanish, with an English translation in 1604), Bacon speculated that a great flood might have wiped out human

---

91 This included two medical histories: “of Diseases and their Symptoms and Signs” and of their “Treatment, Remedies and Cures”. Bacon, *The New Organon*, 236.

92 Bacon, 234. This distinction of natural and civil spheres had an enduring influence on natural inquiries: compare for instance Robert Boyle’s later insistence on separating the study of nature from “humane affairs”, discussed in Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, NJ: Princeton University Press, 1985), 162, 167, 337.

93 Francis Bacon, *The Essayes or Counsels, Civill and Morall*, ed. Michael Kiernan (Oxford; New York: Clarendon; Oxford University Press, 2000), 174.

94 Bacon, 172.

civilisation in the Indies. Acosta had reported Amerindian myths of a deluge in the distant past, of which there supposedly remained some physical traces. He concluded that this could not have been the Biblical flood that covered the world in the time of Noah, but rather a “particular” inundation, in the fashion of the flood of Deucalion of Greek myth.<sup>95</sup> Bacon saw in this American deluge a possible explanation for why Amerindian peoples apparently lacked the technical knowledge of Europeans at the time when the Spaniards arrived in the Indies. He deepened this speculation in his literary work *The New Atlantis* (published posthumously in 1626), where he took up the suggestion that the Indies had once been contiguous with the island of Atlantis — a claim that Acosta had reported but did not believe.<sup>96</sup> When “Divine Revenge” overtook Atlantis in the form of “a particular deluge or inundation”, it consequently also submerged Peru and Mexico, leaving only a thin remnant of the original population in the mountains. Gradually these mountain folk repopulated the low ground, having in the meantime lost the knowledge they had possessed before the cataclysm.<sup>97</sup> This account hewed very closely to Plato’s description of the ancient Athenians’ loss and recovery of knowledge after a similar deluge.<sup>98</sup> For Plato, this flood was part of an endless cycle of great disasters that periodically afflicted the earth.<sup>99</sup> In “Of Vicissitude of Things”, Bacon accordingly considered whether “Plato’s great Yeare” might have some effect in bringing about major alterations in the world, not in affecting individuals — a proposition that veered too close to astrological beliefs for his liking — “but in grosse”.<sup>100</sup> He also found some merit in the claim that the Netherlands experienced the same extreme weather conditions every 35 years: “Great Frosts.

---

95 José de Acosta, *Historia natural y moral de las Indias* (Madrid: R Anglés, impresor, 1894), vol. 1, 112–13.

96 Acosta, 57–58.

97 Francis Bacon, “The New Atlantis,” in *Works*, vol. 3, 142–43.

98 Plato, *Laws*, III.677-78; *Timaeus*, 21B-23C.

99 Plato, *Laws*, III.677. A similar view is expressed in Cicero, *Republic*, VI.23.

100 Bacon, *The Essayes or Counsels, Civill and Morall*, 173.

Great Wet, Great Droughts, Warne Winters, Summers with little Heat, and the like”.<sup>101</sup> While he found the prognostication of astrologers generally unreliable, Bacon indicated that knowledge of the weather would allow for practical forecasting of harmful phenomena. In *The New Atlantis*, the fictional savants of his utopian society practised this kind of prediction regularly, issuing “natural divinations of diseases, plagues, swarms of hurtful creatures, scarcity, tempests, earthquakes, great inundations, comets, temperature of the year, and divers other things; and we give counsel thereupon what the people shall do for the prevention and remedy of them”.<sup>102</sup> Thus while Bacon’s programmatic works stressed the patient compilation of natural histories, in his visions of the practical application of natural knowledge to hazardous occurrences he returned to the traditional practice of clustering diverse phenomena together. Moreover, the essay on vicissitudes covered not only natural revolutions but also discords and schisms in religion, the causes and fortunes of war and the flourishing and decline of states. Since the pursuit of human betterment was the declared goal of Bacon’s reformation of natural knowledge, it seems logical that the distinction between the natural and civil spheres might be unnecessary in applied knowledge (as opposed to “historical” knowledge). However, “Of Vicissitude” raised the much gloomier inference that those divisions might equally melt away in considering the crises and decline of civilisation. Bacon may well have been thinking about current affairs while writing the essay, since the maelstrom of the Thirty Years War (1618-48) made religious and military conflict the dominant issue of European politics. The last two years of Bacon’s life also saw great calamities affecting England: in 1625, the year he printed his final edition of the *Essays*, a major plague epidemic forced the court to retreat to Oxford and Bacon

---

101 Bacon, 173.

102 Bacon, “The New Atlantis,” 166.

to Gorhambury.<sup>103</sup> Later in the year an English military expedition to Cádiz failed miserably, leaving about 1,000 of the participants dead from disease.<sup>104</sup> Whether or not these public circumstances or Bacon's personal decline exerted an effect on his thinking, *The New Atlantis* and the essay on vicissitude offered a counterbalance to his earlier programmatic writing. On the one hand, Bacon had created a new framework for natural knowledge about destructive phenomena, which proved highly influential later in the century, but on the other he affirmed that on a fundamental level the affairs of the world obeyed inner dynamics of fortune and misfortune.

Another important attempt to classify destructive phenomena in a systematic way is visible in the work of the French naturalist and atomist Pierre Gassendi. Much of this was posthumously published in two collections of 1658 and 1674-75.<sup>105</sup> According to Gassendi, a researcher working on natural knowledge (*Science naturelle*) had to begin by articulating an idea of Nature.<sup>106</sup> This meant that when Gassendi himself came to discuss disastrous phenomena such as storms and earthquakes, he always had reference to a single originating principle rather than an unchained mass of mysterious occurrences. Gassendi described Nature in an explicitly mechanical way, as a well-ordered structure, composed of two principal sections, the earth and the sky, which themselves consisted of a large number of smaller categories. According to Gassendi, the natural philosopher, like a master architect, must identify all these sections, "as the great, and the little parts of some great Building, and making a resolution of these parts down to the smallest, he keeps these last as the Principles

---

103 Lisa Jardine and Alan Stewart, *Hostage to Fortune: The Troubled Life of Francis Bacon* (New York: Hill and Wang, 1998), 499. A contemporary account of the outbreak is in John Taylor, *The Fearefull Summer: Or, Londons Calamitie, the Countries Discourtesie, and Both Their Miserie Printed by Authoritie in Oxford, in the Last Great Infection of the Plague, 1625...* (n.p.: n.p., 1636).

104 Jardine and Stewart, *Hostage to Fortune*, 499.

105 Pierre Gassendi, *Petri Gassendi ... Opera omnia in sex tomos divisa ..*, ed. Henri Louis Habert de Montmor (Lugduni: sumptibus Lavrentii Anisson & Ioan Bapt, Devenet, 1658); Pierre Gassendi, *Abrégé de la philosophie de Gassendi*, ed. François Bernier; [modern eds.] Sylvia Murr and Geneviève Stefani (Paris: Fayard, 1992).

106 Pierre Gassendi, *Abregé de la philosophie de Gassendi*, I.iv, 135-36.



from which all things are formed”.<sup>107</sup> In this system earthquakes, storms and comets did not belong together either within a jumbled category of *calamités* or within the capacious Aristotelian framework of meteorology, but in the specific classes of Earth Matters (*Choses Terrestres*), Meteors and Astronomy respectively. Divination, dreams and magic were no longer to be associated with them, and instead belonged in another category: Fantasy, ruled by the Imagination. This kind of systematic division was essential to the student of knowledge, “[f]or Partition, or Distribution is like the Torch that precedes, and that illuminates what he learns, so that he does not err into uncertainty, without knowing where he goes, but so that in all the rest [...] of the Discipline he knows where he is, which path he has taken, what remains to be done, and where he will leave”.<sup>108</sup> Indeed, the clear structure of a well-ordered epistemology reflected the natural harmony of the universe in which “all of the members conspire mutually together to make a beautiful Body, and a beautiful Harmony”.

This emphasis on categorisation and neat divisions clearly distinguished Gassendi’s system from the heteroclitic wonder compilations as well as from the diffuse interests of Binet and the Bureau d’Adresse. Once the parameters and contours of an epistemology had been set out, for Gassendi there was no room for extraneous knowledge or the interference of other disciplines. Theology had no place in natural philosophy, which needed to be entirely mechanical and solely concerned with natural accounts of earthly objects. Adopting a strict epistemic framework meant that he could fearlessly jettison all of those motley aspects of natural knowledge that had emerged as a result of intellectual pluralism. There was little room in this scheme for preternatural phenomena or for

---

107 “comme les grandes, et les petites parties de quelque grand Edifice, et faisant la resolution de ces parties jusques aux plus petites, il tient ces dernieres comme les Principes dont toutes choses sont formées”. Gassendi., Liv, 136.

108 “Car la Partition, ou Distribution est comme le Flambeau qui precede, et qui eclaire celuy qui apprend, afin qu’il n’erre pas dans l’incertitude, sans sçavoir où il va, mais afin que dans toute la suite [...] de la Discipline il sçache où il est, quel chemin il a fait, ce qui luy reste à faire, et par où il sortira. Or la Partition sera convenable et naturelle, si tous les membres conspirent mutuellement ensemble pour faire un beau Corps, et une belle Harmonie”. Gassendi., I.iv, 139-40.

exotic mysteries: every aspect of Nature had to be described definitively, causally explained as clearly as possible, and then placed within an appropriate taxonomic category.<sup>109</sup>

Earthquakes offer an important example of how Gassendi's system functioned. Like Descartes, Gassendi reassigned earthquakes from the diffuse Aristotelian category of meteors to a partition of knowledge specifically concerned with the earth.<sup>110</sup> They were not to be interpreted within natural discussions either as portents or as divine judgements, but only as the mechanical operation of nature within a specific subsection of its functioning. According to Gassendi, the earth trembled and quaked when sulphurous or bituminous exhalations, trapped in caverns beneath the earth, encountered deposits of nitre. The exhalations ignited as they struggled to escape, thus causing a chemical explosion in much the same way as with gunpowder.<sup>111</sup> He based this conclusion jointly on his own reasoning — including analogies to other physical phenomena — and on a combination of external sources. These consisted both of contemporary reports (which he referred to in a vague and inexact way) and ancient texts, which he combed for examples. Like Bacon, Gassendi drew upon Acosta for information about destructive phenomena in South America, noting in particular a sixteenth-century earthquake near Lima that had overturned “the Towns and Mountains, making Fountains, Rivers and Lakes disappear from where they had been, and causing others to be created where before there had been none; the Sea even dropped away for a time near the shore as if it had fallen into the subterranean caverns which gaped wide”.<sup>112</sup> However, unlike Bacon, Gassendi made

---

109 Gassendi, I.iv, 137-39.

110 René Descartes, “Les Météores,” in *Discours de la méthode pour bien conduire sa raison, et chercher la vérité dans les sciences ; plus, La dioptrique ; Les météores ; et, La géométrie: qui sont des essais de cette méthode* (Paris: Fayard, 1987), Discours VIII, 289–90; René Descartes, *Les principes de la philosophie*, trans. Claude Picot (Paris: Chez Henry Le Gras, 1647), IV.76-79.

111 Gassendi, *Abregé de la philosophie de Gassendi*, V.i.7, 87; V.i.6, 78.

112 “bouleversant les Villes, et les Montagnes, faisant disparoitre des Fontaines, des Fleuves, et des Lacs, où il y en avoit, et en faisant naistre d'autres où il n'y en avoit point; la Mer mesme s'abaissa pour un temps proche des rivages comme si elle s'estoit abysmée dans les cavernes souterraines qui s'estoient entrouvertes”, Gassendi, *Abregé de la philosophie de Gassendi*. V.i.7, 93. This description is drawn from Acosta's account of an undated earthquake on the coast

no clear distinction between the description of matters of fact and a search for causes. Instead, his own speculations threaded among the conjectures and descriptions of Pliny, Lucretius, Seneca, Plutarch and Aristotle, and were enhanced by more recent accounts. There was no reference here either to divine punishment or to prodigies: earthquakes followed a predictable and consistent series of patterns according to observable principles. However, the fact that these destructive phenomena were regular manifestations of a mechanical Nature did not reduce their drama: like Binet and Jonston, Gassendi was interested primarily in events of a catastrophic scale, not minor tremors, and his descriptions as such conveyed a sense of marvel and dread rather than a banal interest in the ordinary. As with any natural phenomenon in Gassendi's epistemic scheme, knowledge of earthquakes needed to be mapped out exactly within a typology. He accordingly subdivided seismic movements into three classes, graded by intensity: Trembling (*Tremblement*), Listing (*Panchement*) and Shaking (*Secoïement*). The distinction, partly derived from Seneca's descriptions of earthquake movements, focused on types of motion and their impact on the built environment.<sup>113</sup> An earthquake was of the first type "when we feel the Earth tremble beneath our feet, and we fear that the Towns and the houses may be going to sink into the subterranean caverns".<sup>114</sup> It was of the second class "when we see the Towers and the highest Buildings list to one side, and sometimes tip over, and at times lean against one another".<sup>115</sup> The Shaking sort was the most severe, "when everything collapses, all the houses fall, and the Towns themselves sometimes sink in their entirety

---

of Chile, rather than Peru. Gassendi may have confused this with two other disastrous Peruvian earthquakes in 1582 and 1586, discussed in the same section of Acosta's text. Acosta, *Historia natural y moral de las Indias*, vol. 1, 278–79. Chile experienced major earthquake-tsunamis in 1570 and 1575: Rosa Urrutia de Hazbún and Carlos Lanza Lazcano, *Catástrofes en Chile, 1541-1992* (Santiago de Chile: Editorial La Noria, 1993), 21–24.

113 Seneca, *Naturales quaestiones*, VI.xxii.1. Compare the four types of earthquake movement in Pliny, *Historia naturalis*, II.lxxxiv and in Ammianus Marcellinus, *Histories*, XVII.vii.

114 "lorsqu'on sent la Terre trembler sous ses pieds, et que l'on craint que les Villes, et les maisons ne s'aillent abysmer dans les cavernes souterraines", Gassendi, *Abregé de la philosophie de Gassendi*, V.i.7, 92.

115 "lors que l'on voit les Tours, et les Edifices les plus elevez pancher d'un costé, et quelque fois se renverser, et tantost pancher d'un autre". Gassendi. V.i.7, 92

with all their inhabitants into the caverns”.<sup>116</sup> It was this last terrible kind, Gassendi noted, that had occurred in the distant past in Sidon, Syria and the Peloponnese, and in his own time in Ragusa, Mosul and Kashan in Persia.<sup>117</sup>

While Gassendi’s outline of destructive forces avoided any reference to theology, an examination of related issues in his other writings reveals subterranean complexities in his thinking. In fact, the various components of his typologies of dangerous phenomena shared “some connection, sympathy, communication” that stretched beyond the confines of rationalism.<sup>118</sup> In his critique of the neoplatonic theory of the World Soul, Gassendi stated that God was not simply a divine substance that permeated the world, which would have made every person a tiny god, but a superintending deity who took active charge of the world and its clusters of atoms, like a captain with his ship.<sup>119</sup> Contemplation of Nature elicited admiration for God, since God was ultimately responsible for all harmonious order in the world.<sup>120</sup> On some occasions disorders appeared in the form of prodigies and monsters, due to the operation of fortune and chance (*hazard*), but these anomalies chiefly served to magnify by contrast the wondrous unity of the properly ordered world.<sup>121</sup> Nevertheless, Gassendi was at pains to point out that this order was not foreordained by cosmic necessity. Here he was arguing against both astrologers, who claimed that the stars ruled the fates of humans,<sup>122</sup> and also the followers of those religions centred on predestination — explicitly Muslims, but implicitly also Protestants.<sup>123</sup> He thought determinism was a “very dangerous” dogma for two

---

116 “lorsque tout s’écroule, que les maisons tombent, et que les Villes mesmes entieres avec leurs habitans sont quelquefois abysmées dans les cavernes”, Gassendi, V.i.7, 92-93.

117 Gassendi, V.i.7, 93.

118 “quelque liaison, sympathie, communication”, Gassendi. II.i.8, 67.

119 Gassendi, II.i.8, 71.

120 Gassendi, II.i.17, 169-170.

121 Gassendi, II.i.17, 170-171.

122 Gassendi, VII.iii.2, 402.

123 Gassendi, VII.iii.3, 423.

reasons: firstly, it excused any kind of sinful behaviour by removing the element of human agency, and secondly, it turned God into an immovable tyrant, and life into a fatalistic, hopeless expectation of misery.<sup>124</sup> Accordingly, the world needed the intervention of divine judgements: both in the form of judgements on sinners and of divine mercy, attainable through prayer and penitence.<sup>125</sup>

Ultimately, the fates of men were contingent upon an inscrutable providence, administered by a God whose ways were mysterious and whose judgements were incomprehensible.<sup>126</sup> This aspect of his thinking concurred with the core of Catholic disaster doctrine, even though Gassendi omitted reference to intercession and placatory rites.

Gassendi's understanding of the causes of catastrophic earthquakes and other disasters was therefore less mechanical than his programmatic overview of natural history suggested. Within his epistemic framework, disasters were natural events engendered by earthly secondary causes, and explicable through a well-ordered method of natural philosophy, but on the other they were part of an unsearchable providence, whose apparent harshness was mediated by divine mercy and the chaotic interference of fortune. Whereas the stoics had urged people to contemplate all possible miseries all of the time, Gassendi counselled against such fatalism and drew attention to the overall harmony of the world. Indeed, the compartmentalisation of destructive phenomena within a sophisticated natural classification system could serve an important moral function, by encouraging humans to think about their place within a divinely-balanced cosmos rather than dwelling on the necessity of destruction. By making disasters part of a web of natural typologies Gassendi had envisaged a knowledge of disaster that on the one hand erased the traditional miscellany of scourges,

---

124 Gassendi, VII.iii.3, 423-425.

125 Gassendi, VII.iii.3, 425.

126 Gassendi, VII.iii.3, 427.

misfortunes and assorted meteors, but on the other retained God's active superintendence of Creation.

The programmes of natural inquiry set out by Gassendi and Bacon, despite their reservations and ambiguities, held the potential to transform the contours of disaster knowledge. This was in large part because they challenged what had been a defining feature of writing about disaster — the arrangement of destructive phenomena together in a heteroclitite category of calamities. To achieve this they expanded upon other developments in early modern disaster discussion: the naturalistic study of individual phenomena and the fragmentation of calamities into the all-embracing domain of curiosities or marvels. The union of all disasters within a comprehensive category of adversities created the impression that all the important things that could be known about them had already been uncovered. However, the emphasis of Bacon and Gassendi on the systematic arrangement of phenomena in typologies and the compilation of information (ancient and modern) turned disaster research into an activity with a far greater potential for intellectual impact. The new visions of the first half of the century did not immediately effect a sweeping transformation in disaster knowledge, but they provided the foundations for the substantial changes that occurred from the middle of the century onwards.

## Chapter 2: Proof and prodigies: New evidentiary standards

The innovations in the first half of the seventeenth century laid the foundations for a broader systematisation of disaster knowledge between the 1650s and 1680s. Three factors played into this development: in the first place, an apparent proliferation of catastrophes devastated both sides of the Atlantic in the middle decades of the century. Secondly, the expansion in the means of communication — through printed media, private correspondence networks, ecclesiastical and bureaucratic reporting — greatly increased the circulation of news about disaster and allowed researchers to supplement the descriptions of catastrophes in the ancient world with more recent examples. Finally, the growth in the volume of disaster news coincided with increasing concern about the credibility of testimonies of extraordinary events and phenomena. The evolving "information order" of disaster thus participated in the "enormous expansion of the 'factual'" in seventeenth-century intellectual culture more broadly, and built upon two trends: the move towards systematic classification and the development of evidentiary standards for assessing truthfulness.<sup>1</sup> Out of this context emerged new projects that emphasised the collection of reliable information and its organisation in typologies. This was not a neat, linear transition: the old heterogeneity of disasters re-emerged in various forms, and new projects of information collection built upon older practices of compiling prodigies and judgements. However, by the 1680s disaster researchers were drawing upon much larger information reservoirs with a more critical eye for accuracy and

---

1 Barbara J. Shapiro, *Probability and Certainty in Seventeenth-Century England: A Study of the Relationships between Natural Science, Religion, History, Law, and Literature* (Princeton, NJ: Princeton University Press, 1983), 4; Barbara J. Shapiro, *A Culture of Fact: England, 1550-1720* (Ithaca, NY: Cornell University Press, 2000); Simon Schaffer, "Newton on the Beach: The Information Order of Principia Mathematica," *History of Science* 47, no. 3 (2009): 243–76.

authenticity. They were also employing new quantitative techniques and more precise nomenclatures that facilitated the subsequent formation of radically new ideas about disaster.

Every period has its disasters, but the early modern era seems to have been a particularly calamitous epoch because of the intersection of a number of aggravating factors, including religious, social and political turmoil, climate change and widespread, recurrent epidemics. Although the sixteenth century had its share of terrible calamities,<sup>2</sup> the deadly conjuncture of factors came to a head in the middle decades of the seventeenth century. A long-running historiographical exchange has debated the extent to which these decades can be described as a “general crisis” with demographic, political and economic dimensions.<sup>3</sup> The 1640s-50s were certainly a period of extraordinary political tumult in Europe, marked by civil war in England and rebellion in Ireland, the Frondes in France, the “Green Banner” revolts in Andalusia (1647-52) and major uprisings against Spanish rule in Portugal and Catalonia (from 1640) and Naples and Sicily (1647).<sup>4</sup> Recent work indicates that the troubles of the period coincided with a marked climatic downturn in the wider process of global cooling known as the Little Ice Age, which produced extreme meteorological

---

2 On these, see for instance Andrew Cunningham and Ole Peter Grell, *The Four Horsemen of the Apocalypse: Religion, War, Famine and Death in Reformation Europe* (Cambridge, UK; New York: Cambridge University Press, 2000); Sam White, *The Climate of Rebellion in the Early Modern Ottoman Empire* (New York: Cambridge University Press, 2011).

3 Useful overviews of the debate are in J. H. Elliott, “The General Crisis in Retrospect: A Debate without End,” in *Early Modern Europe: From Crisis to Stability*, ed. Philip Benedict and Myron P. Gutmann (Newark: University of Delaware Press, 2005); “AHR Forum: The General Crisis of the Seventeenth Century Revisited,” *American Historical Review* 113, no. 4 (2008).

4 J. H. Elliott, *The Revolt of the Catalans, a Study in the Decline of Spain, 1598-1640* (Cambridge, UK: University Press, 1963); J. H. Elliott, “Revolts in the Spanish Monarchy,” in *Preconditions of Revolution in Early Modern Europe*, ed. Robert Forster and Jack P. Greene (Baltimore: Johns Hopkins Press, 1970); Orest A. Ranum, *The Fronde: A French Revolution, 1648-1652* (New York: WW Norton, 1993); Jonathan Scott, *England’s Troubles: Seventeenth-Century English Political Instability in European Context* (Cambridge, UK; New York: Cambridge University Press, 2000), part 2; Luis Corteguera, “Loyalty and Revolt in the Spanish Monarchy,” in *Early Modern Europe: From Crisis to Stability*, ed. Philip Benedict and Myron P. Gutmann (Newark: University of Delaware Press, 2005).



conditions and led to (among other things) severely cold winters, recurrent harvest failures and widespread malnutrition.<sup>5</sup>

Alongside these conditions came a vast convergence of disastrous phenomena across the Atlantic world. Among these disasters was a devastating plague epidemic in the Mediterranean with severe and long-lasting demographic impacts. The plague spread across southern and eastern Spain and the Balearic Islands between 1647-54, killing about 20% of the population of Barcelona, 30-34% of that of Valencia, 35% of Córdoba and 45-50% of Seville.<sup>6</sup> Thanks to rigorous cordons, the plague did not spread to central Castile, as it had on previous occasions.<sup>7</sup> Nevertheless, Spain lost some 500,000 people from this catastrophe, a figure amounting to almost 6% of the population it had possessed at the beginning of the century.<sup>8</sup> Entering Sardinia in 1652 and then Naples in 1656, the plague subsequently spread through most of southern and central Italy, including Rome.<sup>9</sup> Spanish-ruled Naples, which suffered some 150,000 deaths (roughly half of its inhabitants), only recovered its pre-plague population levels in the 1730s-40s.<sup>10</sup>

At the same time as the Mediterranean world reeled from the plague, a deadly new phase of epidemics swept the greater Caribbean. The first outbreak of yellow fever in the New World

---

5 Geoffrey Parker, *Global Crisis: War, Climate Change and Catastrophe in the Seventeenth Century* (New Haven: Yale University Press, 2013), chap. 1. It is unnecessary here to assess Parker's more controversial claim that climate change bore a close causative relationship to political events.

6 Vicente Pérez Moreda, "La Peste de 1647-1657 en el Mediterráneo Occidental," *Revista ADEH* 2 (1987): 18-19. Seville had only recently recovered from a disastrous flood in 1642: Hernando Camargo y Salgado, *La iglesia militante: cronología sacra y epitome historial de todo quanto ha sucedido en ella prospero y adverso* (Con privilegio en Madrid: Por Francisco Martínez Acosta de Pedro Garcia de Sodruz, mercader de libros, 1642), ff. 344r-v. One of the best contemporary sources for the epidemic in Barcelona is Miquel Parets, *A Journal of the Plague Year: The Diary of the Barcelona Tanner Miquel Parets, 1651*, trans. James S. Amelang (New York: Oxford University Press, 1991).

7 Vicente Pérez Moreda, *Las crisis de mortalidad en la España interior (siglos XVI-XIX)* (Madrid: Siglo Veintiuno de España, 1980), 300-302.

8 John Lynch, *The Hispanic World in Crisis and Change, 1598-1700* (Oxford, UK ; Cambridge, MA: Blackwell, 1992), 173, 176. Lynch suggests an approximate population of 8.4 million in the 1590s.

9 Guido Alfani, "Plague in Seventeenth-Century Europe and the Decline of Italy: An Epidemiological Hypothesis," *European Review of Economic History* 17, no. 4 (2013): 414.

10 Alfani, 421.

afflicted Barbados in 1647, migrating to the Yucatán in 1648 and Cuba, Guadeloupe and Saint Kitts in 1648-49, killing 20-50% of local populations.<sup>11</sup> The disease travelled to Puerto Rico in 1648 and to Florida in 1649, where it killed the Spanish governor.<sup>12</sup> New Spain experienced a severe smallpox epidemic between 1646-48, which coincided in Mexico City with floods and yellow fever, and elsewhere in the viceroyalty with droughts.<sup>13</sup> In the Yucatán, a deadly combination of disease, drought and acute food shortages in 1648-56 may have halved the region's mostly indigenous population.<sup>14</sup> Guatemala experienced consecutive outbreaks of three different diseases in 1647 (influenza), 1650 (*cucumatz*) and 1654 (plague).<sup>15</sup> In the province of Quito, already suffering from recurrent outbreaks of disease, a city councillor estimated the mortality in 1648 from measles, diphtheria and smallpox at 100,000.<sup>16</sup> While the northern colonies in North America do not seem to have had cases of yellow fever until the 1660s and 1690s,<sup>17</sup> in 1650 Massachusetts experienced what one chronicler described as “the first noted year wherein any store of people died” from disease

---

11 For the outbreak at Barbados, see Richard Ligon, *A True & Exact History of the Island of Barbados...* (London: Printed for Humphrey Moseley, 1657), 21. More generally, see Noble David Cook and W. George Lovell, “Unraveling the Web of Disease,” in *Secret Judgments of God: Old World Disease in Colonial Spanish America*, ed. Noble David Cook and W. George Lovell (Norman: University of Oklahoma Press, 1991), 227–28; J.R. McNeill, *Mosquito Empires: Ecology and War in the Greater Caribbean, 1620-1914* (New York: Cambridge University Press, 2010), 84.

12 Henry F. Dobyns, *Their Number Become Thinned: Native American Population Dynamics in Eastern North America* (Knoxville, TN: Published by the University of Tennessee Press in cooperation with the Newberry Library Center for the History of the American Indian, 1983), 279–80.

13 Virginia García Acosta, Juan Manuel Pérez Zevallos, and América Molina del Villar, eds., *Desastres agrícolas en México: catálogo histórico* (México D. F.: Centro de Investigaciones y Estudios Superiores en Antropología Social, 2003), 180–81.

14 García Acosta, Pérez Zevallos, and Molina del Villar, 180, 182; McNeill, *Mosquito Empires*, 84.

15 L. H. Feldman, “Active Measures in the War against Epidemics in Colonial Guatemala, 1519-1821,” *Caduceus* 7, no. 3 (1991): 7.

16 *Cartas de cabildo de Lima*, 00299c, cited in Suzanne Austin Alchon, *Native Society and Disease in Colonial Ecuador* (Cambridge, UK: Cambridge University Press, 1992), 62.

17 However a chronicle written in Massachusetts sometime after 1680 made the contrary claim that this “plague or pestilential fever” had also scourged the eastern seaboard of North America, having “spread through the whole coast, at least all the English plantations in America”. William Hubbard, *A General History of New England, from the Discovery to MDCLXXX* (Cambridge: Hillard & Metcalf, 1815), 531–32.

among the colonists.<sup>18</sup> The disease mortality in New England was probably small, particularly when set beside the losses in Spanish America, but the epidemic came as a great shock to the puritan settlers' sense of divine favour and protection. Previous smallpox epidemics (most recently in 1633-39) had inflicted huge death tolls among indigenous communities but spared the colonists.<sup>19</sup>

A brief overview of epidemics in the 1640s-50s cannot, of course, offer a full picture of disease environments and mortalities. Other serious disease episodes had occurred in previous decades of the century, including outbreaks of plague in various parts of Europe and typhus in the Americas.<sup>20</sup> In addition, Europeans' introduction of diseases to the New World in much earlier phases of settlement produced mortality levels among indigenous societies of an unparalleled enormity.<sup>21</sup> Nevertheless, the 1640s-50s were remarkable in the way that overlapping epidemics of different diseases afflicted both Europe and the Americas at much the same time. We can consider this period as an unusual but important point in the longer process that Emmanuel Le Roy Ladurie termed "the unification of the globe by disease".<sup>22</sup> While both continents had suffered great epidemics in the past, seldom if ever had the concurrent, mutual experience of this kind of catastrophe linked them in such a conspicuous way.

---

18 Edward Johnson, *Wonder-Working Providence, 1628-1651*, ed. J. Franklin Jameson (New York: Scribner, 1910), 254–56.

19 William Hardy McNeill, *Plagues and Peoples* (Garden City, NY: Anchor Press, 1976), 186. In common with other colonial writers, Nathaniel Morton interpreted the earlier epidemics as a providential clearing of the land for God's chosen people: Nathaniel Morton, *New-Englands Memoriall, or, A Brief Relation of the Most Memorable and Remarkable Passages of the Providence of God Manifested to the Planters of New-England in America with Special Reference to the First Colony Thereof, Called New-Plimouth* (Cambridge: Printed by S.G. and M.J. for John Usher of Boston, 1669), 27–28.

20 Paul Slack, *The Impact of Plague in Tudor and Stuart England* (London; Boston: Routledge & K. Paul, 1985), chap. 3; Noble David Cook, *Born to Die: Disease and New World Conquest, 1492-1650* (Cambridge, UK; New York: Cambridge University Press, 1998), 173–78.

21 Alfred W. Crosby, *The Columbian Exchange: Biological and Cultural Consequences of 1492* (Westport, CT: Greenwood, 1972); Linda A. Newson, "The Demographic Collapse of Native Peoples of the Americas, 1492–1650," in *The Meeting of Two Worlds: Europe and the Americas, 1492-1650*, ed. Warwick Bray and British Academy (Oxford: Published for the British Academy by Oxford University Press, 1993); Cook, *Born to Die*.

22 Ladurie, *The Mind and Method of the Historian*, chap. 2.

In addition to these outbreaks of disease, the middle decades of the century constituted a period of significant and widespread seismic activity. In 1647, one of the most destructive earthquakes of the early modern era ruined the city of Santiago de Chile and killed perhaps a fifth of its population.<sup>23</sup> Another catastrophic earthquake struck Cusco in 1650, while a smaller seismic episode destroyed many buildings in Santiago de Guatemala in 1651.<sup>24</sup> An earthquake in Lima in November 1655 caused only minor damage but generated serious alarm: churches remained open night and day, processions implored God's mercy and preachers took turns giving continuous, round-the-clock sermons at three competing pulpits in the *plaza mayor*.<sup>25</sup> A far more destructive earthquake and tsunami in Chile in 1657 ruined much of the port of Concepción, although the death toll remained low because most of the inhabitants were able to flee in time.<sup>26</sup> In Quebec, settlers, missionaries and indigenous communities expressed amazement at the dramatic effects to the landscape of an earthquake in 1663.<sup>27</sup> A more destructive seismic episode affected the Peruvian cities of Pisco and Ica the following year, reportedly killing more than 400 people.<sup>28</sup>

---

23 Miguel Luis Amunátegui, *El terremoto del 13 de mayo de 1647* (Santiago de Chile: R Jover, 1882); Daniel Riquelme, *El terremoto del Señor de Mayo* (Santiago de Chile: Imprenta Cervantes, 1905); A. Udias et al., "The Large Chilean Historical Earthquakes of 1647, 1657, 1730, and 1751 from Contemporary Documents," *Bulletin of the Seismological Society of America* 102, no. 4 (2012): 1642. An additional 2-4,000 people reportedly died in the epidemic that followed the earthquake.

24 Letter from the *corregidor* of Cusco, 6 April 1650, AGI, Lima, 54, no. 27; Francisco Vásquez de Herrera and Manuel Lobo, *Vida y virtudes del venerable hermano Pedro de San José de Betancur*, ed. Lázaro Lamadrid Jimenez (Guatemala: n.p., 1962), 16, 172.

25 The Peruvian diarist Josephe de Mugaburu claimed that "in the main plaza alone twenty sermons were preached in one day". Josephe de Mugaburu, *Chronicle of Colonial Lima: The Diary of Josephe and Francisco Mugaburu, 1640-1697*, trans. Robert Ryal Miller (Norman: University of Oklahoma Press, 1975), 36.

26 Diego de Rosales, *Historia general de el reino de Chile, Flandes Indiano*, ed. Benjamín Vicuña Mackenna (Valparaiso: Impr del Mercurio, 1877), vol. 1, pp. 205–7.

27 Charles Simon, *Recit du prodigieux tremble-terre arrivé en la Nouvelle-France l'an 1663, : tiré d'une lettre écrite de ce pays par vne personne digne de foy, & confirmé par le rapport de tous ceux qui en sont reuenus cette année avec la flotte de Canada* (n.p.: n.p., n.d.); Reuben Gold Thwaites, ed., "Epistola ad R.P. Joannem Paulum Olivam, Praepositum Generalem Societatis Jesu, Romae. Hieronymus Lalemt; Quebeci in nova francia, August 18, 1663," in *The Jesuit relations and allied documents; travels and explorations of the Jesuit missionaries in North America 1610-1791*, trans. Finlow Alexander et al., vol. 47 (Cleveland, OH: The Burrows Brothers Company, 1899), 267–68.

28 José de Buendía, *Vida admirable y prodigiosas virtudes del venerable y apostólico padre Francisco del Castillo de la compañía de Jesús* (Madrid: A Roman, 1693), 169–73.

The Caribbean also experienced its share of disasters in this period. The yellow fever and malaria outbreaks of the 1640s-50s marked only the beginning of a new pattern of severe disease episodes that played a crucial role in the geopolitics of the region.<sup>29</sup> Barbados, drought-stricken and already seriously weakened by the epidemic of 1647, experienced a severe famine in 1649-50, the destruction of most of its food crops by heavy rains in 1656, and a major fire in 1659.<sup>30</sup> The French and Spanish islands also suffered: hurricanes caused serious damage to the food supply and the built environment of Guadeloupe and Puerto Rico in 1657.<sup>31</sup> In 1663, some 1,500 men drowned when the Spanish treasure fleet became caught in a storm.<sup>32</sup> Another hurricane in 1666 destroyed an English fleet under the command of the governor of Barbados, Lord Willoughby, killing some 2,000 men.<sup>33</sup> The Leeward Islands experienced additional hurricanes in 1657, 1658, 1660, 1665 and 1667.<sup>34</sup>

Although the 1660s witnessed a significant re-consolidation of centralised governmental power in Britain with the Restoration of the Stuart monarchy under Charles II in 1660 and in France with the accession to personal rule of Louis XIV from 1661, disasters continued to pose a major challenge. French royal propagandists had to react rapidly to an earthquake of 1660 in the Pyrenees (one of the strongest in French history), in order to counteract the impression that God frowned

---

29 This geopolitical history is explored in McNeill, *Mosquito Empires*.

30 John Hull, *The Diaries of John Hull, Mint-Master and Treasurer of the Colony of Massachusetts Bay* (Boston: Printed by J Wilson and son, 1857), 187; D. Watts, "Cycles of Famine in Islands of Plenty: The Case of the Colonial West Indies in the Pre-Emancipation Period," in *Famine as a Geographical Phenomenon*, ed. Bruce Currey and Graeme Hugo (Dordrecht; Boston; Hingham, MA: D Reidel; Kluwer Academic Publishers, 1984), 61.

31 Jean-Baptiste Du Tertre, *Histoire generale des Antilles habitees par les François et enrichy de cartes & de figures*, Seconde édition (A Paris: chez Thomas Jolly, 1667), vol. 1, pp. 496–7; Luis A. Salivia, *Historia de los temporales de Puerto Rico* (San Juan: n.p., 1950), 51–52; José Carlos Millás, *Hurricanes of the Caribbean and Adjacent Regions, 1492-1800* (Miami, FL: Academy of the Arts and Sciences of the Americas, 1968), 125–28; Salvador Arana Soto, *Historia de nuestras calamidades* (San Juan de Puerto Rico: Tipografía Miguza, 1968), 114.

32 Sir George Downing to Henry Bennet, the Earl of Arlington, 6/16 November, 1663, NA SP 84/168/39, f. 86.

33 Millás, *Hurricanes of the Caribbean and Adjacent Regions, 1492-1800*, 130–32; Matthew Mulcahy, *Hurricanes and Society in the British Greater Caribbean, 1624-1783* (Baltimore: Johns Hopkins University Press, 2006), 17, 102; Stuart B. Schwartz, *Sea of Storms: A History of Hurricanes in the Greater Caribbean from Columbus to Katrina* (Princeton, NJ: Princeton University Press, 2015), 37–38.

34 [Captain Langford], "Concerning Hurricanes and their Prognosticks & observations of my owne Experience thereupon", BL Egerton MS 2395, ff. 619r-624v; "Captain Langford's Observations of his own Experience upon Hurricanes [sic], and their Prognosticks", *Philosophical Transactions of the Royal Society*, vol. 20, issue 246, 1698, p. 407.

upon the monarchy.<sup>35</sup> Not long afterwards, the so-called “Accession Famine” (*Famine de l’Avènement*) caused around one million deaths in the north of the country.<sup>36</sup> Plague also struck northern France in 1663-64 and 1666-70, while the so-called “Great Plague” devastated London in 1665-66, killing over 100,000 people.<sup>37</sup> In addition, in 1666 the most destructive urban fire of the age razed central London, signalling the beginning of a new regime of major conflagrations that repeatedly wreaked havoc in the city.<sup>38</sup>

The waves of disaster events between 1646 and 1667 were endlessly reported and analysed through the rapidly expanding news media. Several genres of writing conveyed news of catastrophic events, including gazettes — compilations of reports on various affairs of note, ordered by city, which sometimes included accounts of plague deaths, earthquakes, storms and other kinds of destruction. In October 1666 the outstanding item among “the important, and curious news of England” carried by a Venetian gazette was a brief account of the Great Fire of London.<sup>39</sup> Narratives of specific events also continued to be printed in the long-standing format of cheap, sensational booklets. These included English broadsides and pamphlets, Spanish *relaciones de sucesos* and the productions of the French *bibliothèque bleue*.<sup>40</sup> Usually anonymous, these productions offered

---

35 Grégory Quenet, *Les tremblements de terre aux XVIIe et XVIIIe siècles: la naissance d’un risque* (Seyssel: Champ Vallon; Paris Diffusion, Presses universitaires de France, 2005), 186–89.

36 Jean Delumeau and Yves Lequin, *Les malheurs des temps: histoire des fléaux et des calamités en France* (Paris: Larousse, 1987), 321; Christian Jouhaud, *Histoire, littérature, témoignage: écrire les malheurs du temps* (Paris: Gallimard, 2009), chap. 5.

37 Slack, *The Impact of Plague in Tudor and Stuart England*; Françoise Hildesheimer, *La terreur et la pitié: l’Ancien Régime à l’épreuve de la peste* (Paris: Publisud, 1990), 14; A. Lloyd Moote and Dorothy C. Moote, *The Great Plague: The Story of London’s Most Deadly Year* (Baltimore: Johns Hopkins University Press, 2004).

38 David Garrioch, “1666 and London’s Fire History: A Re-Evaluation,” *The Historical Journal* 59, no. 02 (2016): 319–38.

39 “gl’importanti, e curiosi avvisi d[']Inghilterra”. NA SP 120/8.

40 Among a larger literature, see: Tessa Watt, *Cheap Print and Popular Piety, 1550-1640* (Cambridge, UK; New York: Cambridge University Press, 1991); Jerome Friedman, *The Battle of the Frogs and Fairford’s Flies: Miracles and the Pulp Press during the English Revolution* (New York: St Martin’s Press, 1993); Patrick Bégrand, *Signes et bâtiments, monstres et merveilles: stratégies discursives dans les “relaciones de milagros” publiées en Espagne au XVIIe siècle* (Besançon: Presses universitaires franco-comtoises, 2004); Patrick Bégrand, *Las relaciones de sucesos, relatos fácticos, oficiales y extraordinarios* (Besançon: Presses Univ. Franche-Comté, 2006); Andrew Pettegree, *The Invention of News: How the World Came to Know about Itself* (New Haven; London: Yale University Press, 2014); Henry Ettinghausen, *How the Press Began: The Pre-Periodical Printed News in Early*

narratives of events that recycled a range of emotive tropes, often with a moralising message about the divine punishment of sins and the necessity of repentance. A Spanish pamphlet account of the Great Fire, for example, stated unequivocally that “God has permitted this scourge of fire, together with that of the plague, and the war, in order for the English to suffer for their sins”.<sup>41</sup>

A third avenue for the communication of news was private correspondence, which could both report events and offer commentary upon them. An English letter of 1666, for instance, drew together as a single stroke of divine judgement the “Generall Calamities” of that “fatall year”, including the Great Fire and the destruction of Willoughby’s fleet.<sup>42</sup> In the seventeenth-century Republic of Letters correspondence became a crucial means for scholars to learn and disseminate factual information on recent disasters and to transmit ideas. Some individuals within this community cultivated immense personal networks that crossed national and confessional divides, and could therefore act as information brokers for circles of scholars.<sup>43</sup> Such “intelligencers” included Henry Oldenburg and Samuel Hartlib — savants who settled in England from Bremen and Danzig, respectively.<sup>44</sup> Hartlib, for instance, obtained information on a terrible storm of 1660 in Stockholm and an earthquake and floods in Amsterdam in 1661.<sup>45</sup> Oldenburg informed the English

---

*Modern Europe* (A Coruña: SIELAE, Universidade da Coruña, 2015), chap. 6; Carlos H. Caracciolo, “Natural Disasters and the European Printed News Network,” in *News Networks in Early Modern Europe*, ed. Joad Raymond and Noah Moxham (Brill, 2016), 756–78; Roger Chartier, *The Cultural Uses of Print in Early Modern France* (Princeton: Princeton University Press, 2019), chap. 7.

41 “que esta plaga de fuego, junta con la de peste, y guerra, ha permitido Dios, q. las padezcan los Ingleses, por sus pecados, manifestandoles por este camino el riguroso fuego de su divina justicia”. Anon., *Breve relacion del horroso incendio: que ha padecido la ciudad de Londres, desde Domingo 12 de Septiembre, hasta Yueves 16 del mesmo mes, de este año 1666* (En Sevilla: Por Iuan Gomez de Blas, su impressor mayor, 1666), A2v–3r.

42 Nicholas Buckeridge to George Oxenden, December 26, 1666. BL Add. MS 40713, ff. 1r–2v.

43 Elizabeth Yale, *Sociable Knowledge: Natural History and the Nation in Early Modern Britain* (Philadelphia, PA: University of Pennsylvania Press, 2016), chap.s 2–3.

44 Useful studies on Hartlib are in Mark Greengrass, *Samuel Hartlib and Universal Reformation: Studies in Intellectual Communication*, ed. Michael Leslie and Timothy Raylor (Cambridge, UK; New York: Cambridge University Press, 1994). On Oldenburg and London’s disasters of the 1660s, see Marie Boas Hall, *Henry Oldenburg: Shaping the Royal Society* (Oxford; New York: Oxford University Press, 2002), chap. 4.

45 Unknown interlocutors (copies in Hartlib’s hand), 5 November–24 December 1660, HP 15/9/10B; 7 January 1661, HP 15/9/18B.

naturalist Robert Boyle in 1667 that a hurricane in the Leeward Islands “hath ruined all the Houses both of our and the French plantations, and the Castles also, and likewise destroyed all the Sugar-works and the provisions on the ground”, threatening the colonists with imminent starvation.<sup>46</sup> The establishment of learned societies such as the Royal Society in London (1660) and the Académie Royale des Sciences in Paris (1666) allowed such reports to be shared more widely, since at meetings members read aloud some of the accounts of extraordinary events and phenomena that they received in their correspondence. Furthermore, the printed periodicals of these institutions disseminated a curated selection of accounts to a broader reading public. The first volume of the Royal Society’s *Philosophical Transactions* (1665) included accounts by Robert Boyle and John Wallis of a minor earthquake in Oxfordshire.<sup>47</sup> A number of independent periodicals also emerged at this time, such as the *Journal des Sçavans* (from 1665), which conveyed accounts along similar lines of extraordinary phenomena and disaster events.

While intelligencers served the needs of individual scholars and the fledgling scientific societies, long-distance information networks also expanded over the seventeenth century to accommodate government bureaucracies and religious orders.<sup>48</sup> The Spanish bureaucrat Juan Díez de la Calle, *oficial segundo* of the Secretariat of New Spain, received reports of earthquakes in such distant locations as Caracas (1641), Tenerife (1647, accompanying a volcanic eruption) and Santiago de Chile (1647).<sup>49</sup> The governing councils in Madrid needed to be continuously appraised of disasters

---

46 Henry Oldenburg to Robert Boyle, 10 December, 1667. Robert Boyle, *The Correspondence of Robert Boyle*, ed. Michael Hunter, Antonio Clericuzio, and Lawrence Principe, The Boyle Project edition (Charlottesville, VA: InteLex Corporation, 2004), vol. 3, p. 378.

47 *Philosophical Transactions of the Royal Society*, vol. 1, 1665, pp. 166-171, 179-181.

48 On the growth of long-distance communication networks and their importance for the formation of natural knowledge generally, see Steven J. Harris, “Networks of Travel, Correspondence, and Exchange,” in *The Cambridge History of Science*, ed. Katharine Park and Lorraine Daston, vol. 3, Cambridge History of Science (New York: Cambridge University Press, 2008).

49 BNE V.a. Mss/2939.



because of their grave implications for security, economic production, commerce and political stability. Communications between the metropole and the overseas provinces took so long that, much like other aspects of colonial administration in the Spanish empire,<sup>50</sup> local officials and elites had to take responsibility for the immediate practical management of disaster situations.

Nevertheless, the emergence of Díez de la Calle's "empire of paper" allowed the bureaucratic infrastructure to transmit important disaster news more efficiently.<sup>51</sup> Well-connected savants could sometimes get access to imperial news networks: the government official and natural philosopher Robert Southwell, for instance, was able to funnel an official report on the Jamaica earthquake of 1692 to the Royal Society.<sup>52</sup> Finally, ecclesiastical networks circulated detailed reports of disasters between parishes or missions, provincial dioceses and metropolitan bases. After the earthquake in Quebec in 1663, the superior of the Jesuits in New France, Jérôme Lalemant, sent a report of the events to the General of the order at Rome, Gian Paolo Oliva, while the account of another Jesuit writer, Charles Simon, found its way to print in France.<sup>53</sup> François Ragueneau, rector at the Jesuit college at Bourges, sent a Latin translation of Simon's narrative to Oliva, in the hopes of bringing it to the attention of the Pope.<sup>54</sup>

The progressive expansion of each of these means of conveying news over the seventeenth century enabled the increasing circulation of information about disasters. The growth of long-distance communication was particularly important because it opened up sources of news about the

---

50 Tamar Herzog, *Upholding Justice: Society, State, and the Penal System in Quito (1650-1750)* (Ann Arbor: University of Michigan Press, 2004).

51 On his "empire of paper" see Guillaume Gaudin, *Penser et gouverner le Nouveau Monde au XVIIe siècle. L'empire de papier de Juan Díez de la Calle, commis du Conseil des Indes* (Paris: L'Harmattan, 2013).

52 See the discussion of this disaster in chap. 4.

53 Thwaites, "Relation de ce qui s'est passé," 267–68; Simon, *Recit du prodigieux tremble-terre arrivé en la Nouvelle-France l'an 1663*.

54 Charles Simon, "Relatio Terræmotus in Nova Francia, 1663," in *The Jesuit relations and allied documents; travels and explorations of the Jesuit missionaries in North America 1610-1791*, ed. Reuben Gold Thwaites, trans. Finlow Alexander et al., vol. 48 (Cleveland, OH: The Burrows Brothers Company, 1899), 182–83. The letter enclosing the account is dated at Bourges, 12 December, 1663.

extreme destructive phenomena of the Americas, especially the hurricanes of the Caribbean and the great earthquakes that devastated Spanish American cities. In the first half of the century, English and French scholars such as Bacon and Gassendi possessed very little information on these occurrences and relied heavily on a few brief observations from scarce sixteenth-century printed works, most notably Acosta's *Historia natural y moral de las Indias*, Gonzalo Fernández de Oviedo y Valdés' *De La Natural Hystoria de Las Indias* (1526) and the *Decades* of the Italian humanist Pietro Martire d'Anghiera, published in separate pieces in Latin between 1511 and 1580, with a partial English translation in 1555.<sup>55</sup>

Even in the second half of the seventeenth century, up-to-date reports on destructive phenomena in the Spanish empire remained a precious commodity, since obtaining them typically required access to bureaucratic or ecclesiastical networks. Preparing his *Discourse on wind* (1671), the Anglican clergyman Ralph Bohun lamented the inaccessibility of Spanish accounts of hurricanes and earthquakes. He had been “assur'd, that the best accounts are to be had from Oviedo, and other Spaniards, & the descriptions they have made of the New-World, yet their books are so rarely to be met with, that very few of the Spanish Journalls come to our hands”. This was not an absolute obstacle, since he eventually managed to get his information circuitously, both in the form of an Italian translation of Oviedo by Battista Ramusio and through the brief accounts of South American earthquakes and volcanic eruptions in the French *Hydrographie* (1667) of Georges Fournier.<sup>56</sup>

Despite Bohun's complaints, the availability to him of relevant French and Italian publications reflects the increasingly cosmopolitan nature of information networks in the second half of the

---

55 Pietro Martire d'Anghiera, *The Decades of the Newe Worlde or West India...*, trans. Richard Eden (Londini: Indibus Guilhelmi Powell for Edwarde Sutton, 1555).

56 Ralph Bohun, *A Discourse Concerning the Origine and Properties of Wind: With an Historical Account of Hurricanes, and Other Tempestuous Winds* (Oxford: Printed by W Hall for Tho Bowman, 1671), 260–63, 269–80; Georges Fournier, *Hydrographie: contenant la theorie et la pratique de toutes les parties de la navigation*, Seconde edition, reueüe, corrigée & augmentée par l'auteur auant son deceds (A Paris: Chez Jean Du Puis, 1667), 537–38.

seventeenth century.<sup>57</sup> Better-connected savants had more resources at their disposal than Bohun. The Jesuit polymath Athanasius Kircher, based at the order's College in Rome, was able to draw on both an extensive correspondence network and Jesuit documents for his research on earthquakes and volcanic eruptions. These he combined with his personal observations of an earthquake in Campania in 1638 and of the volcanic activity of Etna and Vesuvius — he famously had himself lowered into Vesuvius' crater to observe the magma close-up.<sup>58</sup> Publishing treatises and essays disseminated not only ideas and personal observations but also precious testimonies of destructive natural phenomena, which was crucial for scholars who lacked large networks of informants. Thus Kircher's *Mundus subterraneus* (1664-65), which assembled much of his earthquake and volcano research, in turn functioned as a crucial mine of information for other researchers over subsequent decades.<sup>59</sup> The Royal Society quickly published an approving review and summary of the book in the *Philosophical Transactions*, and an abridged English translation appeared in 1669.<sup>60</sup> In addition, a Jesuit correspondent of Kircher's based in Spain, José de Zaragoza, recycled a considerable portion of Kircher's earthquake and volcano data in his *Esfhera en comun, Celeste y Terraqueo* (1675).<sup>61</sup>

---

57 For the cosmopolitanism of the scholarly community generally, see Anne Goldgar, *Impolite Learning: Conduct and Community in the Republic of Letters, 1680-1750* (New Haven: Yale University Press, 1995).

58 Conor Reilly, "Father Athanasius Kircher, S.J.: Master of an Hundred Arts," *Studies: An Irish Quarterly Review* 44, no. 176 (1955): 464; Tara E. Nummedal, "Kircher's Subterranean World and the Dignity of the Geocosm," in *The Great Art of Knowing: The Baroque Encyclopedia of Athanasius Kircher*, ed. Daniel Stolzenberg (Stanford, CA; Fiesole (Firenze): Stanford University libraries, 2001).

59 Athanasius Kircher, *Mundus subterraneus, in XII libros digestus...* (Amstelodami: apud J Janssonium & E Weyerstraten, 1665).

60 *Philosophical Transactions*, 1665, vol. 1, no. 6, 104-118. Athanasius Kircher, *The Vulcano's, or, Burning and Fire-Vomiting Mountains, Famous in the World, with Their Remarkables...* (London: Printed by J Darby, for John Allen, and are to be sold by him, and by Benjamin Billingsly, 1669). On the book's reception, see William C. Parcell, "Signs and Symbols in Kircher's *Mundus Subterraneus*," in *The Revolution in Geology from the Renaissance to the Enlightenment*, ed. Gary D. Rosenberg (Boulder, CO: Geological Society of America, 2009).

61 Joseph Zaragoza, *Esfhera en comun Celeste y Terraqueo* (En Madrid: Por Iuan Martin del Barrio, 1675). See also Horacio Capel, "Organicismo, fuego interior y terremotos en la ciencia española del xviii," *Geo Crítica: Cuadernos Críticos de Geografía Humana* 12, no. 27-28 (1980): Online edition; Thomas F. Glick, "On the Influence of Kircher in Spain," *Isis* 62, no. 3 (1971): 380.

However, as the circulation of information about these phenomena expanded so did concerns about the credibility and authenticity of testimonies. In one sense this was merely a reflection of a broader trend: the growth of news media in general provoked counter-currents of scepticism that questioned the accuracy of news reports and generated “a new feeling of uncertainty” about the world.<sup>62</sup> However, the problems of accuracy and authenticity were magnified in the case of disasters because they were characterised by extraordinary occurrences. Moreover, much seventeenth-century writing about these events was intertwined with the heterogeneous sphere of preternatural occurrences, since disasters were often associated with portents, visions and prodigies. To some extent, scepticism about stories of destructive phenomena shared in a nascent critique of prodigy and judgement tales more broadly, which emerged as a consequence of the way in which religious sects and political factions blatantly exploited these stories for propaganda during the bitter civil conflicts of the century.<sup>63</sup> There was also a class dimension to the growth of scepticism: English savants increasingly predicated the accuracy of natural inquiries on social rank, requiring investigators to possess gentlemanly status to distinguish them from the supposed credulity of the common people.<sup>64</sup> However, examples from Canada to Chile also reveal the existence of a much broader, trans-Atlantic trend in this period toward questioning the truth of claims about disasters and their associated prodigies. This was not a complete paradigm shift: belief in prodigies continued to be widespread later in the century: some accounts of the earthquake at Lima in 1687, for instance,

---

62 Brendan Dooley, “News and Doubt in Early Modern Culture: Or, Are We Having a Public Sphere Yet?,” in *The Politics of Information in Early Modern Europe*, ed. Brendan Dooley and Sabrina Alcorn Baron, (London; New York: Routledge, 2001), 276–77.

63 Alexandra Walsham, *Providence in Early Modern England* (Oxford ; New York: Oxford University Press, 1999), 333–34; William E. Burns, *An Age of Wonders: Prodigies, Politics, and Providence in England, 1658-1727* (Manchester, UK; New York: Manchester University Press, 2002).

64 Steven Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England*, Science and Its Conceptual Foundations (Chicago: University of Chicago Press, 1994).

insisted on the accuracy of premonitory visions and portents of the disaster.<sup>65</sup> However, an important current of doubt had emerged that gained strength over time and demanded new evidentiary standards in disaster research.

Even writers that exhibited a keen interest in prodigies and miracles began to display misgivings about some stories. This is discernible, for instance, in Charles Simon's account of the Canadian earthquake in 1663, which intermingled detailed personal observations with reports of visions and wonders. The ghost of the martyred missionary Jean de Brebeuf had allegedly uttered premonitory warnings, pious women dreamed of rampaging demons and impending divine judgements, traders reported seeing a fiery city in the air surrounded with whirlwinds, a "monstrous spectre" was observed at Quebec City and porpoises were heard to wail and bellow near the town.<sup>66</sup> Simon tended to accept the visions of Christian Indians at face value but accorded less weight to the testimonies of unconverted people as witnesses of prodigies and portents: "either they really saw these things, or, as happens in troubled circumstances, thought they saw them".<sup>67</sup> Indeed, despite his enthusiasm for reporting holy visions, he sounded a note of caution about some testimonies:

There were not wanting, as prognostics of the great evils which threatened us, informers (*denuntiatores*) who, inspired as it were with prophetic spirits, spread abroad among the multitude the things which they themselves invented. This commonly happens in matters troubled and obscure (*in rebus turbatis et obscuris*), whose future issue the curious desire to know, the guilty, as being thoroughly conscious of their sins, dread, and the prudent can calmly expect, — yet no one can divine and certainly foretell, unless taught by God.<sup>68</sup>

---

65 Some of these were related in "Copia de una Carta que el P.e Fr. Domingo Alvarez de Toledo Procurador General de Corte, de la orden de Nro. P.e San Francisco escrivio desde Lima al Reverendissimo P.e General en Este Chasque; su fha en 29. de octubre de 1687", BNE MSS/9375, ff. 138r-140r.

66 Simon, "Relation de ce qui s'est passé," 212–15.

67 Simon, 204–7.

68 Simon, 208–9.

A remarkable incident in 1656 demonstrated the dangers of credulity concerning tales of disasters and the extraordinary impact that false or exaggerated accounts could have. In September English warships near Cádiz captured a young Spanish nobleman, Francisco Lopez de Zúñiga, the eldest son of the Marqués de Baides, former governor of Chile. The teenager, whose parents had died in the fierce sea battle with the English, proceeded to feed his captors a series of increasingly elaborate stories about an earthquake at Lima the previous year.<sup>69</sup> The young marquis gave the English naval officer Richard Stanyer the astonishing news that 12,000 people had died at Lima, that the city had sustained severe damage, and that in Chile the Andean tribes were on the brink of launching a major rebellion.<sup>70</sup> Stanyer conveyed Lopez to Lisbon, half-starved and dressed in rags, where he impressed the leading English naval official General at Sea Edward Montagu as “a most ingenious and intelligent youth”.<sup>71</sup> By this point Lopez’ account had taken on almost apocalyptic tones, involving “the fearfulest earthquake and raining of fire from heaven [...] that has been heard of in the world”. Lopez now claimed that the city was not just damaged but entirely “swallowed up” by the earth, along with the port of Callao. He further related that the famous silver mountain of Potosí, the most important source of Spain’s bullion supply, had been completely levelled with the plain. There could be no possibility of mining precious metals in the Viceroyalty of

---

69 An English agent in Madrid reported in an encrypted message that 500 Spaniards had drowned in the sea battle, and that the Spanish king was furious at the loss of the silver the Spanish fleet had been carrying. However, he made no mention of an earthquake. Anonymous to Matthew Bonell, 27 September 1656, in John Thurloe, *Collection of the State Papers of John Thurloe, Esq; Secretary First to the Council of State and Afterwards to the Two Protectors Oliver and Richard Cromwell*, ed. Thomas Birch (London: Fletcher Gyles, 1742), vol. 5, p. 425. During the six-hour naval engagement the English set fire to the Spanish flagship. The Marqués de Baides and his wife drowned after leaping from the burning wreck into the sea, and two of their children also perished. A long Spanish printed account of the fleet’s eventful voyage from Callao and its capture describes in detail the battle and the subsequent fate of the prisoners, but does not refer to the earthquake story: Diego Portichuelo de Ribadeneira, *Relación del viaje y sucessos que tuvo desde que salió de la ciudad de Lima, hasta que llegó a estos Reynos de España el Doctor Don Diego Portichuelo de Rivadeneira* (En Madrid: por Domingo García y Morras, 1657).

70 Note of 10 September 1656, attached to the letter of Captain Richard Stanyer to the Generals of the Fleet, 9 September, *Collection of the State Papers of John Thurloe*, vol. 5, p. 400.

71 Edward Montagu to John Thurloe, September 20, 1656, *Collection of the State Papers of John Thurloe*, vol. 5, p. 435.

Peru ever again. Lopez claimed that to recoup these great losses, the Spanish king would be forced to open the gold mines of Hispaniola, whose existence he had hitherto kept a closely-guarded secret. This account must have raised exciting possibilities for Montagu: thanks to the disaster at Lima, Oliver Cromwell's failed Western Design of the previous year to conquer Spanish America might now be revived, making use of the newly-acquired island of Jamaica as a forward base. Not only was the Spanish Crown severely weakened by the loss of Lima and Potosí, but a renewed assault on Hispaniola (whose small garrison had humiliatingly rebuffed an attack by the English fleet) would hand to Cromwell's Britain the mineral resources it needed to build an empire. Furthermore, the indigenous peoples of Spanish America hated their colonial oppressors and the notorious Inquisition so bitterly that they would be "readye to receive libertye" from an English army and rise up against the Spaniards. To supplement this intelligence Montagu managed to extract from his astute young captive a detailed account of the strengths and weaknesses of the Caribbean ports and of the presence of the main Spanish silver fleet in Havana — details that would prove invaluable in planning a new invasion.<sup>72</sup>

A jubilant Secretary John Thurloe duly conveyed this "very remarkable" news to Henry Cromwell in Ireland, though with the prudent proviso that "because this is the first tyme we have heard of it, it is thought necessary to have it seconded by other hands, before we doe give full credit thereto".<sup>73</sup> Meanwhile, Montagu brought Lopez and one of his brothers with him when he returned to London, lodging them at his own house and treating them as honoured guests. Oliver Cromwell himself met the young marquis, greeting him in Latin and tearfully commiserating the loss of his

---

<sup>72</sup> For the history of the Western Design, see Carla Gardina Pestana, *The English Conquest of Jamaica - Oliver Cromwell's Bid for Empire* (Cambridge, MA: Harvard University Press, 2017).

<sup>73</sup> John Thurloe to Henry Cromwell, undated, vol. 5, p. 472. Thurloe claimed that the disaster story was "also asserted by other prisoners", though it is unclear how he obtained that impression.

parents, before assuring him that he was no prisoner and would be returned to Spain at England's expense.<sup>74</sup> Despite this noble treatment of the boy, however, Thurloe and his associates were still waiting anxiously for more news of Peru on November 19:

We long to hear the confirmation of that earthquake in those parts; for certainly this loss would go near to ruin Spain. And although it would make the world somewhat poorer (for by the hands of Spain so much money has been derived and dispersed hitherto throughout all nations) yet there would be no great loss by that; these riches having been the sad causes and occasions to so many sins and abominations. And in former times when there was less store of money, the people lived more happily than now a days.<sup>75</sup>

Meanwhile, Spanish propagandists in the Netherlands were busy spreading a tale about the accidental discovery of an ancient treasure trove in a mountain near Toledo. According to the report, an opulent palace had been uncovered, complete with marble pillars, rooms full of jewels and chests bursting with ducats. Thurloe and his agents sneered at this "pretty story", believing that it had been designed to disguise the real extent of Spain's losses from the English seizure of its silver and the destruction of its American mines in the earthquake. Once the news of the Peruvian catastrophe became publicly known, a humiliated Felipe IV would have no choice but to sue for peace.<sup>76</sup>

As it turned out, however, the story of the disaster was a tremendous exaggeration. A strong earthquake in November 1655 had indeed caused some damage and widespread alarm; at least two people died and families slept outside for some time out of fear of further destruction.<sup>77</sup> But the city

---

74 Portichuelo de Ribadeneira, *Relación del viaje*, f. 68r.

75 *Collection of the State Papers of John Thurloe*, vol. 5, p. 606.

76 Intelligence from Frankfurt, November 19, 1656, *Collection of the State Papers of John Thurloe*, vol. 5, p. 606.

77 Mugaburu, *Chronicle of Colonial Lima*, 36.



had not been engulfed in the earth, fire had not descended from the skies, and Potosí continued to yield precious silver for the Spanish Crown. Whether the “ingenious and intelligent youth” had consciously determined to deceive his captors from the outset or whether he himself had heard only a muddled account of the earthquake during his sea voyage is unclear.<sup>78</sup> In either case, he embellished the event in a highly imaginative way that cleverly played upon English geo-strategic ambitions.<sup>79</sup> As a whole, the incident both revealed the immense impact of news about distant disasters and demonstrated the vital importance of obtaining accurate information. Cases like this powerfully reinforced the point that extraordinary claims about elemental destruction needed to be weighed carefully.

Disaster researchers in the 1650s-60s recognised both the danger of false reporting and the need for more robust standards of proof. The Jesuit missionary and historian Diego de Rosales devoted a chapter of his history of Chile (completed in 1674 but unpublished before the nineteenth century) to an assessment of the region’s earthquakes and volcanic eruptions.<sup>80</sup> Considering the indigenous legends that associated the volcanoes of the Andes with the spirits of past chiefs, Rosales commented that these were merely the “fables” of a “people ignorant of natural causes”.<sup>81</sup> From his perspective, modern natural philosophy could dispel such myths. Following a theory of subterranean combustion similar to that set out by Gassendi, he suggested that the bowels of the

---

78 The marquis’ fleet must have received news of the earthquake while it was in the Caribbean. Lopez’ allusions to the mounting grievances of the indigenous population and their readiness to rebel had some factual basis in the ongoing insurgency in Chile: the diarist Mugaburu reported a revolt on November 26, 1655. However, the complex situation in Chile was hardly representative of the empire in the Indies in general, as Lopez seems to have led Montagu to believe. Mugaburu, 37.

79 Impostors and fictitious tales represented as true accounts were fairly common in the seventeenth century, and far from unknown in the eighteenth. See for instance Juan Pimentel, *Testigos del mundo: ciencia, literatura y viajes en la ilustración* (Madrid: Marcial Pons Historia, 2003), chap. 1; Ruth Mackay, *The Baker Who Pretended to Be King of Portugal* (Chicago; London: University of Chicago Press, 2012); Michael Keevak, *The Pretended Asian: George Psalmanazar’s Eighteenth-Century Formosan Hoax* (Detroit: Wayne State University Press, 2004).

80 Rosales, *Historia general de el reino de Chile, Flandes Indiano*, vol. 1, chap. 4.

81 “[...] gente ignorante de las causas naturales [...]”. Rosales, vol. 1, p. 202.

mountains were replete with an explosive combination of fire and sulphur, which had caused major eruptions in 1640 and 1653.<sup>82</sup> In addition, he was convinced that the great Chilean earthquakes of 1570, 1647 and 1657 were connected with the region's volcanism, which he thought had caused the earth to "boil".<sup>83</sup> On the other hand, he was also convinced that earthquakes were expressions of the wrath of God, "who by means of the earth punishes those who sin upon it".<sup>84</sup> Rosales was in Concepción during the 1657 earthquake and tsunami, and was able to reconstruct the events using his own observations.

Like Quebec, Chile had its earthquake visionaries, but Rosales applied to these the same sense of doubt that he used in dismissing indigenous volcano beliefs. In particular, he found one case "worth recounting in order to understand revelations and not to believe them easily, but rather to examine them with astuteness and prudence".<sup>85</sup> This was the story of a boy of ten to twelve years of age, who claimed that while fleeing from the disaster at Concepción he had met an ancient bearded man in a cave of a nearby mountain. According to the boy, this pious hermit told him to hurry back and warn the citizens that their town was about to be totally destroyed in an even greater cataclysm, along with much of the kingdom of Chile and other provinces of the Indies. Rosales noted with scorn that the common people (*el vulgo*) quickly embraced the prophecy and combined it with others which "they augmented and embellished, so that everybody was agitated, and as the tremors repeated themselves, every person expected the end and believed that the earth would open and swallow them all".<sup>86</sup> The rumours spread rapidly to Santiago and thence to Peru, where they joined

---

82 Rosales, vol. 1, p. 202.

83 Rosales, vol. 1, p. 204.

84 "[...] que por medio de la tierra castiga a los que en ella pecan [...]" Rosales, vol. 1, p. 208.

85 "[...] un caso que es digno de contarse para conocer revelaciones y no creerlas facilmente, sino examinarlas con astucia y prudencia". Rosales, vol. 1, p. 207.

86 "[...] que el vulgo aumentaba y encarecia, con que andaban todos alborotados, y como los temblores se repetian, a cada uno esperaban el fin y que la tierra se avia de abrir y tragarlos a todos". Rosales, vol. 1, p. 207.

with other revelations that seemed to confirm the original tale. Above all, in Rosales' view, it was the boy's tender age that lent credit to the story, since it was hard to imagine an innocent child inventing malicious tales. Nevertheless, the local governor, the bishop and other prelates (including Rosales) determined to investigate the truth of the story, summoning the boy to appear before them. Although the child duly repeated the prophecy, Rosales settled on a strategy to catch him out. Pretending to accept the boy's story, he invented some additional aspects to the hermit's predictions and asked the boy if he had simply forgotten to mention them. The boy initially agreed that the hermit had indeed told him these things as well, but when Rosales revealed the ruse the child finally admitted that the whole story was a lie — he claimed that a soldier had invented the tale and forced him to act out his part in it. To Rosales the episode demonstrated “the caution needed before believing such revelations and the care with which they have to be examined”.<sup>87</sup> This was not a pervasive, secularising suspicion — Rosales had no problem in accepting the authenticity of divine providence and miracles in disasters generally. Instead, it expressed a growing sense of caution about the veracity of claims and predictions about disaster situations.

However, this sceptical trend sat uneasily beside an emphasis on the extraordinary aspects that characterised destructive phenomena. Accentuating the extreme and the unusual in earthquakes or storms inclined some researchers towards the traditional heteroclite framework. French works about the West Indies such as Jean-Baptiste du Tertre's *Histoire generale des Antilles* (1654, with a substantially enlarged second edition in 1667) and Charles de Rochefort's *Histoire naturelle et morale des iles Antilles de l'Amerique* (1658) demonstrated both some of the older organisational habits and new

---

<sup>87</sup> “[...] el tiento que es menester para creer semejantes revelaciones y el cuidado con que se an de examinar”. Rosales, vol. 1, p. 208.

attempts to categorise natural calamities.<sup>88</sup> The completed history of du Tertre, a Dominican naturalist who worked as a missionary in the Antilles from 1640, actually offered two parallel organisational schemes. In a volume dedicated to the natural history of the French Caribbean territories, he placed hurricanes within a section on climatic conditions, as part of a subset of “agitations of the air” (*agitations de l’air*), alongside whirlwinds (*tourbillons*) and gusts or gales (*rafalles*).<sup>89</sup> Yet in the first volume, devoted to civil history, he relegated his description of a hurricane of c.1656 to a chapter concerned with the ambiguous category of “highly extraordinary things” (*choses fort extraordinaires*) alongside an earthquake on Martinique and a slave revolt on Guadeloupe.<sup>90</sup> The natural history discussion made no attempt to connect the hurricanes of the Caribbean to the theories and frameworks of classical meteorology, instead offering a dramatic description of these “very horrible and very violent tempests” that vividly contrasted the strange calm before the storm with the total desolation it left behind: “the saddest spectacle that one could imagine”.<sup>91</sup> Here du Tertre covered the periodicity of the storms, indigenous practices of forecasting them (of which he was a sceptic), the spectacular damage they wrought, and the means by which colonists survived them (clinging to the boles of trees).<sup>92</sup> The description of the hurricane in the civil history gave additional details on the phases by which the storm progressed, including an account of the strange sounds that preceded it and the frightening change in the colour of the sky (which he compared to metal withdrawn from a furnace).<sup>93</sup> However, it also ventured into the territory of the older prodigy

---

88 The expanded edition of du Tertre’s work in 1667 included two volumes, to which two more were added in 1671.

89 Du Tertre, *Histoire generale des Antilles*, vol. 2, pp. 71–3.

90 Du Tertre, vol. 1, chap. 19. On the question of the year in which this storm occurred (which is very unclear in du Tertre’s account), see Millás, *Hurricanes of the Caribbean and Adjacent Regions, 1492-1800*, 125–28.

91 “de tres-horribles & tres-violentes tempestes”; “[...] le plus triste spectacle qu’on se puisse imaginer [...]”. Du Tertre, *Histoire generale des Antilles*, vol. 2, pp. 71–2.

92 Du Tertre, vol. 2, pp. 71–3.

93 Du Tertre, vol. 1, pp. 496–7.

accounts in its superlatives: this was the most terrifying storm ever witnessed; its fury was such that one would have said the whole island would be obliterated from the face of the earth.<sup>94</sup> The hurricane was followed by an equally prodigious plague of caterpillars that devoured the remaining crops, and a subsequent famine. While Du Tertre offered a natural explanation for the caterpillars — the hurricane had left behind “a certain infection in the air” which produced the vermin — his account recalled the plagues of Egypt in Exodus, and this Biblical dimension also appeared in his brief observation that hurricanes serve as images foreshadowing the deluge of fire that would form part of the End Times.<sup>95</sup> Du Tertre’s employment of the word *fléau* (scourge) to connect the hurricane and the caterpillars with the earthquake, and by extension with the slave uprisings, also recalled the older heteroclitite concept of calamity.<sup>96</sup>

This liminal position of disaster between prodigy and environmental hazard is also visible in the natural history of Rochefort, a Huguenot whose sojourns in the West Indies in the 1630s-40s included time as a pastor on La Tortue (Tortuga).<sup>97</sup> His own account of Caribbean hurricanes lifted many of its key details from the first edition of du Tertre’s book, but repurposed and expanded them as part of an attempt to encourage Protestant immigration to the French colonies.<sup>98</sup> Du Tertre had wished to draw attention to the travails the French had endured and overcome in the Indies with a dramatic illustration of hurricanes, which were “such a sad and deplorable thing, that if this disorder happened often, I do not know who would have the heart & the courage to go to the

---

94 Du Tertre, vol. 1, p. 496.

95 “une certaine infection dans l’air” Du Tertre, vol. 1, p. 497; vol. 2, p. 71.

96 Du Tertre, vol. 1, p. 498.

97 Everett C. Jr Wilkie, “The Authorship and Purpose of the ‘Histoire Naturelle et Morale Des Îles Antilles’, an Early Huguenot Emigration Guide,” *Harvard Library Bulletin* 2, no. 3 (1991): 33–34.

98 It was du Tertre’s awareness of the imminent publication of a plagiarised version of his work that compelled him to issue the first, unfinished version of the *Histoire generale*, and the similarities between his and Rochefort’s work later gave rise to debate about whether he should be credited with the *Histoire naturelle et morale* as well. As Everett Wilkie points out, however, the differences between the two works (as well as other contributing evidence) confirm Rochefort’s authorship of the latter. Wilkie, 31–32. Nevertheless, Rochefort’s plagiarism is particularly visible in the section on hurricanes.

Indies".<sup>99</sup> By contrast, Rochefort sought to downplay the threats posed by the elements in order to allay the apprehensions of potential colonists, and this imperative to minimise the fear of Caribbean disasters influenced both his description and his classification of them. He grouped hurricanes with thunder and earthquakes in a chapter on what he termed “incommodities” (*incommodités*) — a category that also included (in the following chapter) such nuisances as mosquitoes.<sup>100</sup> His prefatory comments encouraged readers to consider these discomforts as expected counterparts to the region’s beauty: after all, he explained, every country has its agreeable and disagreeable features.<sup>101</sup> On the one hand, hurricanes exhibited prodigious effects: a recent one at Saint Christophe (Saint Kitts) had shattered ships carrying tobacco, which poisoned the fish and caused their corpses to float in great crowds on the water.<sup>102</sup> On the other hand, they were also to be considered as ordinary occurrences that should not elicit any more trepidation than other, more familiar kinds of adversity. Moreover, by describing storm destruction at Bordeaux in 1599, and reproducing the account of a second storm of 1645 in La Rochelle, Rochefort attempted to demonstrate that Europe suffered disasters (*desastres*) that were just as terrible as those of the Indies.<sup>103</sup> Indeed, there was no reason to maintain a separate term for the storms of the Caribbean, since the tempests of France were so terrifying “that one cannot deem them anything other than *Hurricanes*”, and former residents of the

---

99 “[...] une chose si triste & si déplorable, que si ce desordre arrivoit souvent, ie ne sçay qui auroit le coeur & le courage d’aller aux Indes”. Du Tertre, *Histoire generale des Antilles*, vol. 2, p. 72.

100 Charles de Rochefort, *Histoire naturelle et morale des îles Antilles de l’Amerique. : Enrichie de plusieurs belles figures des raretez les plus considerables qui y sont d’écrites. : Avec vn vocabulaire Caraïbe*. (A Rotterdam: Chez Arnould Leers, 1658), ch.s 23-24.

101 Rochefort, 242.

102 Rochefort, 244. Rochefort does not give a date for this event, but it is probably the 1650 disaster mentioned by du Tertre, who says that 28 ships were wrecked in the vicinity of the island: Du Tertre, *Histoire generale des Antilles*, vol. 2, p. 29. On this storm, see also the entries in Andrés Poëy Y Aguirre, *Table chronologique de quatre cents cyclones qui ont sévi dans les Indes occidentales et dans l’océan Atlantique nord: pendant un intervalle de 362 années (depuis 1493 jusqu’en 1855)* (Paris: Impr Administrative de Paul Dupont, 1862), 9; Millás, *Hurricanes of the Caribbean and Adjacent Regions, 1492-1800*, 119.

103 Rochefort, *Histoire naturelle et morale des îles Antilles de l’Amerique.*, 245–46.

Caribbean who experienced the storm at La Rochelle used the same term for both.<sup>104</sup> Furthermore, he claimed that the great storms of the Caribbean were rare, confined to three months (from July to September), and while it was true that hurricanes had become more frequent in recent years (an observation he copied from du Tertre), there were now more houses capable of withstanding them.<sup>105</sup> Moreover, Rochefort emphasised that pious settlers could find secure shelter in their faith: it was God who caused hurricanes, and the Lord directed them to the benefit of His children, just as He did fires and earthquakes.<sup>106</sup> Putting a new spin on du Tertre's apocalyptic motif, he suggested that Protestant immigrants should be cheered when they considered that no hurricane could be more terrifying than the final destruction of the world.<sup>107</sup> Thus in Rochefort's formulation, Caribbean disasters formed part of a universal category of commensurable calamities, while at the same time constituting ordinary features of a particular environment, whose divinely-ordered regularity could be a source of comfort.

While some natural historical writing exhibited a tension between accentuating and downplaying the prodigious qualities of hurricanes, the genre of judgement collections that specialised in purveying dubious tales of prodigious events began to display an awareness that some of these stories were more plausible than others. As early as 1642, the author of one of these compilations, Henry Burton, sensed that readers were becoming increasingly unpersuaded by "fained miracles", "fabulous stories" and "old Wives tales" that failed to meet a basic threshold of believability. Indeed, the lack of quality control in the genre threatened to turn readers into "prophane Scoffers to

---

104 "[...] de si épouvantables Tempestes, que l'on ne les peut estimer autre chose que des *Ouragans*." Rochefort, 245.

105 Rochefort, 246–47; Du Tertre, *Histoire generale des Antilles*, vol. 2, p. 71.

106 Rochefort, *Histoire naturelle et morale des îles Antilles de l'Amerique*, 248.

107 Rochefort, 247–48.

jeare at, and play upon, thereby to disgrace and discredit all truths in this kinde”.<sup>108</sup> To differentiate his own work, Burton assured readers that his accounts of sudden deaths, urban fires and plague outbreaks were the product of “credible report” and “good testimony under the hands of men of sufficient credit”. On one level this kind of response to scepticism was merely verbal performance. We can detect similarly superficial attempts to display truthfulness in the titles of sensational pamphlet literature about disasters and other extraordinary occurrences, which often included words like “true relation” (*récit véritable, relación verdadera*) or “true and perfect narrative”.<sup>109</sup>

However, other writers responded to the growth of scepticism by searching for the means to provide robust standards of proof for judgements and wonders. John Beale, an English clergyman and early Fellow of the Royal Society, was an important devotee to this cause. He was convinced that “particular Prodigyes” were signs of public calamity, and some of these had indeed “forenoted the late troubles of these nations” (i.e. the Wars of the Three Kingdoms in Britain).<sup>110</sup> He noted that some of his contemporaries were inclined to reject prodigy stories out of hand, but argued that human experience had proven their importance: “Are all prodigyes, & Signes to bee despised, & neglected?”, he asked. “If soe, Howe cam all Historians, inspired, holy, & prophane, soe constantly to record them?”<sup>111</sup> God sent these signs deliberately in order to show His followers what to do: the problem was that they were treated haphazardly and ignorantly, so that their import was too often lost. Beale complained that he “could not find one Man besides my selfe, [tha]t tooke these matters

---

108 Henry Burton, *A Divine Tragedie Lately Acted, or, A Collection of Sundrie Memorable Examples of Gods Judgements upon Sabbath-Breakers and Other like Libertines in Their Unlawfull Sports Hapning within the Realme of England...* (London, 1642), 2.

109 For instance: Anon., *L'estonnement populaire, ou Recit veritable du grand tremblement de terre, arrivé aux environs, & dans la ville de Bordeaux, ces iours derniers* (Paris: Chez Iean Brvnet, ruë sainte Anne, proche le palais, 1660); John Bushel, *A True and Perfect Narrative of the Late Dreadful Fire Which Happened at Bridge-Town in the Barbadoes, April 18, 1668...* (London: Printed by Peter Lillicrap, 1668). This development is explored more broadly in Frances E. Dolan, *True Relations: Reading, Literature, and Evidence in Seventeenth-Century England* (Philadelphia: University of Pennsylvania Press, 2013).

110 John Beale to Samuel Hartlib?, 17 August 1657, HP, 31/1/35A.

111 HP 31/1/35A-B.



into their serious consideration; that I could not see any publick care, undertakeing, or, the acknowledgement of any peculiar discipline of Observing, Recording, or Interpreting the Signes of remarkeable tokens or executions of Gods Judgements or mercyes over Nations, Cittyes, Townes, Villages & Families”.<sup>112</sup> Beale probably had in mind Bacon’s call for a “history of providences” — “the notable events and examples of God’s judgments, chastisements, deliverances, and blessings”.<sup>113</sup> However, since the *Advancement of Learning* had left that category intentionally vague, he also drew on Bacon’s advice for the sifting of errors and fables associated with the “history of marvels”. The Baconian method of creating “histories” from precise observations needed to be extended to accounts of judgements and portents, so that a robust practice could be established for the prophetic reading of divine signs and the discovery of fraudulent accounts: “Is it a busines soe slight, That it deserves noe discipline, but must bee left, as it were only to chance?”<sup>114</sup> Beale therefore called for the creation of a “colledge” of interpreters, to be trained in a disciplined method of collecting, assessing and determining the meaning of portents. These men would also ensure that awareness of such extraordinary facts did not remain confined to the circles of the learned, but were also conveyed to “*publique notice*”.<sup>115</sup> The Lord’s signs would no longer be squandered but rather expertly interpreted and used as clear guides for the good of all. In this way, major calamities could be anticipated and averted.

A number of initiatives to collect, assess and order systematically stories about prodigies began to emerge in response to these kinds of considerations. Beale himself seems to have had some connection to one of these projects, a design for the collection of “illustrious providences”

---

112 “Of Mr Pooles Designe”, September 23 1657, CUL MS Dd.iii.64, f. 138r. This paper is not signed, but is generally regarded to have been written by Beale.

113 Francis Bacon, “The Advancement of Learning,” in *Works*, ed. James Spedding, Robert Leslie Ellis, and Douglas Denon Heath (London: Longman, 1857), vol. 3, pp. 341–42.

114 HP 31/1/35B.

115 HP 31/1/35B.

proposed by the English Presbyterian churchman Mathew Poole in the 1650s. Although Poole's design never left the planning phase, we possess a manuscript setting out the goals and guidelines of his programme.<sup>116</sup> Networks of correspondence were to be established between ministers, and the minister in a given county or region would choose four or five "men of judgm[en]t activity, & zeall" who would actively solicit accounts of providences (both current and past) from the inhabitants of the vicinity, and report back to the minister. The network was initially to be confined to England, but could later be extended to Scotland and Ireland. When a providence was reported, the appropriate minister would investigate, establishing the time, place, circumstances and witnesses of the case. He would then draw up an account and ask the witnesses to sign it, alongside a notation of their address and social rank so that they could swear to their account in court. Witnesses should be carefully assessed to be *fide digni* (worthy of trust), and wherever possible, they should be required to make an affidavit before a justice of the truth of their account. After these proceedings had finished, the minister would then send his report to Poole. Poole should also be informed if a given providence crossed county lines so that he could coordinate inquiries. He would keep the originals of the reports in Sion College, and would arrange for them to be printed for the public benefit. The providences to be collected would include divine judgements, spectral apparitions and incidents of witchcraft, as well as the extremely vague category of phenomena that were "extraordinary & very observable".<sup>117</sup>

Poole's procedure was characterised by two features: an information collection mechanism and a means of certifying reliable information. The latter aspect was founded upon legal and ecclesiastical procedures for determining truth and trust: the concept of *fide digni*, for instance, was a part of the

---

116 "A Design for Registring [sic] of Illustrious Providences", CUL MS Dd.iii.64, ff. 136r-137r.

117 CUL MS Dd.iii.64, f. 137r.

machinery of medieval ecclesiastical governance that had originated in Roman civil law.<sup>118</sup> However, it lent heavily on the reliability, competence and good faith of individuals — especially the ministers, who had to be both active investigators and good judges of character and truthfulness. It assumed that ministers, by virtue of their status and training, would be entirely trustworthy, and at the same time uniquely qualified to reach conclusions about preternatural occurrences. By removing the shield of anonymity from alleged witnesses of wonders, the system reduced some of the potential for invention, but it could provide no independent means of verifying testimonies about fleeting events. Even more importantly, the proposals give no hint as to how (or even whether) the providences collected would be interpreted, meaning that Poole’s scheme offered no solution to the controversies that afflicted seventeenth-century discussions of prodigies.

Unlike Beale, Poole does not seem to have envisaged the creation of a body of knowledge analogous to the natural histories being developed by the Hartlib Circle and the group centred around John Wilkins at Wadham College, Oxford. The observation and recording of “illustrious providences” had overwhelmingly practical purposes: they were supposed to impart urgent messages from God to the world, to help mortals comply with the divine plan and to defeat atheism. Although some historians have detected Baconian affinities in Poole’s project, in reality there no evidence that he saw it as fulfilling part of Bacon’s programme.<sup>119</sup> Instead, the motives for Poole’s design, as articulated in the guidelines for collecting, were entirely religious. The manuscript explained that all Christians had a duty to take note not only of God’s word (Scripture) but also his

---

118 For a discussion of this concept in the medieval context, see Ian Forrest, *Trustworthy Men: How Inequality and Faith Made the Medieval Church* (Princeton, New Jersey: Princeton University Press, 2018), 108.

119 Scholars have often overstated the “Baconian” character of Poole’s scheme. Although both Bacon’s and Poole’s collecting schemes built upon legal mechanisms to ensure credibility, Poole’s proposals neither referred to Bacon explicitly nor drew upon his ideas. For assumptions of a supposed parallel to the Baconian programme, see Keith Thomas, *Religion and the Decline of Magic* (London; New York: Penguin, 1991), 110–11; Michael P. Winship, *Seers of God: Puritan Providentialism in the Restoration and Early Enlightenment* (Baltimore, Md: Johns Hopkins University Press, 1996), 61; Burns, *An Age of Wonders*, 16.

works (providences). To allow any sacred messages to escape human notice was a terrible sin, which Scripture promised would invite God’s destructive wrath. Here the manuscript quoted from Psalm 28:5 (“Because they regard not the works of the Lord, nor the operation of his hands, he shall destroy them, and not build them up”) — a passage that suggested to early modern minds that a punishment in the form of a mighty calamity would befall those who ignored divine signs and warnings. This was precisely the sense in which Calvin interpreted the line: “[l]est we should be struck, therefore, with an incurable plague, let us learn to awake our minds to the consideration of God’s works, that we may be taught to fear him, to persevere in patience, and to advance in godliness”.<sup>120</sup> Poole in his own Biblical commentary confirmed that the Psalm referred to those who did not give “serious Observation” of God’s providential operations and preservations and refused to acknowledge them: such people “may well be presumed to be Guilty of Rebellion against God’s Will, and of the Contempt of his Providence”. God would accordingly “[d]estroy them utterly and irrecoverably; because they wilfully shut their Eyes against the Light of Gods Word, and Works”.<sup>121</sup> Those Biblical nations that had become rebels against God had never prospered. As Poole noted in his monumental *Synopsis Criticorum* (a compilation of biblical exegesis over the ages), Scripture promised that peoples who ignored the Lord’s commands would be punished with terrible disasters, which would in turn serve as signal prodigies for future generations to show them the wages of disobedience.<sup>122</sup> The repeated punishments of Egypt in the Book of Exodus offered a clear demonstration of what happened to those who failed to heed divine warnings, while on the other

---

120 Jean Calvin, *Commentary on the Book of Psalms*, trans. James Anderson (Edinburgh: Printed for the Calvin Translation Society, 1845), vol. 1, pp. 471–472.

121 Commentary on Psal. 28:5 in Matthew Poole, *Annotations upon the Holy Bible...* (London: Printed by John Richardson, for Thomas Parkhurst, Dorman Newman, Jonathan Robinson, Bradbazon Ailmer, Thomas Cockeril, and Benjamin Alsop, 1683), vol. 1.

122 Commentary on Deuteronomy 28:45-46 in Matthew Poole, *Synopsis criticorum aliorumque S. Scripturae interpretum* (Londini: Typis J Flesher (usque ad I Sam deinde à II Reg inclusive ad finem voluminis) & T Roycroft: Prostat apud Cornelium Bee, 1669).

hand the narrow escape of Nineveh from destruction in the Book of Jonah showed that a timely appreciation of divine admonitions could rescue a society from ruinous disaster. The collection of providences was thus for Poole not so much a gathering and ordering of matters of fact, to be used as the basis for constructing a coherent epistemology, as an unending spiritual mission with intrinsic moral value, and an essential public service. Above all, it was a type of precautionary activity that would avert catastrophic judgements in the future.

The manuscript guidelines added that the faithful bore an associated duty to publish their observations of providences so that other Christians as well as unbelievers should become aware of them. This duty fell heaviest upon ministers, as God's "trumpets". The transmission of these providences had to occur not only across space but also time: future generations also had to learn about the providences that their predecessors had observed, just as ecclesiastical histories had recorded the providences of past ages. God intended his providences to be "remembered" in this way: they could not be allowed "to be buried in the grave of oblivion". In contrast to the esoteric science of astrology, with its closely-guarded trade secrets and its adherents' pursuit of financial gain and personal reputation, Poole's ministers would convey information about providences at no charge and as transparently and speedily as possible for the public good. The connected duties of observation, recording, collection, publication, inquiry and remembrance would defeat any single person, and so demanded a coordinated effort on the part of the faithful. Anticipating the complaint that it was sacrilege to pry too closely into God's secrets, Poole and his colleagues asserted that God intended his providences to be "exactly & diligently enquired into".<sup>123</sup> The

---

123 "A Design for Registering [sic] of Illustrious Providences", CUL MS Dd.iii.64, f. 136r. For the commonality of a disapproval of close inquiries into providences, see Walsham, *Providence in Early Modern England*.

manuscript cited Psalm 111:2, which appeared to authorise 'study' of the Lord's works.<sup>124</sup> As Poole indicated elsewhere in his gloss on this passage, he understood the Scriptural approval of study as an injunction to observe and consider providences, "both as to the nature of them, and God's counsels and ends in them; whereas the works of God are oftentimes not apprehended or minded, or are mistaken and misconstrued, by ungodly men".<sup>125</sup>

While he maintained that true providences had too often gone unheeded to the detriment of all, Poole understood that the reverse had also happened: sectarian commentators had been far too eager to launch themselves into the over-confident interpretation of signs and wonders which had in fact never occurred. The problem was that many accounts of providences were leavened with "a great mixture of false & foolish & unwitnessed fictions", which not only misled people but cast suspicion on true accounts. In the past, people had been too ready to accept and publicise doubtful accounts of providences, which spread delusion among a credulous populace. An official, collaborative system of assessment could identify and suppress those dubious stories before they could spread. A key goal of Poole's design was to convince "Atheists" of God's truth, and since people are taught more easily by examples than by theological argument, a certified publication of authentic providences could be a powerful evangelical tool. However, because of the carelessness of prodigy reporters in the past, sceptics would not now believe a given account of a prodigy without a good deal of supporting evidence. Hearsay and invention (the stuff of most contemporary accounts) would not suffice. Prodigy stories needed to be "evidenced by such proofes, as may convince gainsayers" and confirmed by a consensus of "the generality of judicious men". A

---

124 Psalm 111:2, KJV: "Great are the works of the Lord; They are studied by all who delight in them."

125 Poole, *Annotations upon the Holy Bible...*, vol. 1., Psal. CXI.2.

sufficiently robust record of providences would finally overthrow atheism, properly terrify sinners, and comfort the faithful.

Appended to the manuscript is a commentary, dated 1657 and probably written by Beale.<sup>126</sup> He expressed his approval of Poole's design, which he attributed to divine inspiration.<sup>127</sup> However, he also had some suggestions for improving its functioning. Beale offered a slightly broader view of the category of 'providences', encompassing divine judgements or mercies (what Poole called "Preservations" and other writers sometimes termed 'deliverances'), as well as "Prodigyes, Visions, & other Signes".<sup>128</sup> He pointed out that important providences were to be found not only in recent experience but also in Scriptures, as well as in the histories of every religion. In order to form a comprehensive body of data, it would be necessary for these repositories to be examined minutely.<sup>129</sup> However, for busy ministers so much extra scholarly activity would constitute an intolerable burden, and so he advised the creation of special remunerated positions within the ecclesiastical structure, whose occupants would have the sole task of poring over historical and religious texts to collect "such signes, & sinns & judgements & vertues & graces & mercys, as are linked together".<sup>130</sup> Instead of (or in addition to) a group of brethren working for free, animated only by zeal, and employing the legal mechanisms of Church governance, Beale envisaged a network of professional information gatherers. Only the humanistic nature of their activities would distinguish this body of scholars from the hierarchical organisation of scientific researchers that populated Francis Bacon's vision in *The New Atlantis*.

---

126 Burns, *An Age of Wonders*, 17.

127 CUL MS Dd.iii.64, f. 138r.

128 CUL MS Dd.iii.64, f. 138r. For Poole's use of "Preservations", see Poole, *Annotations upon the Holy Bible...*, vol. 1., Psal. XXVIII.5.

129 CUL MS Dd.iii.64, f. 138r.

130 CUL MS Dd.iii.64, f. 139v.

In addition, Beale suggested that the organisers should approach the most learned men in these matters as consulting experts — “persons of ye greatest abilityes & profoundest judgement from severall parts” — to refine investigatorial methods, to point out any problems with specific accounts, and to add authority to the network’s activities.<sup>131</sup> Accordingly, he suggested Poole’s network recruit the services of the Cambridge theologian Ralph Cudworth (1617–1688) and the Anglican clergyman and political theorist George Lawson (*d.* 1678). These scholars would together be capable of ascertaining methods to determine “true prodigyes” and to decide how (and to what extent) their meaning could be unravelled — thus supplying the crucial deficit in Poole’s scheme. Such men could also formulate criteria by which prodigies could be distinguished from “the Ordinary or necessary operations of nature” — an indication that Beale, unlike Poole, was thinking carefully about how to delineate a category of ‘natural’ phenomena.<sup>132</sup> The recommendation that Poole consult with these individuals implied that knowledge of how to assess and interpret prodigies was not evenly spread: the average minister might be able to relay information about providences (if he could overcome his impulse to exaggerate), but to understand them required a special gift and learning that only a few possessed. Elsewhere Beale was less shy in acknowledging that he considered himself to be among this number. This appeal to expertise was an innovation that paralleled the attempts by Beale’s fellow natural philosophers to ground their work upon some kind of social authority. Drawing in personnel from other confessions would also place Poole’s design above the prodigy propaganda of recent years, so “[t]hat it may not bee suspected or reported to bee a strategem only to advance a Presbyteriall faction”.<sup>133</sup> Whereas printed judgement collections often

---

131 CUL MS Dd.iii.64, ff. 138v-139r.

132 CUL MS Dd.iii.64, f. 139r.

133 Note that Beale himself was a clergyman of the Church of England, not a Presbyterian. CUL MS Dd.iii.64, f. 139r.



depicted divine punishment of rival sects and confessions, the Latitudinarian-inclined Beale counselled that Poole's writers make an effort to moderate the wording of their publications so as not to offend any groups of readers.<sup>134</sup> He also pointed to the shortcomings of Poole's authentication mechanisms: even intelligent witnesses who were *fide digni* would find it hard to avoid the natural compulsion to exaggerate and to modify the truth. As a result, he advised a posture of "heedfull warinesse" that would examine each alleged prodigy critically rather than simply collecting accounts.<sup>135</sup> Lastly, he cautioned Poole and his colleagues to exercise restraint and discretion when they considered publicising accounts of judgements that could do permanent damage to the reputations of alleged sinners and their families — especially if they were named in print — and might therefore draw the enmity of their powerful friends. Beale refused to disclose his own stories of judgements until Poole gave him an "engagement of Secrecy", and even then he would conceal the real names of those involved, having repented of his rash disclosures in the past.<sup>136</sup> He claimed to have been actively collecting prodigy accounts for the last two decades, and described himself as "stored with Secrets", but he mysteriously refused to part with his hoard, unless it was to those select people he considered to be "secretaryes to the Almighty".<sup>137</sup> He agreed that it was a sin to hide the works of God from the public, but he quoted Scripture to the effect that not everything should be revealed to all men at once. Beale's modified version of the project would have made it simultaneously more extensive and more cautious. He advocated ever greater collaboration and investigation, well beyond the confines of Presbyterianism, but also demanded space for secrecy and confidentiality.

---

134 CUL MS Dd.iii.64, f. 139r.

135 CUL MS Dd.iii.64, f. 139r.

136 CUL MS Dd.iii.64, ff. 141r-v.

137 CUL MS Dd.iii.64, f. 138v.

Although Poole's scheme never eventuated, a similar project appeared in New England under the guidance of the prominent congregationalist preacher Increase Mather. After the death of the minister John Davenport in 1670, Mather found among his papers a manuscript copy of Poole's guidelines.<sup>138</sup> Mather inferred that he had received it from the intelligencer Samuel Hartlib.<sup>139</sup> Sensing the importance of Poole's project, Mather consulted with colleagues about the potential for "the reviving of this work".<sup>140</sup> In May 1681 he presented a set of proposals to an assembly of the ministers of Massachusetts that shared many of Poole's objectives but also introduced important differences. New England's patchwork of largely autonomous congregationalist communities could not provide the tightly-ordered Presbyterian chain of communications that Poole had envisaged. The Massachusetts proposals therefore adopted a less formal procedure, requiring all the colony's ministers and elders to make individual inquiries about illustrious providences in their locality, recording the facts of the case and the names of the witnesses. One Elder would then compile the providences that the ministers sent him. Before these could be published, a special meeting of the Elders would convene to review them — perhaps echoing Beale's concerns about the need for careful limits on what to reveal, or possibly as a final stage of quality control.<sup>141</sup> The Massachusetts proposals also differed from Poole's in the delineation of the types of providences to be collected. These would comprise not only recent events but occurrences in the distant past. They would include judgements on sinners, apparitions, instances of witchcraft, demonic possessions,

---

138 Increase Mather, *An Essay for the Recording of Illustrious Providences: Wherein an Account Is given of Many Remarkable and Very Memorable Events, Which Have Hapned This Last Age, Especially in New-England* (Boston in New-England: Printed by Samuel Green for Joseph Browning, and are to be sold at his shop, 1684), A7r.

139 Hartlib was certainly aware of Poole's design, as is clear from his "Ephemerides" of May-December 1657: "Mr Poole Minister of London [...] is upon a designe of collecting all signal and extraordinary Providences of God, wherby the mouth of Atheisme may bee stopped. The formality of collecting of them is the essential part of the designe. As that by one minister in every shire that is judicious it may bee undertaken, that the report bee brought in upon oath taken before a magistrate. That the party engage to take the same oath as often as shall bee required. That the Originals of all these Intelligences bee reserved as upon record in Sion-Colledge London". HP 29/6/20A.

140 Mather, *An Essay for the Recording of Illustrious Providences*, A7r.

141 Mather, A8v.

remarkable deliverances, notable fulfillments of prayer, "or what ever else shall happen that is Prodigious".<sup>142</sup> Crucially, the first entries in the category of "Divine Judgements" were "Tempests, Floods, Earth-quakes, Thunders as are unusual", suggesting a special emphasis on destructive or alarming elemental phenomena. Since only "remarkable" occurrences were to be included, this implied that it was possible and desirable to distinguish between ordinary and extraordinary natural events, although the proposals did not suggest a means of making the distinction. Although the initiative for compiling providences remained with Mather, the core of the work derived from his collaboration with other ministers. Mather relied on a large personal network of correspondents that extended across the New England colonies as well as to England, Ireland, the Netherlands and other countries.<sup>143</sup>

The culmination of these collecting activities was Mather's *An essay for the recording of illustrious providences* (1684): a compilation of tales of divine deliverances from disaster at sea, prodigies, judgements, ghosts, witches, and curiosities natural and human. This was very much a hybrid creation, which fused the genres of judgement and prodigy collections with the natural philosophy of the Royal Society. Storms and lightning formed a central part of the work. On one level, they operated as examples of divine judgements and remarkable deliverances, as when three children miraculously survived a lightning strike on a house in Roxborough.<sup>144</sup> However, they were also natural phenomena susceptible to physical explanation — the result of explosions produced by the chemical reaction of sulphur and nitre in the clouds.<sup>145</sup> In addition, Mather thought that storms

---

142 Mather, A7v.

143 Francis Bremer, "Increase Mather's Friends: The Trans-Atlantic Congregational Network of the Seventeenth Century," *Proceedings of the American Antiquarian Society* 94, no. 1 (1984): 59-96.

144 Mather, *An Essay for the Recording of Illustrious Providences*, 80.

145 Mather, 109–15.

could be the instruments of Satan and practitioners of black magic.<sup>146</sup> Finally, he believed that they had a providential character, “which is very mysterious and beyond humane Capacity to comprehend”.<sup>147</sup> Although Mather’s *Essay* drew on printed works, from Beard’s *Theatre of Gods judgements* to the Royal Society’s *Philosophical Transactions*, the core of the work derived from his correspondence network, which kept him apprised of disasters in both North America and Europe. In 1682, for instance, a correspondent in Bristol wrote to him about floods in the Netherlands in which 1,000 people had allegedly drowned.<sup>148</sup> In addition to storms and floods, Mather also compiled examples of earth movements, including five earthquakes in New England and six cases of the ground sinking or migrating.<sup>149</sup>

The *Essay* also reflected Mather’s longer personal practice of collecting “remarkables”.<sup>150</sup> In the 1670s Mather was consistently attempting to trace providential patterns in public and private events. He was in the habit of regularly listing in his diary recent “Causes of Humiliation” (divine chastisements) and “Grounds of Thankfulness” (instances of mercy or deliverance).<sup>151</sup> This decade supplied a particularly heavy sequence of calamities for Massachusetts, including “King Philip’s War” of 1675-76, smallpox epidemics in 1675-76 and 1677-79 and major fires in 1676 and 1679. Mather lost his house and his church in the 1676 conflagration, which burned down between forty-five and fifty houses in Boston’s North End.<sup>152</sup> This event cast a long shadow over the preacher’s

---

146 Mather, 124–28.

147 Mather, 109.

148 Ichabod Chauncy to Increase Mather, 1682, BPL MS Am 1502 vol. 4, no. 31, f. 2v.

149 Mather, *An Essay for the Recording of Illustrious Providences*, 322–28.

150 This is a point that historians have sometimes overlooked. See for instance Thomas, *Religion and the Decline of Magic*, 110–11; Peter Lockwood Rumsey, *Acts of God and the People, 1620-1730* (Ann Arbor, MI: UMI Research Press, 1986), 31–33.

151 Increase Mather, *Diary by Increase Mather, March, 1675-December, 1676: Together with Extracts from Another Diary by Him, 1674-1687*, ed. Samuel A. Green (Cambridge: J Wilson, 1900).

152 Samuel Sewall, *Diary of Samuel Sewall: 1674-1729*, Collections of the Massachusetts Historical Society; Ser. 5, v. 5-7 (Boston: Massachusetts Historical Society, 1878), vol. 1, pp. 28–9. See also the account of Captain Lawrence Hammond (the original of which is now missing), reproduced in Mather, *Diary*, 54.

life and work, helping to make disasters the cornerstone of both his public campaign for moral reformation and his providence collection. In 1677 he delivered a thunderous sermon (printed in 1679) “concerning the danger of apostasy”, in which he warned that God was about to “kindle another fire in Boston ere long, that shall burn to the Foundation of the Mountains”.<sup>153</sup> He also called for a collection of special providences to be made, in the manner of the Book of Chronicles and other Biblical texts, which would keep “a lasting Record and Monument” of God’s mercies to New England.<sup>154</sup> One of the functions of this record would be to contrast God’s approval of the purity of the founding generation of colonists with His harsh correction of their increasingly degenerate and “unconverted” descendants in “trouble upon trouble, wars, sicknesses, Sword, Fire, desolations in every corner of the Land”.<sup>155</sup> Mather thus yoked providence collection and disasters to his campaign for public reformation. After another fire in August 1679 destroyed between eighty and two hundred houses, several warehouses and a number of ships with — causing damage that Mather estimated at £150,000 — his campaign gained enormous traction.<sup>156</sup> In September the Massachusetts General Court appointed a synod, at Mather’s urging, to consider the question “What are the Evils that have Provoked the Lord to bring his Judgments on New-England. And, What is to be done that so those Evils may be Reformed?”<sup>157</sup> After a few days of discussion, the assembled ministers agreed to a manifesto, drawn up by Mather, which unsurprisingly linked the fires, the

---

153 Increase Mather, *A Discourse Concerning the Danger of Apostasy...Delivered in a Sermon, Preached in the Audience of the General Assembly of the Massachusetts Colony at Boston in New England, May 23, 1677: Being the Day of Election There* (Boston: n.p., 1679), 80–81.

154 Mather, 71.

155 Mather, 82–83.

156 Governor Bradstreet to the Privy Council committee for trade and foreign plantations, 18 May 1680, NA CO 1/44, No. 61, f. 410r; Mather, *Diary*, 50.

157 Cotton Mather, *Parentator: Memoirs of Remarkables in the Life and the Death of the Ever-Memorable Dr. Increase Mather, Who Expired August 23, 1723* (Boston: Printed by B Green for Nathaniel Belknap, at the corner of Scarlet’s-Wharff, 1724), 84–85.

epidemics and the war to the decline of godliness.<sup>158</sup> By May 1680, when a second synod convened, Mather (though extremely ill) was at the height of his power.<sup>159</sup> Thus, when the ministers met again in 1681 to consider the proposals on collecting providences, it was abundantly clear that this project would be an extension of Mather's overall programme for tracing patterns in judgements and deliverances, and applying these for the rehabilitation of society along godly lines.

Nevertheless, in the *Essay* Mather strove to uphold the standards of proof on which both Poole's design and the 1681 proposals insisted. He often quoted directly from letters and books, such as the English non-conformist clergyman James Janeway's book of sea deliverances (published posthumously in 1674).<sup>160</sup> In other cases he tried to link the credibility of testimonies to moral character: he described informants alternately as "A Worthy Person" or "a Person of great integrity".<sup>161</sup> Sometimes he took his impression of the informant's piety as a measure for reliability: the skipper How's preservation from maritime disaster was the account of "a godly man".<sup>162</sup> While such determinations hardly amounted to objective standards, they indicated Mather's commitment to weighing the trustworthiness of testimonies by attempting to establish whether the witness was *fide digni*, in Poole's terms. Furthermore, the size of Mather's information network sometimes allowed him to draw on several accounts of phenomena for purposes of comparison. For instance, his Connecticut correspondents Thomas Hanford, John Bishop, William Jones and Israel Chauncy

---

158 Increase Mather, [*The Necessity*] of Reformation with the Expedients Subserving Thereunto Asserted in Answer to Two Questions, I. *What Are the Evils That Have Provoked the Lord to Bring His Judgements on New-England?*, II. *What Is to Be Done That so Those Evils May Be Reformed?* / Agreed upon by the Elders and Messengers of the Churches Assembled in the Synod at Boston in New-England, Sept. 10, 1679 (Boston: Printed by John Foster, 1679), 2.

159 Increase Mather, *A Confession of Faith, Owned and Consented unto by the Elders and Messengers of the Churches Assembled at Boston in New-England, May 12, 1680* (Boston: John Foster, 1680).

160 James Janeway and John Ryther, *Mr. James Janeway's Legacy to His Friends: Containing Twenty Seven Famous Instances of Gods Providences in and about Sea Dangers and Deliverances...* (London: printed for Dorman Newman, at the Kings Armes in the Poultry, 1674).

161 Mather, *An Essay for the Recording of Illustrious Providences*, 39, A4r.

162 Mather, 58.

furnished him with several perspectives on storms in the summer of 1682.<sup>163</sup> In one case Mather noted that he had refused to print a testimony of a storm, "not having received a full and clear account" of events.<sup>164</sup> This referred to a narrative sent by his nephew John Cotton Junior to Increase's son Cotton Mather (who was evidently assisting his father) in late 1683, shortly before the printing of the *Essay*.<sup>165</sup> Although Cotton Junior insisted that "[t]he Relation of this man is faithfull, he is a child of godly parents", the younger Mather declined to accept it without further clarification, pointing out that the description of the storm "is imperfect as to the circumstance".<sup>166</sup> John Bishop, a minister at Stamford, commented that "it is sad we cannot come at the certainty of such things we hear many times" — "It is pity & most unmeet that the Providence of God (especially in such awful works) should be either belyed, or concealed".<sup>167</sup> Mather's evidentiary scruples were not shared by all contemporary writers, however. He gave a relatively restrained account of the earthquake in Quebec in 1663, which he claimed had cleaved a huge boulder and exposed a hole of vast depth beneath it.<sup>168</sup> The Anglican naturalist John Josselyn's *Chronological Observations of America* (1673), on the other hand, asserted that from out of the great pit beneath the boulder had escaped a horde of "infernal Spirits".<sup>169</sup> While Mather had no trouble believing in the existence of evil spirits — he

---

163 Thomas Hanford (at Norwalk) to Increase Mather, July 15 1682, BPL MS Am 1502 vol. 4, no. 51; John Bishop (at Stamford) to Increase Mather, 3 August 1682, BPL MS Am 1502 vol. 4, no. 52; William Jones (at New Haven) to Increase Mather, 1682, BPL MS Am 1502 vol. 4, no. 6; Israel Chauncy (at Stratford) to Increase Mather, 6 February 1683 (N.S.), BPL MS Am 1502 vol. 5, no. 3.

164 Mather, *An Essay for the Recording of Illustrious Providences*, 311.

165 John Cotton Junior to Cotton Mather, 13 December 1683. John Cotton, Jr, *The Correspondence of John Cotton Junior*, ed. Sheila McIntyre and Len Travers, Publications of the Colonial Society of Massachusetts, Vol. LXIX (Boston: The Colonial Society of Massachusetts, 2009), 289–90.

166 Cotton Mather to John Cotton Junior, 20 December 1683. Cotton, Jr, 290–91.

167 John Bishop to Increase Mather, April 11 1682, BPL MS Am 1502 vol. 4, no. 39.

168 Mather, *An Essay for the Recording of Illustrious Providences*, 323.

169 John Josselyn, *Chronological Observations of America, from the Year of the World to the Year of Christ, 1673* (London: Printed for Giles Widdowes, 1674), 58–59.

devoted a whole chapter of the *Essay* to demons and demonic possession — he was nonetheless only prepared to accept their role in natural and preternatural occurrences with sufficient proof.<sup>170</sup>

As Mather's *Essay* indicated, even researchers concerned to connect storms and other destructive phenomena with divine providence and diabolical agency had begun to display the awareness of a need for standards of proof. A similar trend can be observed in English judgement collections from the 1660s. Not even this traditionally heterogeneous genre, notorious for its uncritical deployment of dubious tales ("fained miracles" and "fabulous stories" in Burton's words) could remain immune from the increasing concern with factual accuracy. Just as in other genres, the assessment of truthfulness in judgement collections depended on legal concepts and metaphors.<sup>171</sup> However, whereas Poole's design relied on methods of certification to uncover the truth that ultimately derived from canon law, the judgement collections of the second half of the seventeenth century adopted a more aggressive mode of claiming truthfulness that bore a resemblance to the adversarial processes of the common law. In this sense, claims about natural phenomena were partisan arguments supported by proofs rather than neutral inquiries into facts, but they nevertheless acquired increasingly complex approaches to dealing with the evidentiary burden.

After the Restoration of the monarchy in England in 1660, non-conformist writers used accounts of prodigies and judgements to suggest God's displeasure with Charles II's government and its ecclesiastical reforms, and to strike back at officials and ordinary people who criticised or abused the godly.<sup>172</sup> Judgement compilations from this period reflected an increasing preoccupation with strange natural events. This shift in emphasis conveyed the simultaneous impression that the

---

170 Josselyn had tried to court the attention of the Royal Society by dedicating to the President and Fellows his *Two Voyages to New-England* (1674), but due to his uncritical reporting of wonders the Society refrained from endorsing his work. John Josselyn, *John Josselyn, Colonial Traveler: A Critical Edition of Two Voyages to New-England*, ed. Paul J. Lindholdt (Hanover: University Press of New England, 1988), xvi–xvii.

171 Shapiro, *Probability and Certainty in Seventeenth-Century England*, chap. 5.

172 For this context see Friedman, *The Battle of the Frogs and Fairford's Flies*; Burns, *An Age of Wonders*.



Restoration was unnatural, and that nature itself had become disturbed. Initially authors gave little thought to arranging these reports in a way that would reflect their special character, instead cramming this material into compilations beside the more traditional fare of the sudden deaths and afflictions of guilty individuals. Henry Jessey's *The Lords loud call to England* (1660) included accounts of storms and an earthquake within an extremely miscellaneous collection of reporting, which covered such memorable prodigies as the mysterious appearance of armies of toads and flies at Fairford, as well as individual judgements on the enemies of the godly, and relations of the persecution of godly ministers and families by royalist bands. Jessey made little attempt to order the collection according to any epistemic or ontological scheme. Considering events in France, he set reports of an earthquake at Bordeaux and Toulouse in June 1660 alongside a forest fire near Fontainebleau caused by lightning ("fire from heaven"), and rains of giant hailstones, blood, frogs and "strange vermine, that eat up the Corne".<sup>173</sup> At the end of the book, descriptions of a hail storm in southern England immediately followed an account of the simultaneous death of a large number of dogs that occurred on the day of the proclamation of the king.<sup>174</sup> Nevertheless, Jessey took providential compendia in a new direction by demonstrating how the compilation of reports of natural observations could augment and add weight to spiritual and political agendas. Subsequent works deepened that association by placing storms and other disastrous phenomena at the core of the text. This turn enabled writers to show in gruesome detail what Burton had earlier warned: that the toleration of flagrant sinners would produce large-scale disasters that affected everybody.

---

173 Henry Jessey, *The Lords Loud Call to England: Being a True Relation of Some Late, Various, and Wonderful Judgments, or Handy-Works of God, by Earthquake, Lightning, Whirlwind, Great Multitudes of Toads and Fflies; and Also the Striking of Divers Persons with Sudden Death, in Several Places...* (London: printed for L Chapman, in Popes-head Alley, and for Fr Smith at the Elephant and Castle near Temple-Bar, 1660), 6.

174 Jessey, 44, 42–43.

The most controversial, influential and innovative of the judgement collections during the Restoration was the three-part *Mirabilis Annus* (1661-62). Charles II's government did its best to seize copies of the publications but despite great efforts was never able to identify its authors.<sup>175</sup> Like other incendiary tracts, they were the work of a circle known as the "Confederacy press": an alliance of dissenting ministers like Jessey with London printers and stationers who held radical religious and political sympathies, such as Livewell Chapman, who had printed Jessey's collection.<sup>176</sup> This underground confederacy for a time successfully evaded the censors in producing anti-royalist propaganda, despite "the watchful eye that is continually upon the Press".<sup>177</sup> In contrast to Jessey's mélange of tales, the *Mirabilis Annus* compilations divided their stories into four sections: the first three categories consisted of prodigies seen in the heavens, on the earth and in the waters, and the fourth set out the typical judgements on sinners and the terrible fates suffered by the persecutors of the godly. Distinguishing individual judgements from marvellous occurrences in nature, and subdividing the latter into categories, constituted a rudimentary attempt to subject the unwieldy mass of prodigies into vaguely ontological classes. Though simple, the arrangement by elements thus indicated the same trend towards systematic classification that existed in natural philosophy. John Worthington wrote to Hartlib about *Mirabilis Annus*, "which I suppose you have seen or heard of", implying that it would be useful for him as a source of "prodigies and strange occurrences".<sup>178</sup> The conviction underlying the focus of the work on strange natural phenomena was that a close examination of the alterations of the physical environment would reveal divine messages, "the whole

---

175 Thomas, *Religion and the Decline of Magic*, 1971, 111–12.

176 Burns, *An Age of Wonders*, 22–23.

177 Anon, *Mirabilis Annus Secundus, or, The Second Year of Prodiges Being a True and Impartial Collection of Many Strange Signes and Apparitions, Which Have This Last Year Been Seen in the Heavens, and in the Earth, and in the Waters...* (n.p.: n.p., 1662), 54.

178 John Worthington to Samuel Hartlib, 26 October 1661, John Worthington, *The Diary and Correspondence of Dr. John Worthington ... from the Baker Mss. in the British Museum and the Cambridge University Library and Other Sources*, ed. James Crossley and Richard Copley Christie (Manchester (UK): Printed for the Chetham Society, 1855), vol. 2, part 1, p. 63.

World being nothing else but Gods Book in Folio, and every Creature and Providence as a several page, in which we may plainly read his eternal Power and God-head”.<sup>179</sup> These “signs and Prodigies” amounted to God’s “hand-writing upon the wall”, portending both great political changes and “sad calamities”.<sup>180</sup> Storms and earthquakes formed an important part of the section dealing with “Prodigies happening on the Earth”. These included a minor earthquake in Leicestershire in January 1660 (which the authors nevertheless described as “very great”), storms in Hereford, Bucks and Bedford (May), Dover (August), Leicestershire (September), Yorkshire (November and December), Cheshire and Guernesy (November) and Oxford (December).<sup>181</sup> There was also an account of heavy rains and floods, so that in London “most of the streets were like Rivers” and “[t]he oldest man living can hardly remember the like”.<sup>182</sup> The tract presented these occurrences simultaneously as divine messages about the new regime, as present calamities causing major losses and as “forewarning signes” of disasters to come.<sup>183</sup>

Like Mather, the *Mirabilis Annus* authors attempted to establish the veracity of their accounts by insisting on the faithful transmission of the original reports and the personal credibility of their relators. They associated most of their accounts either with trustworthy individuals “of known Integrity” — “credible persons eye-witnesses”, “very many discreet & sober persons”, “an honest discreet person” — or the general agreement of a community, suggesting that “the Truth of these things is notoriously known to the Generalities of the Inhabitants” of a vicinity.<sup>184</sup> In the preface to the first installment, they proclaimed that “we have not *feigned* any one of the particulars here

---

179 Anon., *Eniautos Terastios, Mirabilis Annus, or The Year of Prodigies and Wonders: Being a Faithful and Impartial Collection of Several Signs That Have Been Seen in the Heavens, in the Earth, and in the Waters...* (n.p.: n.p., 1661), A2v.

180 Anon., *Eniautos Terastios*, A2r.

181 Anon., *Eniautos Terastios*, 14, 32–36, 39–41, 44–45, 48–49.

182 Anon., *Eniautos Terastios*, 52–53.

183 Anon., *Eniautos Terastios*, 48.

184 Anon., *Eniautos Terastios*, 20, 35, 40–41, 42–43.

inserted, nor so much as a *Circumstance* relating to any of them, but have *faithfully* and *impartially* published them as they were communicated to use from *credible persons*".<sup>185</sup> They also claimed to have subjected these stories to a process of vetting, in which they were "scanned and weighed to the uttermost", even "casting away many things which we could not but judge *probable*, because not satisfied in the *certainty* of them".<sup>186</sup> Of course, the end product could hardly have been described as a sober and balanced reporting of facts, even by contemporary standards, but whether the authors genuinely engaged in any kind of critical assessment of their dubious source material is not the key point. What is significant is that they deemed it either necessary or useful to claim evidentiary standards in reporting extraordinary phenomena. An adversarial employment of proofs gave their readers not just a collection of wild tales but a cohesive case for God's disapproval of the regime.

One of the techniques the authors of the first installment pioneered to establish both the truth and the meaningfulness of strange occurrences in nature was the use of historical analogies (with accompanying citations) drawn from sources such as the chronicles of John Stow (1580) and Richard Baker (1643). The accounts of the tempests of 1660 were juxtaposed with a list of past storms that had acted as the harbingers of great changes, including a hailstorm in 1496 followed by a great plague in London, the storm of 1628 that preceded the assassination of the Duke of Buckingham and the strong winds that presaged the Civil Wars.<sup>187</sup> A list of parallels similarly accompanied the account of the earthquake in Leicestershire and explained its significance. An earthquake in 105 CE had followed the persecution of the Christians under the Roman Emperor Trajan, while the tremors in England in 1580 preceded papal military aid to the rebels in Ireland.<sup>188</sup>

---

185 Original emphasis. Anon., *Eniautos Terastios*, A2v.

186 Original emphasis. Anon., *Eniautos Terastios*, A2v.

187 Anon., *Eniautos Terastios*, 40, 48.

188 Anon., *Mirabilis Annus Secundus, or, The Second Year of Prodigies*, 49.

The second installment of the *Mirabilis Annus* in 1662 retained the same basic framework but dropped the lists of historical parallels, which had received criticism for encouraging sedition.<sup>189</sup> By leaving out the parallels, they were able to claim that they supplied “only a *plain* and *naked* account”, of facts, related in a “faithful and impartial” manner.<sup>190</sup> Responding to criticism that many of the incidents in the first volume lacked credibility, the authors of the second installment trialled a new approach in the collection of information about elemental events: the assembly and synthesis of many testimonies instead of a single report.<sup>191</sup> This is noticeable in their discussion of a great storm of 18 February 1662, in which they drew together accounts from many different parts of England. The compilation of testimonies revealed general patterns, including a geographical zone of impact (northern England and Scotland had only experienced higher than usual winds), which the authors suggested contained a providential meaning to be revealed by God in due course.<sup>192</sup> From this assemblage they attempted to derive patterns of testimony, which they grouped by types of impact: fatalities, wind damage to buildings, barns and trees, “wonderful” effects and “signal and eminent Preservations”.<sup>193</sup>

The fact that the authors drew a distinction between most of the storm’s effects and special prodigies or deliverances indicates the development of a more nuanced view of elemental destruction. Although all natural disruptions were the work of the Lord, their effects could be ranged along a spectrum, from least to most extraordinary. Even the wind damage took place on several moral levels: the authors apparently considered the death of “an honest Yeoman” swept from his ladder to occupy a different plane of significance from the destruction of the property of

---

189 Anon, *Mirabilis Annus Secundus*, A4r-v.

190 Anon, *Mirabilis Annus Secundus*, A4v.

191 Anon, *Mirabilis Annus Secundus*, A3v–4r.

192 Anon, *Mirabilis Annus Secundus*, 61.

193 Anon, *Mirabilis Annus Secundus*, 54–61.

conformist ministers or of barns, which they interpreted as a sign of God's decision to take away the fruits of the earth from England and its erring regime.<sup>194</sup> The third volume further refined this practice of storm investigation, in the description of a heavy hailstorm with thunder and lightning on 30 July 1662 that affected northwestern England. In this case the compilers had collected over fifteen separate accounts, which they ordered geographically rather than by classes of effects.<sup>195</sup> The purpose of this altered arrangement seems to have been to enhance the impression of credibility. By suggesting that "Persons of unquestionable Reputation" in many locales had confirmed the circumstances of the event, in many cases with written testimonies "from the most authentick hands", the authors of the volume conveyed the impression of a widespread public acceptance of their claims.<sup>196</sup> The direct quotation of an excerpt of a letter penned "by a Person of credit and quality" in Ormeschurch (near Liverpool) suggested that textual evidence existed somewhere, which served as concrete proof that the occurrence was not pure invention.<sup>197</sup> In addition, the text reveals a significant change in emphasis, from the simple discovery of prodigious occurrences towards the amassing of detailed observations. The various accounts vied in their attempts to render the extraordinary size of the hail stones: some guessed at a measurement (between five and eight inches) and a weight (a quarter of a pound) while others actually measured them, or compared their size to other objects: the stones were as big as musket balls, walnuts, goose eggs or even "an ordinary Child".<sup>198</sup> One witness at Eardly in Staffordshire both measured them and offered several size

---

194 Anon., *Mirabilis Annus Secundus*, 55, 57.

195 Anon., *Mirabilis Annus Secundus, or, The Second Part of the Second Years Prodigies: Being a True Additional Collection of Many Strange Signs and Apparitions Which Have This Last Year Been Seen in the Heavens, and in the Earth, and in the Waters...* (n.p.: n.p., 1662), 16–20.

196 Anon., *Mirabilis Annus Secundus, or, The Second Part of the Second Years Prodigies*, 16.

197 Anon., *Mirabilis Annus Secundus, or, The Second Part of the Second Years Prodigies*, 18. For the importance of the mere existence of written material in establishing the truth of strange events in seventeenth-century England, see Dolan, *True Relations*.

198 Anon., *Mirabilis Annus Secundus, or, The Second Part of the Second Years Prodigies*, 17–19.

analogies: hens' eggs, ducks' eggs, tennis balls; while an acquaintance set them beside his pocket watch and found them to be similar in size.<sup>199</sup>

While the evidentiary experiments of the *Mirabilis Annus* constituted attempts to augment the reliability (or rather, the appearance of reliability) of qualitative testimonies, researchers in other areas were exploring ways to enhance the credibility of statements about hazardous phenomena through the use of quantitative data. This aspect of investigation into disaster can be considered part of a broader programme of the mathematicisation of natural philosophy that some savants (most famously Isaac Newton) attempted to advance over the course of the seventeenth century.<sup>200</sup> The 1660s marked a major milestone in the quantitative analysis of epidemic diseases, with the appearance in print of the prominent merchant John Graunt's *Natural and political observations... upon the bills of mortality* for London (1662, with four subsequent editions in 1662, 1665 and 1679).<sup>201</sup> These bills, which originated in 1592 and were kept regularly from 1603, amounted to weekly computations of the number of burials in the capital. They were undertaken by the parish and city clerks on the basis of reports furnished by women known as "searchers" in coordination with the sextons responsible for presiding over burials, and they appeared in the form of short printed booklets supplied to paying subscribers.<sup>202</sup> Over the 1620s and '30s additional figures were added to

---

199 Anon., *Mirabilis Annus Secundus, or, The Second Part of the Second Years Prodigies*, 17–18.

200 Peter Dear, *Discipline & Experience: The Mathematical Way in the Scientific Revolution*, Science and Its Conceptual Foundations (Chicago: University of Chicago Press, 1995); Steven Shapin, *The Scientific Revolution* (Chicago, IL: University of Chicago Press, 1996), 56–64; Peter Dear, *Revolutionizing the Sciences: European Knowledge and Its Ambitions, 1500-1700* (Princeton, NJ: Princeton University Press, 2001), chap. 4.

201 Bibliographical data on the various editions is in Geoffrey Keynes, *A Bibliography of Sir William Petty, F.R.S. and of Observations on the Bills of Mortality by John Graunt, F.R.S.* (Oxford: Clarendon Press, 1971), 79–82. The first edition is reproduced in John Graunt, *Natural and Political Observations Made upon the Bills of Mortality*, ed. Walter F. Willcox (Baltimore: The Johns Hopkins press, 1939). A long-running debate has considered at length whether Graunt or William Petty was the real author of the *Observations*. The current scholarly consensus is that Graunt was indeed the author but Petty probably made significant contributions. See, for instance, William Lynch, *Solomon's Child: Method in the Early Royal Society of London*, (Stanford, CA: Stanford University Press, 2001), 198–99; Ted McCormick, *William Petty and the Ambitions of Political Arithmetic* (Oxford: University Press, 2009), 131–32.

202 Graunt, *Natural and Political Observations Made upon the Bills of Mortality*, 19–26.

the bills, so that readers could identify the number of deaths for each parish, as well as peruse a breakdown of the cause of death as determined by the searchers, sometimes in consultation with a physician.<sup>203</sup> Graunt claimed that most Londoners used the bills as a guide to determine whether a plague was worsening — which helped wealthy people determine whether to flee the city and tradesmen to predict how much business they were likely to obtain — or else looked for bizarre causes of death as fodder for casual conversation.<sup>204</sup> By contrast, Graunt treated the bills as data upon which to found observations about public health, demography and commerce, which could be useful for governmental decision-making.<sup>205</sup> In the second of two dedications, to Sir Robert Moray, privy councillor and president of the Royal Society, he claimed a connection of this exercise to natural history.<sup>206</sup> Graunt asserted that, like the mechanical pursuits of the Royal Society, his quantitative studies of the population would serve both the public good and the collaborative research enterprise of the “Parliament of *Nature*”.<sup>207</sup>

A comparative analysis of mortality statistics allowed Graunt to reach specific conclusions on the nature of plagues. He identified four great plague periods (1592-3, 1603, 1625 and 1636), using these as his main basis of comparison.<sup>208</sup> In addition to employing what he called “the *Mathematiques* of my Shop-Arithmetique”, Graunt also grounded his analysis on a categorisation of sicknesses.<sup>209</sup> “Acute” or “epidemic” diseases such as plagues, smallpox and measles differed both in nature and cause from “chronical” or endemic ones: the former manifested in temporary outbreaks (clearly

---

203 Graunt, 20–27.

204 Graunt, 17.

205 This goal is most clearly visible in the first dedication, to Sir John Roberts (or Robartes), Privy Councillor and Lord Privy Seal, and in the conclusion. Graunt, 3–5, 78.

206 Graunt, 6–8.

207 Graunt, 7, 18.

208 Graunt, 45.

209 Graunt, 7.



visible in the mortality statistics) while the latter were more stable in a given locale.<sup>210</sup> He believed that plague and other epidemic diseases spread by corruption of the air, which took “suddain and vehement Impressions”, rather than from the emanations of individual bodies.<sup>211</sup> This guiding assumption allowed Graunt to reason backwards to discover the state of the air in a given geographical zone (or in the case of endemic illnesses, the state of diet).<sup>212</sup>

One of Graunt’s intentions with this work was to support royalist propaganda, by offering a new way of discrediting the claims of the king’s critics. Whereas the authors of the *Mirabilis Annus* had used their assembly of qualitative data to make the claim that the Restoration had ushered in a period of calamities, in which the disruptions of the elements were both more frequent and of greater intensity than in previous eras, Graunt used a mathematical analysis to argue that the return of a Stuart king to the throne in 1660 had actually coincided with a particularly healthy year. He explicitly framed this as a counter-blast to vindicate “both *Monarchie*, and our present *King’s Familie* from what seditious men have surmised against them”.<sup>213</sup> Although he refrained from drawing a direct connection between the Restoration and the country’s health, which might be considered “*Superstitious*”, he nevertheless approached such a conclusion by observing that it was “as if God Almighty had caused the healthfulness and fruitfulness thereof to repair the *Bloodshed*, and *Calamities* suffered in [the king’s] absence”. Here he positioned his use of quantitative data as a means of testing the truthfulness of claims made about epidemic disease on the basis of sparse anecdotal evidence. Graunt’s identification of “plague years” and other “sickly years” debunked the long-standing myth that the accession of a new monarch brought plague – clearing the king of any moral

---

210 Graunt, 30–31.

211 Graunt, 47–48.

212 Graunt, 30.

213 Graunt, 51.

responsibility for epidemics.<sup>214</sup> While acknowledging that the quantitative data he relied upon might itself be erroneous in some cases, he believed that such deficiencies could be accounted for and corrected through statistical methods.<sup>215</sup>

Graunt and Petty have frequently been regarded as founding figures for statistics, demography, social analysis, economics and political economy.<sup>216</sup> However, we know less about how the quantitative study of epidemics they pioneered contributed to the wider discussion of disaster in this period. In fact, after the Royal Society reprinted Graunt's *Observations* under its own imprimatur in 1665, a number of anonymous works appeared that built upon and adapted Graunt's achievement, in some cases with outright plagiarism. In part these additional publications were motivated by the need to bring Graunt's figures and analysis up to date, so as to include the Great Plague of 1665-6.<sup>217</sup> In a short booklet entitled *London's dreadful visitation* (1665), an anonymous author compiled 52 of the weekly bills of mortality for a period of just under twelve months, from December 1664 to 1665.<sup>218</sup> These numbers showed the first phase of the latest epidemic, in which plague deaths rose from 17 on the week of May 23-30, 1665, to a height of 7,165 on 12-19 September, followed by a decline (with temporary fluctuations) as the weather cooled. The book presented the data unfurnished, without the analyses of the *Observations*. However, the printer's short preface indicated that Graunt's political arithmetic could be transformed into a moral calculus. The printer explained that his

---

214 This myth can be discerned for instance in Thomas Dekker, "The Wonderful Year (1603)," in *The Plague in Print: Essential Elizabethan Sources, 1558-1603*, ed. Rebecca Carol Noel Totaro, Medieval and Renaissance Literary Studies (Pittsburgh, PA: Duquesne University Press, 2010).

215 For instance, Graunt, *Natural and Political Observations Made upon the Bills of Mortality*, 48.

216 McCormick, *William Petty and the Ambitions of Political Arithmetic*, 131; Stephan Gregory, "The Tabulation of England: How the Social World Was Brought in Rows and Columns," *Distinktion (Aarhus)* 14, no. 3 (2013): 305-25.

217 The fifth edition of the *Observations* in 1676 finally offered a mortality table showing the plague deaths for 1665 (though not 1666), but the main body of the text was not updated with this data.

218 Anon., *London's Dreadful Visitation, or, A Collection of All the Bills of Mortality for This Present Year: Beginning the 20th of December, 1664, and Ending the 19th of December Following: As Also the General or Whole Years Bill: According to the Report Made to the King's Most Excellent Majesty* (London: Printed and are to be sold by E Cotes, 1665). This work is sometimes erroneously attributed to Graunt, as noted in the *English Short Title Catalogue*, R12998.

objective in publishing the work was not to assist in public policy or natural history but rather to advance the spiritual aim of moral reform. He expressed the hope that the perusal of plague statistics would enable his readers, firstly, to “recall to minde Gods Mercies, and with Awfulness tremble at His Judgments”; secondly to encourage gratitude to God for being spared among the “*many Thousands in or near this City, whom He hath in One year swept away with the Beesome of a Temporal Destruction*”; and finally to spur a general repentance, which was the only way to regain God’s favour for London and the only sure mechanism to avoid destruction in future plagues.<sup>219</sup> The work thus re-packaged and re-purposed the quantitative project as an accessory to the public spiritual mission of plague sermons and tracts.

If the quantitative study of mortalities in a single year could reveal the contours of an epidemic over time and space, an understanding of their severity and frequency required historical comparison. In a volume entitled *Reflections on the Weeekly [sic] Bills of Mortality* (1665), an anonymous author both plagiarised Graunt’s *Observations* and made an attempt to provide a wider historical frame in which to assess English epidemics.<sup>220</sup> Where *London’s dreadful visitation* provided weekly bills of mortality for a single year, the *Reflections* presented synthesised yearly statistics for the four periods that Graunt had previously identified as the major “plague-years”.<sup>221</sup> These tables allowed for a comparison of the course of each epidemic over time. For instance, one chart juxtaposed on a single page the monthly and weekly figures of plague deaths from the four plague years and the current year (1665).<sup>222</sup> A reader glancing at these numbers at the time of printing would have

---

219 Anon., A2r-v.

220 Anon., *Reflections on the Weeekly [Sic] Bills of Mortality for the Cities of London and Westminster, and the Places Adjacent: But More Especially, so Far as They Relate to the Plague and Other Mortal Diseases That We English-Men Are Most Subject unto : With an Exact Account of the Greatest Plagues That Have Happened since the Creation ..* (London: Printed for Samuel Speed, 1665). On the

221 Anon., 1–23.

222 Anon., 32.

immediately understood that the outlook for the ongoing epidemic in London was not good.<sup>223</sup> Indeed, what the author left unsaid was that a statistical plotting of several epidemics and their comparison might allow for future projections, thus giving mathematics a limited predictive capacity outside of the calculations of astrologers. The author had followed Graunt's example in seizing upon the potential of statistics both to transcend some of the credibility issues of qualitative testimony and to ground observations that could not otherwise be made. Paradoxically, however, the dubious accuracy of some of the data in the *Reflections* also demonstrated that numbers could convey a false impression of trustworthiness. In 1665 John Bell, the clerk in charge of the register at the Company of Parish Clerks (the body that assembled the weekly bills of mortality), published an authoritative set of bills in order to counteract "the many and gross mistakes which have been imposed upon the World by divers *Ignorant Scriblers [sic]* about the *weekly Accompts of former Visitations*" of plague.<sup>224</sup> He singled out for particular opprobrium the *Reflections*, for its exaggerated count of plague deaths. The fact that the *Reflections* "bears the face of a *Sober Discourse*" highlighted the most troubling feature of quantitative disaster investigation: readers without access to the raw data or the tools to analyse it were likely to accept statistics at face value, so that the employment of numerical material allowed authors to present false claims under the mantle of mathematical objectivity.<sup>225</sup>

Beyond the more specific case of recent English epidemics, the *Reflections* also furnished comparative data for plagues that were more remote in time, in a short essay with the ambitious title

---

223 The mortality figures offered by the *Reflections* for 1665 ran to the last week of June, by which point plague deaths were already ten times that of late May. Looking at the other columns on the page devoted to previous outbreaks, a reader could easily ascertain that June marked an early stage in an epidemic, and that the number of deaths could be expected to snowball in the late summer and autumn.

224 John Bell, *London's Remembrancer, or, A True Account of Every Particular Weeks Christnings and Mortality in All the Years of Pestilence within the Cognizance of the Bills of Mortality, Being XVIII Years* (London: Printed and are to be sold by E Cotes...Printer to the Company of Parish Clerks, 1665), A2v.

225 Bell, A2v.

"An Exact Account of the greatest Plagues that have happened since the world began".<sup>226</sup> When set beside the careful mathematical work in the rest of the volume (especially the part lifted directly from Graunt), the "Exact Account" presents a strange contrast. Here the author offered an inconsistent and chronologically jumbled list of events from 171 to 1624 CE, with an enormous gap between 254 and 1348. The descriptions of individual plagues are vivid (if somewhat clichéd). For instance, of an epidemic in England in the eighth year of Henry IV's reign, the writer noted "the air was so corrupted, that birds fell down dead, beasts ran mad, the waters stank, and the living were not able to bury the dead".<sup>227</sup> The essay began abruptly with a long discussion of the Black Death, which included a stern moral lecture on, amongst other things, the abandonment of the sick and medical profiteering — topics of continuing relevance in the context of the plague of 1665. The author echoed the fears of many preachers that the moral reformation that epidemics and other disasters stimulated in an affected population was only fleeting in nature: in the case of the Black Death, he claimed that the rapid slide back into sin led God to punish Christians with famine and war.<sup>228</sup> This served as an implicit moral lesson for what could happen if Londoners in 1665 likewise reneged on their spiritual commitments. The essay also deepened Graunt's explanation of epidemic sickness as the product of infected air.<sup>229</sup> This is visible in one of two extraordinary explanations that the author offered for the natural origin of the Black Death. This account suggested that a great fire descended from the sky or emanated from the earth, and while moving westward burned whole countries and released noxious smoke into the air. However, the explanation the author considered as better supported by the historical testimony instead reflected the persistent appeal of prodigious

---

226 Anon., *Reflections on the Weekly Bills of Mortality*, 23–31.

227 Anon., *Reflections*, 30–31.

228 Anon., *Reflections*, 27–28.

229 He discusses the relationship of corrupted air, plague and changes in the physical environment of London at 43–44.

motifs: he described a three-day-long rain of blood and snakes in the city of “Lameen” (possibly Medina), which poisoned the whole region and damaged the tomb of Mohammed.<sup>230</sup>

The careful scrutiny Graunt applied to statistics is not visible in the “Exact Account”: although the author offered suspiciously detailed mortality numbers for some past epidemics — as with the 14,664 Venetians he claimed to have died in the plague of 1570 — he did not mention the sources of his information.<sup>231</sup> Elsewhere, he accepted the dubious testimony of unnamed “authentick Writers”, as when he observed that in the plague of 254 CE, “there perished more people for sin, then [sic] did in the great Deluge: and probably enough, because of the great increase, beyond that in the days of Noah”.<sup>232</sup> On the other hand, the very title of the “Exact Account” suggested an ambition to meet rigorous standards of proof. The essay should be seen as an attempt to merge a new-found interest in quantitative data with a commitment to the conventional theological view of disasters as “Visitations of Almighty God”, through the employment of the existing technique of compiling a historical archive.<sup>233</sup> Consequently its collection of epidemics constituted an intermediary form of disaster investigation: a reconciliation of statistical reporting and analysis (which promised a credibility transcending words alone) with pre-existing interpretive traditions based on description, exegesis and providential reasoning. In drawing Graunt’s calculations into a providential scheme, the author reflected a broader practice. Even Bell, who blasted the inaccuracies of the *Reflections*, similarly sought to emphasise the point that plagues had “supernatural

---

230 Anon., *Reflections*, 27. Earlier (p. 24) he had suggested instead that the plague originated in “Cataya” in upper India. Rains of venomous animals formed a motif in several medieval explanations of the plague. The account in the *Reflections* shows marked similarities to that offered in a letter by Louis Heyligen [Sanctus] of Beeringen, incorporated in the anonymous Flemish *Breve Chronicon Clerici Anonymi*. This letter reported prodigious rains in eastern India over three days. The first day witnessed a rain of frogs, snakes, lizards, scorpions and other poisonous creatures; on the second day a torrent of great hailstones occurred; on the third day fire poured down from the heavens and burned all the cities of the region. For this account, see the reproduction in, Rosemary Horrox, ed., *The Black Death* (Manchester; New York: Manchester University Press, 1994). 41–42.

231 Anon., *Reflections*, 29.

232 Anon., *Reflections*, 28–29.

233 Anon., *Reflections*, 24.

causes” as well as natural ones.<sup>234</sup> Bell approvingly quoted Bishop Andrews’ sermon attributing the plague of 1665 to a divine punishment on England for the rebellion against and execution of Charles I.<sup>235</sup> While he allowed a place for medical expertise (both Galenic and chemical), he pointed out that “the first and great Antidote and Preservative against the Plague, is hearty Repentance and fervent Prayer”.<sup>236</sup>

While other writers drew on Graunt’s data and statistical methods to create their own plague archives according to a providential framework, Graunt’s collaborator William Petty continued to expand the body of statistically-based observations in the 1670s and ‘80s. Petty was a founding fellow of the Royal Society who had acquired vast estates in Ireland while conducting surveys in aid of Oliver Cromwell’s land confiscation programme.<sup>237</sup> It was Petty who most likely contributed the additional material in the fifth edition of the *Observations* (Graunt having died in 1674), which included mortality statistics from Dublin that Petty later expanded in a separate publication.<sup>238</sup> Petty also added an appendix that amounted to an archive of mortality figures (particularly during plagues) from a variety of cities between 1618 and 1657. Alongside the numbers he presented written descriptions: the plague at Naples killed 1,300-1,400 per day, so that “the well were not able to help, or bury the dead”; while in Bergen in 1618 “the whole City was in tears, that the Coffin-makers refused to make Coffins, that parents carried their children, and children their parents to the

---

234 Bell, *London’s Remembrancer*, D3v.

235 Bell, D2v–3r. His view of natural causes (expressed at D3v) encompassed an eclectic mixture of ideas: infection of the air, astral influence, climatic conditions, the disruption of humoural balance in individuals, immoderate diet and the consumption of diseased livestock.

236 Bell, D3v.

237 Adam Fox, “Sir William Petty, Ireland, and the Making of a Political Economist, 1653–87,” *The Economic History Review* 62, no. 2 (2009): 388–404.

238 William Petty, *Observations upon the Dublin-Bills of Mortality, MDCLXXXI, and the State of That City* (London: Printed for Mark Pardoe, 1683). Petty conceived this work as an accompaniment to Graunt’s *Observations*, expressing the wish (on p. 1) that it “may serve as Snuffers to make the same Candle burn clearer”.

grave”.<sup>239</sup> In this way, Petty reconnected Graunt’s cold statistics to written testimonies, whose well-worn tropes and emotive rhetoric contained information that was nevertheless apparently as essential for Petty’s political arithmetic as it was for researchers employing purely qualitative techniques. The combination of these different kinds of data furnished the means for additional observations: plagues in “Southern Countries” are more severe but begin and end more suddenly; plagues also diminish faster than they increase.<sup>240</sup>

In the 1680s, Petty’s personal papers reveal an increasing drive to make quantitative studies of plagues useful to the public through the application of “political arithmetic” to governance.<sup>241</sup> After the accession of Petty’s former patron the Duke of York as James II in 1685, Petty moved permanently to London in the hope of achieving both preferment to positions of authority and an influence over policy-making.<sup>242</sup> In the event he received neither, dying in December 1687, but in these final years he revived his interest in the application of mathematical methods to disaster prevention and amelioration. This is clearly visible in an unpublished manuscript dated 7 October 1687 and entitled “Of Lessening the Plagues of London”, where he set out a list of policy proposals that he thought would halve the number of deaths in the next outbreak.<sup>243</sup> By this stage Petty confidently identified the periodicity of “pestilentiall years” as one in twenty, with an average

---

239 John Graunt, *Natural and Political Observations Mentioned in a Following Index, and Made upon the Bills of Mortality*, The fifth edition much enlarged (London: Printed by John Martyn, 1676), 110.

240 Graunt, 110–11.

241 On Petty’s political arithmetic generally, see Lynch, *Solomon’s Child*, 198–99. For its evolution, especially over the 1670s, see McCormick, *William Petty and the Ambitions of Political Arithmetic*, 162–63, chap. 5. Graunt had also entertained hopes that his *Observations* would be useful for governmental decision-making, but Petty greatly accentuated this aspect in his own work.

242 Toby Barnard, “William Petty”, *The Oxford Dictionary of National Biography*; McCormick, *William Petty and the Ambitions of Political Arithmetic*, 276, 283–84.

243 “Of Lessening the Plagues of London. 7 Octob 1687”, BL Add MS 72867, ff. 19r-21r. This manuscript is bound next to one entitled “Of the Plague” (ff. 17r-18v), which contains another set of proposals, some of which seem to be earlier versions of those in “Of Lessening the Plagues”.



mortality of one sixth of the population.<sup>244</sup> The earlier work on mortality bills had already revealed that outbreaks followed a seasonal pattern; Petty now felt secure in asserting that the number of infections in such outbreaks increased for three months and then declined from a peak for a further three months, as colder weather set in.<sup>245</sup> He predicted that the next epidemic would kill 120,000 Londoners; audaciously assigning a monetary value of £70 to each person, he computed the total economic loss for the country at £8,400,000. With this figure in mind, he coolly calculated that a budget of £50,000 would be needed to fund a successful public health intervention.<sup>246</sup> Petty considered the available remedies: dismissing medicines, the killing of dogs and the lighting of fires in streets as being of dubious utility against the pestilence, he identified the isolation of the infected as the only clearly effective strategy, in the customary form of the shutting up of houses suspected of harbouring infected tenants and the creation of pesthouses outside the city.<sup>247</sup> His own proposal amounted to the creation of pesthouses on a large scale, through a massive scheme of forced relocations. This programme would involve the mandatory evacuation of infected urban households to dispersed dwellings in the nearby countryside, whose inhabitants would be compelled to leave for places further abroad at a week's notice. The plague budget (to be levied from the evacuees themselves) would cover the cost of supplying wagons, medicines and "Bookes of devotion" for every household, and renting the country houses for four months. This would give London a lower

---

244 BL Add MS 72867, f. 19r. Among the unpublished manuscripts in the Petty Papers is one entitled "A Parley between L&P about the Plague". This document seems to indicate that Petty made a bet with his interlocutor (probably the physician Richard Lower) on the accuracy of the 1/6 mortality estimate, to the effect that Petty would pay him £5 for every death beyond 1/6 of the population, while "L" would pay Petty £6 for every death below that figure. See William Petty, *The Petty Papers; Some Unpublished Writings of Sir William Petty*, ed. Henry William Edmund Petty-Fitz Maurice Lansdowne (London; Boston and New York: Constable & Co; Houghton Mifflin Co, 1927), vol. 1, p. 26.

245 BL Add MS 72867, f. 19v.

246 BL Add MS 72867, f. 19v.

247 BL Add MS 72867, f. 19r. Here he contradicted Graunt, who had earlier argued that policies of "seclusions" were expensive and ineffective, in part because he believed that the plague spread through a general contamination of the air rather than transmission via infected individuals. Graunt, *Natural and Political Observations Made upon the Bills of Mortality*, 4.

population density over the crucial first phase of the epidemic.<sup>248</sup> Petty claimed that the end result of these measures would be to halve the number of plague cases in the city, thereby averting a large (and calculable) economic loss.<sup>249</sup>

Petty's unpublished writing on London's fires in the same period exhibited a similar eagerness to provide policy solutions to avert disaster that were to be based on systematic calculations of the built environment. These plans fitted into the context of an emergent fire insurance industry (which included London's first Fire Office, established in 1681), since insurers constructed their profit model on probabilistic computations of fire risk.<sup>250</sup> In a sketch labelled "Of building a Towne" and endorsed "Building of howses [sic] against fire. 1686", Petty proposed a radical change to the urban landscape that had been devastated by the Great Fire two decades earlier.<sup>251</sup> In this vision, buildings should be arranged in squares, with gaps between each structure. In the centre of the square a water tower would be built, "from the Top whereof water may be Shot" to extinguish flames in any of the surrounding houses. There was a certain irony in Petty's design for ready water access during fires, since his erstwhile collaborator Graunt had been falsely accused of abetting a Catholic conspiracy to bring about the Great Fire of 1666, by stopping up the water pipes at Islington and carrying away the keys to the turncocks on the night before the conflagration.<sup>252</sup> Petty's development of fire

---

248 BL Add MS 72867, ff. 19v-20r.

249 BL Add MS 72867, f. 19r.

250 Cornel Zwierlein, *Prometheus Tamed: Fire, Security, and Modernities, 1400 to 1900* (Leiden; Boston: Brill, 2021), chap. 4.

251 "Of building a Towne", BL MS 72897, f. 110r. He expressed more detailed thoughts on the rebuilding of London in a manuscript entitled "A Computation of the Late Losse per the fire", endorsed at the end as "Heads about the Rebuilding of London", BL Add MS 72867, H. 55, ff. 1r-4v. The Marquis of Lansdowne considered that Petty may have written the second of these manuscripts prior to 1672, when rebuilding work on his own London houses (destroyed in the Great Fire) began. See Petty, *The Petty Papers; Some Unpublished Writings of Sir William Petty*, vol. 1, 25.

252 Gilbert Burnet, *Burnet's History of My Own Time*, ed. Osmund Airy (Oxford: Clarendon press, 1897), vol. 1, 324. Graunt was a member of the New River Company at the time and thus would have had access to the pipes. Burnet's account was published in 1723 but probably written before 1705: William Petty, *The Economic Writings of Sir William Petty: Together with the Observations upon the Bills of Mortality, More Probably by Captain John Graunt*, ed. Charles Henry Hull (New York: AM Kelley, 1963), vol. 1, p. xli. According to Burnet, the accusation against Graunt originated in the immediate

prevention strategies, which drew upon his experience in surveying, shows the distance he had travelled from the statistical observations he and Graunt had made in the 1660s. In the early years of the Restoration and the context of the partisan reporting of prodigies, quantitative techniques promised to provide firm ground on which to counter anti-monarchical claims and identify the true effects of plagues. By the late 1680s, however, the contest over prodigies had given way to a focus on improving disaster mitigation and prevention measures, even as the triumph of systematic collecting had complicated — without diminishing — providential interpretations of catastrophe.

While the statistical inquiries of the 1660s-80s added another set of techniques to the repertoire of disaster researchers, medical writers around the same time contributed more sophisticated approaches to the classification of disease. Although the objective of identifying particular ailments and remedies had deep roots stretching back to classical Hellenistic medicine, in practice sixteenth and early seventeenth-century physicians could not draw upon a shared taxonomy of individual diseases. Instead, epidemiological nomenclature consisted of a bricolage of terms derived from both classical medical literature and modern vernaculars, whose precise employment diverged between practitioners. Moreover, terms such as “plague”/*peste* were often used interchangeably for illnesses with a very diverse range of symptoms and public health impacts.<sup>253</sup> That terminological flexibility resulted in part from the focus of the humoral model of health on the internal causes of sickness as a state of disequilibrium rather than on the external agents of infection. However, it also reflected the eclectic *mélange* that characterised disaster nomenclature more generally before the mid-seventeenth century. The development of a much more subtle nosology, drawn more from clinical

---

aftermath of the fire; he derived his information from Bishop William Lloyd and the Countess of Clarendon. Graunt denied the charges against him; in fact, the fire destroyed his house and may have exacerbated the financial difficulties that led to his bankruptcy. See C.G. Lewin, “John Graunt”, *The Oxford Dictionary of National Biography*. However, Graunt’s recent conversion to Catholicism must have made him an easy target in the context of the proliferation of anti-papist sentiment and suspicion after the fire.

<sup>253</sup> Slack, *The Impact of Plague in Tudor and Stuart England*, 25.

observation than from anatomical theory, gradually transformed the outlook of medical practitioners and theorists towards disease from the 1660s and '70s, even if the therapies that physicians offered remained on balance more harmful than helpful to their patients.

This trend towards the drawing of increasingly fine epidemiological distinctions intersected with two key movements in seventeenth-century medicine: Helmontian iatrochemistry (chemical medicine), with its emphasis on specific treatments for individual ailments, and neo-Hippocratic environmental medicine, which looked for the external causes of disease, especially in aerial miasmas. Both movements intersected in the work of the English physician Thomas Sydenham, whose *Observationes medicae* (1676) attempted to identify patterns within and between diseases, which would form the basis for a new nosology. Sydenham regarded the chief failure of modern medicine to consist in practitioners' frequent misdiagnoses of patient conditions, which was itself the inevitable result of the lack of an adequate classification of ailments. He therefore called for diseases to be "reduced to definite and certain *species*", just as botanists classified types of plants.<sup>254</sup> In his opinion the production of an accurate nosology would depend upon the consistent practice of making detailed observational records of individual disease cases. After such close examinations diseases that to "the careless observer" appeared to be the same could be seen to have "wholly different characters, as little like one another as coin and counters".<sup>255</sup> Given the diversity of epidemic diseases and their bewildering tendency to display changes, he prescribed an approach that relied equally on methodical, diligent scrutiny and on adaptiveness: "I steadily investigate the disease,

---

254 Original emphasis. Thomas Sydenham, "Medical Observations Concerning the History and Cure of Acute Diseases," in *The Works of Thomas Sydenham, M.D.*, ed. William Alexander Greenhill and R. G. Latham, 3rd ed., Publications of the Sydenham Society (London: Printed for the Sydenham Society, 1848), vol. 1, 13.

255 Sydenham, vol. 1, 32.

I comprehend its character, and I proceed straight ahead, and in full confidence, towards its annihilation”.<sup>256</sup>

Furthermore, since Sydenham ascribed epidemic diseases to particles of “morbific matter” produced by atmospheric exhalations, he thought it was possible to categorise the environmental conditions favourable to certain diseases.<sup>257</sup> Tracing patterns in the generation of these exhalations required the simultaneous collection of data on atmospheric conditions and morbidity. Sydenham consequently identified the atmospheric “constitutions” dominant in specific periods (in the *Observationes* he provided studies of five sets of years: 1661-64, 1665-66, 1667-69, 1669-72 and 1673-75) which he thought either gave rise to or exacerbated certain species of diseases.<sup>258</sup> This phasic conception of disease, which greatly extended and sharpened Graunt and Petty’s rough identification of “sickly years”, promised to break down into specific, comprehensible medical categories not only diseases but the time and space in which they arose. One of the practical outcomes of this drive to classify was an emphasis on new treatment regimens and especially therapeutic specifics. These were remedies tailored to attack the morbid matter that Sydenham thought caused the disease, rather than interventions to correct the internal humoral imbalances that were the focus of Galenic medicine. Sydenham accordingly became both an opponent of bloodletting and an early advocate of cinchona bark for the treatment of fevers.<sup>259</sup>

Although Sydenham never received great esteem in the medical profession during his lifetime, the posthumous cultivation of his reputation by a small circle of supporters — and especially John Locke’s championing of his climatic approach — later brought him tremendous international

---

256 Sydenham, vol. 1, 33.

257 See for instance, Sydenham, vol. 1, 29.

258 Sydenham, vol. 1, 29.

259 R. R. Trail, “Sydenham’s Impact on English Medicine,” *Medical History* 9, no. 4 (1965): 359.

influence as the “English Hippocrates”.<sup>260</sup> Nevertheless, unlike many of his admirers in the following century, Sydenham remained humble about the possibility of reducing general climatic patterns of disease to precise laws, because the constitutions he identified were not simply the result of predictable atmospheric processes but rather the outcome of “certain hidden and inexplicable changes within the bowels of the earth”.<sup>261</sup> This left room for a providential role in regulating cycles of disease. An undated essay labelled “Theologia rationalis” sheds light on Sydenham’s view about the divine order visible in the Creation. Here he explained that God did not intervene in the world by suspending the laws of nature, but by means of many small manipulations. Although less visible than natural events, “the footsteps of this moral providence of God” could nonetheless “be often discovered beyond all reason of doubt, in several events, both relating to whole countries, and likewise to particular men”.<sup>262</sup> As an example, he suggested that providence could save a man from drowning in a shipwreck by introducing numerous obstacles to the voyage and even by altering his desire to go to sea.<sup>263</sup> The constitutions that produced epidemics thus reflected a conspiracy of many causes that arose from both consistent natural patterns and subtle divine direction.<sup>264</sup>

Although providential analyses of disasters remained important in the second half of the seventeenth century and beyond, the disaster research conducted in the 1660s-80s developed a range of crucial innovations that underpinned later work. The proliferation of calamities in the middle decades of the century and the expanding reporting on them through various forms of news media provided researchers with unprecedented amounts of information. On the other hand, a counter-

---

260 Peter Anstey, “The Creation of the English Hippocrates,” *Medical History* 55, no. 4 (2011): 457–78.

261 Sydenham, “Medical Observations Concerning the History and Cure of Acute Diseases,” vol. 1, 33.

262 Thomas Sydenham, “Theologia Rationalis,” in *The Works of Thomas Sydenham, M.D.*, ed. William Alexander Greenhill and R. G. Latham, Publications of the Sydenham Society (London: Printed for the Sydenham Society, 1848), vol. 2, 311.

263 Sydenham, vol. 2, 310.

264 Harold J. Cook considers the “Theologia rationalis” an anticipation of natural theology: “Sydenham, Thomas”, *Oxford Dictionary of National Biography*.

current of scepticism about the flow of disaster news demanded new ways to ascertain and demonstrate the reliability of accounts. Researchers developed a range of strategies to deal with this problem that reflected the diversity of interest in extraordinary natural occurrences. The schemes of Poole and Mather attempted to leverage correspondence networks in a collaborative effort to obtain reports. In place of the old information order with its anonymous accounts of strange events, they emphasised the identification of informants and the assessment of their credibility as witnesses. The *Mirabilis Annus* collections further attempted to enhance the believability of qualitative testimonies, firstly by providing historical analogies and later by obtaining many different reports of a single event. Meanwhile, Graunt and Petty demonstrated that accurate claims about plagues required the acquisition and analysis of quantitative evidence. Finally, Sydenham's medical research suggested that the accurate analysis of epidemics required, on the one hand, the division of diseases into a single complete nosology, and on the other, the careful and consistent gathering of atmospheric data. Late seventeenth- and eighteenth-century disaster researchers thus inherited a template for investigation that emphasised standards of proof, collaborative inquiries and the combination of qualitative and quantitative evidence.

### **Chapter 3: Disaster astrology: Scepticism, reform and syncretism**

As scholars between the 1650s and 1680s built a new epistemic order for disaster research they found themselves reacting to a series of international media events that threw into relief the divergence between the new and old styles of disaster knowledge. A sequence of eclipses and comets between 1652 and 1682 generated widespread debate about whether and how disasters could be predicted and what sort of knowledge was capable of understanding them. On one level, astrological interpretations challenged the emerging trends in disaster research, opposing the new emphasis on systematic arrangements and standards of proof with a heterogeneous arrangement of calamities and a free-wheeling employment of archaic rules. Predictions of catastrophe also threatened to disrupt the social order by fomenting panic. By attacking astrologers, other scholars were able to articulate for disaster research a new purpose in dispelling fears through natural inquiries. However, over the course of these debates astrologers also increasingly adopted the new standards and practices of disaster research. The consequences of the debates differed geographically, but the overall trend was to push disaster astrology to become a much more systematic epistemology, with a more collaborative method, a more cautious approach to analysis and a more sophisticated set of ontological categories. Meanwhile, drawing attention to the failings of astrology allowed savants to develop in greater detail a core set of ideas about what a robust and reliable epistemology of disasters might look like.

Despite the clear relationship between premodern astrology and the interpretation of disastrous phenomena, historians of disaster have so far paid the astrological tradition little serious attention. Unlike seismology, volcanology, fire insurance and emergency management, disaster astrology has



not yet found a biographer.<sup>1</sup> This neglect is not a reflection of the historical importance of astral interpretation but rather of the liminal status of modern astrological practice, which is for the most part unconcerned with public events and no longer holds any academic role. In the historiography of astrology in the seventeenth century, on the other hand, studies have largely tried to address the vexed question of astrology's decline among the educated classes. One long-running debate has revolved around whether astrology was killed (by science, by the Church, or by satirists), or whether it died of natural causes — either because it became increasingly out of step with current opinion or because it collapsed as a result of its internal contradictions. It was once a commonplace that the “Scientific Revolution” inevitably led to the death of astrology; partly because historians presumed that because the interconnections of the Neoplatonic universe had been a central component of medieval and Renaissance astrology, astral scholarship could not survive the destruction of the Ptolemaic geocentric cosmos and Isaac Newton's laws of motion. As one historian put it, before the seventeenth century astrology was universally accepted, but after the publication of Newton's *Principia* (1687) “[t]he astrological wings of high-flying science melted; it fell back to earth and became terrestrial”.<sup>2</sup> According to another influential narrative, “the subject was left to die a natural death”, “[t]he clergy and satirists chased it into its grave, but the scientists were unrepresented at the

---

1 Charles Davison, *The Founders of Seismology* (Cambridge, UK: The University Press, 1927); Haraldur Sigurdsson, *Melting the Earth: The History of Ideas on Volcanic Eruptions* (New York: Oxford University Press, 1999); Robin Pearson, *Insuring the Industrial Revolution: Fire Insurance in Great Britain, 1700-1850* (Aldershot, UK; Burlington, VT: Ashgate, 2004); Scott Knowles, *The Disaster Experts: Mastering Risk in Modern America* (Philadelphia: University of Pennsylvania Press, 2011); Deborah R. Coen, *The Earthquake Observers: Disaster Science from Lisbon to Richter* (Chicago; London: The University of Chicago Press, 2013); Conevery Bolton Valenčius, *The Lost History of the New Madrid Earthquakes* (Chicago; London: The University of Chicago Press, 2013); Sean Cocco, *Watching Vesuvius: A History of Science and Culture in Early Modern Italy* (Chicago: The University of Chicago Press, 2013); Cornel Zwierlein, *Promethens Tamed: Fire, Security, and Modernities, 1400 to 1900* (Leiden; Boston: Brill, 2021).

2 Lynn Thorndike, “The True Place of Astrology in the History of Science,” *Isis* 46, no. 3 (1955): 277. It should be noted, however, that Thorndike was also instrumental in promoting the historical study of premodern astrology as a serious topic of research.

funeral”.<sup>3</sup> One of the few long-range histories of astrology agrees that the discipline “was not killed”; “astrology died, like an animal or plant left stranded by evolution”.<sup>4</sup> Major reassessments of Newton, which among other things have demonstrated that he was interested in restoring the “true” theological meaning of comets, have greatly complicated our understanding of astronomy without dethroning the astrological decline thesis.<sup>5</sup> Some scholars have suggested that astrology lost its legitimacy as a result of broader changes in religion or society. In one view, the crises of the seventeenth century forced a hardening of divisions between orthodox theology and radical apocalyptic speculation, which relegated astrology to a heterodox position.<sup>6</sup> A related interpretation stresses the association of astrology with political radicalism and the development of a “fracture” between rationalist astronomy and the occult arts.<sup>7</sup> A more recent move to recast the process of decline as “marginalisation” has directed attention to the changing place of astrology in more specific intellectual and social circles — particularly universities — but has not fundamentally altered the general terms of the debate.<sup>8</sup>

Most of the classic narratives of the demise of astrology focused on England, and while studies of other areas have usefully illustrated different contexts and developments, few attempts have been

---

3 Keith Thomas, *Religion and the Decline of Magic* (London; New York: Penguin, 1991), 418.

4 S. J. Tester, *A History of Western Astrology* (Woodbridge, Suffolk: Boydell Press, 1987), 240.

5 Simon Schaffer, “Newton’s Comets and the Transformation of Astrology,” in *Astrology, Science, and Society: Historical Essays*, ed. Patrick Curry (Woodbridge, UK; Wolfeboro, NH: Boydell Press, 1987), 243.

6 Robin Bruce Barnes, *Prophecy and Gnosis: Apocalypticism in the Wake of the Lutheran Reformation* (Stanford, Calif.: Stanford University Press, 1988), chap. 6; Robin Bruce Barnes, *Astrology and Reformation* (Oxford: Oxford University Press, 2016), chap. 6.

7 Patrick Curry, *Prophecy and Power: Astrology in Early Modern England* (Cambridge, UK: Polity, 1989), ch.s 2-3.

8 See the contributions to *Early Science and Medicine*, Vol. 22, No. 5/6, 2017, and Rienk Vermij and Hiro Hirai, “The Marginalization of Astrology: Introduction,” *Early Science and Medicine* 22, no. 5–6 (2017): 405–9. In some ways the shift in emphasis to marginalisation represents a revival of older themes. See for instance Peter Wright, “A Study in the Legitimation of Knowledge: The ‘success’ of Medicine and the ‘Failure’ of Astrology,” in *On the Margins of Science: The Social Construction of Rejected Knowledge*, ed. Roy Wallis (Keele: University of Keele, 1979), 85–101.

made to integrate these into a new synthesis.<sup>9</sup> Among other things, expanding the geographical focus offers a challenge to the periodisation of decline, since key debates about the legitimacy of astrology in Spain, for instance, ran well into the eighteenth century.<sup>10</sup> A further problem is that historians of astrology have tended to focus on one type of astrological practice — “judicial” astrology — as a metonym for astrology as a whole.<sup>11</sup> Judicial astrology produced precise “judgements” that related to specific individuals, providing guidance or predicting the trajectory of future events. It included the construction of nativities — calculations of the planetary positions at the time of a person’s birth, by which that person’s character and future life could be mapped out — as well as the answering of specific questions (“horaries”) and the provision of advice about the propitious times to begin an enterprise (“elections”). Among other things, judicial astrologers gave clients information about personal relationships, career prospects and business dealings, helped them find lost property or missing persons and counselled on the potential success or danger of

---

9 For astrology beyond England, see for instance Hervé Drévilion, *Lire et écrire l’avenir: l’astrologie dans la France du Grand Siècle, 1610-1715* (Seysssel: Champ Vallon, 1996); Claudia Brosseder, “Astrology in Seventeenth-Century Peru,” *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences* 41, no. 2 (2010): 146–57; Lauren Kassell, “Stars, Spirits, Signs: Towards a History of Astrology 1100–1800,” *Studies in History and Philosophy of Biological and Biomedical Sciences* 41, no. 2 (2010): 67–69; Tayra M. C. Lanuza Navarro, “The Dramatic Culture of Astrological Medicine in Early Modern Spain,” in *Medical Cultures of the Early Modern Spanish Empire*, ed. John Slater, María Luz López Terrada, and José Pardo Tomás (Farnham, UK: Ashgate, 2014); Víctor Navarro Brotons, *Disciplinas, saberes y prácticas: filosofía natural, matemáticas y astronomía en la sociedad española de la época moderna* (Valencia: Universitat de València, 2014); Tayra M. C. Lanuza Navarro, “From Intense Teaching to Neglect: The Decline of Astrology at the University of Valencia and the Role of the Spanish Novatores,” *Early Science and Medicine* 22, no. 5–6 (2017): 410–37.

10 On the anti-astrological side of the debate, see for example “Astrología judiciaria y almanaques”, in Benito Jerónimo Feijóo, *Teatro crítico universal*, ed. Agustín Millares Carlo (Madrid: Ediciones de “La Lectura,” 1923), vol. 1. The first volume of this work was published in 1726. Martín Martínez, *Juicio final de la astrología, en defensa del Teatro crítico universal: dividido en tres discursos ...* (En Madrid: En la Imprenta Real, 1727). For the defence of astrology see Juan Salinero, *Pragmática del tiempo en defensa de la buena astrología contra el juicio final de la astrología que escribió ... Martín Martínez* (En Madrid: se hallará en casa de Juan de Moya, 1727); Diego de Torres Villarroel, *Entierro del juicio final, y vivificación de la astrología, herida con tres llagas, en lo natural, moral, y político: y curada con tres parches: parche primero, la astrología es buena, y cierta en lo natural: parche segundo, la astrología es verdadera, y segura en lo moral: parche tercero, La astrología es útil, y provechosa en lo político* (En Madrid: En la Imprenta de Antonio Marin: Se hallará en casa de Juan de Moya, frente de San Felipe, 1727).

11 Keith Thomas went so far as to suggest that judicial astrology was simply the formal title for all astrology. Thomas, *Religion and the Decline of Magic*, 1991, 338.

undertaking voyages.<sup>12</sup> For a number of reasons, including the alleged certainty of its predictions and its implicit denial of God-given free will, judicial astrology was subject to a chorus of criticism from several quarters that coalesced in the fifteenth century, periodically increased in volume in the sixteenth and grew to a crescendo in the seventeenth century. In tracking the decline of astrology, historians have generalised the criticism of the judicial branch to all other parts of the practice. Indeed, one important study explicitly justified a focus on judicial astrology precisely because it was the most controversial branch and the one that experienced the greatest degree of change.<sup>13</sup> However, there is no reason to suppose that each of the parts of astrology shared the same trajectory. On the contrary, the fortunes of natural and medical astrology were quite different, and in some places they may even have flourished while their judicial cousin diminished. In short, the judicial focus has left us with a problematic picture of what happened to astrology and a limited awareness of the importance of other astrological branches.

In order to connect astrology to broader developments in disaster knowledge in the seventeenth century we need to shift the focus to natural astrology, the division that dealt most directly with the effects of the heavens on natural phenomena and non-human actors. “Disaster” was itself an astrological term deriving from Latin *dis* + *astrum* (via Italian *disastro*), approximating to “ill-starred” or unfortunate.<sup>14</sup> Within the cosmic model jointly envisioned by Ptolemy, Aristotle, Manilius and Firmicus, and later refined by Arabic and Persian scholars, the planets and stars were perfect entities occupying a superior superlunary realm. Their movements and configurations in the macrocosm exerted influences upon the inferior sublunary realm and its inhabitants. By altering the four

---

12 The best description of these consulting practices is still that of Thomas, ch.s 10-11.

13 Curry, *Prophecy and Power*, 7.

14 Gerrit J. Schenk, “Disastro, Catastrophe, and Divine Judgement: Words, Concepts and Images for ‘natural’ Threats to Social Order in the Middle Ages and Renaissance,” in *Disaster, Death and the Emotions in the Shadow of the Apocalypse 1400-1700*, ed. Jennifer Spinks and Charles Zika (London: Palgrave Macmillan, 2016), 55–57.

essential Aristotelian qualities — dry, moist, hot and cold — which along with the elements constituted all matter, these correspondences were in theory responsible for many phenomena within the natural environment. The four qualities also interacted with the four humours that ruled the human body, either balancing or unbalancing them.<sup>15</sup> As a result, celestial movements were in theory responsible for good or bad health, not just within individuals but within the population at large, and astrologers claimed to predict “sickly seasons” when there would be disease outbreaks. At the same time, the heat and pull of the sun helped to draw forth the earthy exhalations which according to Aristotle produced earthquakes.<sup>16</sup> Each planet and star had its own special properties and associations, which it was capable of transmitting to the earth and of combining with others depending on their relative positions (including “conjunctions” and “oppositions”). When specific planets were in certain “aspects” or configurations they had positive or “benific” properties, while “malefic” conjunctions such as that of Saturn and Mars generated baleful effects on the earth, including earthquakes, fires, wars and heresies. It was possible to describe astral changes as the precursor of these kinds of effects in two ways: either by assigning them a causative role — for example through the doctrines of sympathy and antipathy, or through changes in temperature and humidity — or by a symbolic reading of them as the signs of future events. For instance, particular astral conjunctions and comets could either cause plague by generating noxious miasmas on earth, or act as portents of a coming epidemic.<sup>17</sup> Astrologers undertook the astronomical activities of

---

15 Useful overviews can be found in E. M. W. Tillyard, *The Elizabethan World Picture* (New York: Vintage Books, 1943), 52–79; Curry, *Prophecy and Power*, 8–15; Anthony Grafton, *Cardano's Cosmos: The Worlds and Works of a Renaissance Astrologer* (Cambridge, MA: Harvard University Press, 1999), chap. 2.

16 Aristotle, *Meteorologica*, II.7.

17 Paul Slack, *The Impact of Plague in Tudor and Stuart England* (London ; Boston: Routledge & K. Paul, 1985), 26–27.

studying the movements of the celestial bodies and created tables to chart them.<sup>18</sup> On the basis of these, they were able to make predictions (“prognostications”), which after the invention of printing were commonly circulated as cheap pamphlets and hugely popular almanacs.<sup>19</sup> Since the stars played a major role in early modern medicine, astrologers also frequently gave medical advice, and many physicians practised some astrology as part of their trade.<sup>20</sup> In theory, natural astrology was limited: it could only disclose conjectural probabilities rather than certainties. This was an important restriction because it allowed both for the maintenance of the Christian doctrine of free will and for the uninhibited operation of God’s providential workings within the world. However, such ostensible limitations did not stop astrologers from claiming a degree of certain knowledge about future events, nor did it prevent both theological and secular critics from accusing astrology of impiety and even atheism. Astrology was therefore a field of learning that occupied an uncertain space: tremendously popular among large sections of the public and highly lucrative, but subject to suspicion and derision from some intellectual quarters, and occasionally even legal prosecution. As one scholar has pointed out, early modern astrologers bore some resemblance to modern economists: experts in possession of doubtful predictive powers, heavily criticised but nonetheless indispensable.<sup>21</sup>

Nevertheless, prior to the seventeenth century the activities of natural astrologers seemed to have a substantial intellectual warrant. The Scholastic compromise between medieval Christian

---

18 The relationship between premodern astronomy and astrology is difficult to pin down. In some eras they may have effectively constituted a single scholarly tradition, while in the seventeenth century many astronomers were engaged in observing the stars but had no interest in astrological interpretation. Some historians regard the application of the distinction in an early modern context as largely anachronistic, e.g. Curry, *Prophecy and Power*, 31–32.

19 The classic account of the astrology of the almanacs is in B. S. Capp, *English Almanacs, 1500-1800: Astrology and the Popular Press* (Ithaca, NY: Cornell University Press, 1979).

20 Thomas, *Religion and the Decline of Magic*, 1991, ch.s 10-11; Grafton, *Cardano’s Cosmos*, chap. 2; Monica Azzolini, *The Duke and the Stars: Astrology and Politics in Renaissance Milan* (Cambridge, MA: Harvard University Press, 2013), chap. 4.

21 Grafton, *Cardano’s Cosmos*, 10. For prosecutions of well-known astrologers, see Thomas, *Religion and the Decline of Magic*, 1991, 412–13.

theology and Aristotelian natural philosophy had created a legitimate niche for natural astrology by reconciling freedom of the will with Aristotle's principles of celestial influence.<sup>22</sup> Although Luther and Calvin subsequently criticised judicial astrology, they had no problem with predictions concerned with the physical matter of the natural world.<sup>23</sup> Furthermore, the Reformation reinvigorated the theological interpretation of astral phenomena as harbingers of terrestrial calamities. Reading the skies in this way did not strictly require formal astrological training, but it nonetheless tended to justify and encourage astrological study. Among the Protestant Reformers this theological spur to astrological practice formed part of a larger programme, initially championed by Philipp Melancthon, to connect celestial prognostication to eschatology.<sup>24</sup> A decree of Sixtus V of 1586 (*Coeli et terrae creator deus*) severely curtailed judicial astrology in Catholic countries but did not restrict natural or medical astrology.<sup>25</sup> The Spanish Inquisition's catalogue of forbidden books of 1583 also included a rule prohibiting publications from making prognostications that contravened the doctrines of providence and free will, or which set out methods for predicting the future from astral observation. While the rule forbade the judicial practices of making nativities, elections and interrogations, it did not condemn astrology outright. Those parts of astrology that dealt with the weather, "general world events" (*sucesos generales del mundo*), agriculture, navigation and medicine — in

---

22 Curry, *Prophecy and Power*, 7.

23 Euan Cameron, *Enchanted Europe: Superstition, Reason, and Religion, 1250-1750* (Oxford; New York: Oxford University Press, 2010), 190; Barnes, *Astrology and Reformation*, 135.

24 Barnes, *Astrology and Reformation*, chap. 4.

25 The text of the bull is reproduced in Claude Pithois, *A seventeenth-century exposure of superstition: select texts of Claude Pithois (1587-1676)*, ed. P. J. S. Whitmore, (The Hague: Nijhoff, 1972), 239–47. On the immediate context and consequences of the decree see Ugo Baldini, "The Roman Inquisition's Condemnation of Astrology: Antecedents, Reasons and Consequences," in *Church, Censorship, and Culture in Early Modern Italy*, ed. Gigliola Fragnito, trans. Adrian Belton (Cambridge, UK; New York: Cambridge University Press, 2001). For the application of the bull in Spain see Víctor Navarro Brotóns, "La astronomía," in *Historia de la ciencia y de la técnica en la Corona de Castilla*, ed. Luis García Ballester, vol. 3 (Valladolid: Junta de Castilla y León, Consejería de Educación y Cultura, 2002), 295.

other words, most of the functions of natural and medical astrology — were all licit.<sup>26</sup> In Spanish America, the Inquisition targeted political prognostication and astral magic but not stellar weather forecasting, and universities continued to teach medical astrology.<sup>27</sup> In 1647-48 a new Inquisition rule applying to New Spain, Guatemala, Nicaragua and the Philippines made almanacs subject to censorship but expressly permitted forecasts related to the weather and connected phenomena such as plagues.<sup>28</sup> Francis Bacon explicitly set aside as the preserve of a reformed *astrologia sana* the prediction of natural phenomena and great social upheavals: “comets [...] all kinds of meteors, floods, droughts, heats, frosts, earthquakes, irruptions of water, eruptions of fire, great winds and rains, the various seasons of the year, plagues, epidemic diseases, plenty and dearth of grain, wars, seditions, schisms, transmigrations of peoples; and in short of all commotions or greater revolutions of things, natural as well as civil”.<sup>29</sup>

The boundary between the judicial and non-judicial variants of astrology, however, was not always clear-cut for astrologers or their critics, and some practitioners, like the Englishman William Lilly, engaged in each type of astrology indiscriminately.<sup>30</sup> The distinction seemed especially thin when astrologers attempted to interpret the significance of comets and eclipses for both the natural

---

26 This rule was republished in subsequent editions of the Index: it is Regla General no. IX in *Index librorum prohibitorum et expurgatorum [...] de Consilio supremi Senatus generalis Inquisitionis Hispaniarum* (Genevae: Sumptibus Jacobi Crispini, 1619). The same rule is listed as Regla VIII in *Novus index librorum prohibitorum et expurgatorum...* (n.p.: ex typographaeo Francisci de Lyra, 1632). See also Navarro Brotóns, “La astronomía,” 294–95. As Navarro Brotóns points out, astrologers continued to practise the judicial variety of astrology in Spain despite these prohibitions, often with the precautionary measure of stating that none of their predictions interfered with human free will, but when they exceeded the bounds of the permissible the Inquisition became involved.

27 Jorge Cañizares Esguerra, “New World, New Stars: Patriotic Astrology and the Invention of Indian and Creole Bodies in Colonial Spanish America, 1600-1650,” *The American Historical Review* 104, no. 1 (1999): 50.

28 The rule is reproduced in José Miguel Quintana, *La Astrología En La Nueva España En El Siglo XVII - de Enrico Martínez a Sigüenza y Góngora* (Mexico: Bibliófilos mexicanos, 1969), p. 101. See also Anna More, “Thinking with the Inquisition: Heretical Science and Popular Knowledge in Seventeenth-Century Mexico,” *Romanic Review* 103, no. 1/2 (2012): 117-18.

29 Francis Bacon, “Of the Dignity and Advancement of Learning,” in *Works*, ed. James Spedding, Robert Leslie Ellis, and Douglas Denon Heath, vol. 4 (London: Longman, 1857), vol. 4, p. 353.

30 Ann Geneva, *Astrology and the Seventeenth Century Mind: William Lilly and the Language of the Stars* (Manchester ; New York: Manchester University Press, 1995).



world and human societies. In addition, the predictions of natural astrology shared with judicial astrology the problem of inaccuracy. This became particularly apparent in 1524 when a massive deluge promised by earlier prognostications failed to materialise.<sup>31</sup> Partly on the basis of the commonality of inaccurate predictions, some critics discovered errors and problems in every variety of astrology. Nevertheless, critiques of natural and medical astrology were much less frequent and tended to be more measured than the polemics against judicial astrology. There was also much more interest in preserving those aspects and “reforming” them, in order to make them more robust and precise in their methods and therefore less prone to error in their results. Among natural philosophers around the middle of the seventeenth century attitudes to astrology occupied a spectrum. On one end of the continuum were fierce critics who repudiated all forms of astrology. Gassendi, for instance, insisted on the fallacy of both judicial astrology and astral predictions of earthquakes, fires, floods, plagues and storms, pointing to the false announcements of the deluge in 1524 as an example of “the vain Predictions of our Star-prophets”.<sup>32</sup> On the other side of the spectrum were naturalists like Elias Ashmole, a founding member of the Royal Society who was an ardent believer in the utility of all kinds of astrology, and cast horoscopes and nativities.<sup>33</sup> Many more savants occupied a middle ground: neither committed to astrological principles nor willing to rule out the possibility of celestial influences on natural phenomena.

Those positions came under pressure as a series of eclipses and comets in the 1650s-80s attracted immense public discussion and debate. Initially the focus of this discussion was on two

---

31 Ottavia Niccoli, *Prophecy and People in Renaissance Italy* (Princeton, N.J.: Princeton University Press, 1990), chap. 6; Barnes, *Astrology and Reformation*, chap. 3; Lydia Barnett, *After the Flood: Imagining the Global Environment in Early Modern Europe* (Baltimore, Maryland: Johns Hopkins University Press, 2019), 29–31.

32 Pierre Gassendi, *The Vanity of Judiciary Astrology. Or Divination by the Stars* (London: Printed for Humphrey Moseley, and are to be sold at his shop at the Prince’s Armes in St Pauls Church-yard, 1659), 60–67.

33 See for instance Elias Ashmole, *Elias Ashmole (1617-1692): His Autobiographical and Historical Notes, His Correspondence, and Other Contemporary Sources Relating to His Life and Work*, ed. C. H. Josten (Oxford: Clarendon, 1967), vol. 2, pp. 598–99.

solar eclipses in 1652 and 1654, which astrologers widely declared would be the heralds of massive calamity. Magnified by the journalistic press, these predictions became international news. Astral occurrences were already at the heart of the emergent news media, as indicated by the names of gazettes suggesting planetary influence or astronomical practice, such as the various *Mercures* and *Observers*.<sup>34</sup> Besides these, printing presses across Europe churned out a huge volume of astrological pamphlets and almanacs. England was a particularly fertile environment for those publications, since the old regime of censorship collapsed during the English Revolution, and the Company of Stationers' former monopoly on almanacs broke down.<sup>35</sup> For the first time, Parliament appointed an astrologer, John Booker, as the official licenser for almanacs.<sup>36</sup> In 1652 English prognosticators collectively predicted that an eclipse that year would give rise to terrifying events. The physician and astrologer Nicholas Culpeper announced that “[t]he effects of this Eclipse will spare none it lights upon, neither will it play or dally with them, but, Torrent-like, sweep them away with a mighty ruine”.<sup>37</sup> Three leading astrologers, Booker, William Lilly and George Wharton — former Civil War opponents — put aside their rivalries to observe the course of the hours-long eclipse they had confidently predicted, on what became known as “Black Monday”.<sup>38</sup> The populace responded to these predictions with panic: many Londoners fled the capital in terror, piling their goods on carts and finding refuge in the countryside. In the event the eclipse was an incredible anticlimax: it lasted

---

34 Eileen Adair Reeves, *Evening News: Optics, Astronomy, and Journalism in Early Modern Europe* (Philadelphia: University of Pennsylvania Press, 2014).

35 Curry, *Prophecy and Power*, 20.

36 Curry, 20, 23.

37 Nicholas Culpeper, *Catastrophe Magnatum, or, The Fall of Monarchie a Caveat to Magistrates, Deduced from the Eclipse of the Sunne, March 29, 1652, with a Probable Conjecture of the Determination of the Effects* (London: Printed for T. Vere and Nath. Brooke, 1652), 10.

38 William Lilly, *Annus Tenebrosus, or The Dark Year Or Astrologically Judgements upon Two Lunar Eclipses, and One Admirable Eclipse of the Sun, All Visible in England, 1652. Together with a Short Method How to Judge the Effects of Eclipses* (London: Printed for the Company of Stationers, and H. Blunden, 1652).

a scarce few minutes, and was all but invisible thanks to cloudy conditions.<sup>39</sup> France witnessed a very similar situation in 1654, when prophecies of disaster attending an eclipse “terrified almost all Paris and the surrounding area”.<sup>40</sup> The panic was supposedly so acute that people “abandoned themselves to fear at the report of so many harmful occurrences” to come, and some women insisted that children born in the month of August would not live out the year.<sup>41</sup> Again, the event proved unremarkable, and in both countries the apparent failure of astrologers excited severe criticism. The anonymous pamphlet *Black Munday turn'd white* ridiculed the false predictions of Lilly and his cohort, suggesting instead that “those Kingdoms, Cities, &c. by them threatned, will stand and flourish, when they shall lie in the dust”.<sup>42</sup> Critics castigated astrologers not only for their inaccuracies and inconsistencies — “so various are they in their several judgments, that all their Predictions seem to be incredulous” — but also as threats to public safety.<sup>43</sup>

It was in France that astrologers experienced the fiercest confrontations with sceptics, led by Gassendi. The astrologer Jean-Baptiste Morin fought a desperate defence in the 1650s against these opponents — some of whom he had previously angered through his own rancorous printed diatribes and personal attacks.<sup>44</sup> As a result, Morin was the butt of relentless derision and mockery from French scholars — he was described by turns as a dung beetle and a “ridiculous mouse” in a

---

39 William E. Burns, “‘The Terriblest Eclipse That Hath Been Seen in Our Days’: Black Monday and the Debate on Astrology during the Interregnum,” in *Rethinking the Scientific Revolution*, ed. Margaret J. Osler (Cambridge ; New York: Cambridge University Press, 2000).

40 “[...] a effrayé presque tout Paris et ses environs [...]” Jean Baptiste Morin, *Remarques astrologiques sur le Commentaire du Centiloque de Ptolémée, ou la seconde partie de l’Uranie de Messire Nicolas de Bourdin, marquis de Villennes, etc.* (Paris: Retz, 1976), 110.

41 “[...] se sont laissez aller à la crainte au recit de tant de fascheux accidens [...]” Anon., *Examen du jugement de l’Argolin sur l’éclipse du mois d’août 1654* (Paris: impr de P Le Petit, 1654), 2.

42 Anon., *Black Munday Turn’d White: Or, the Astrologers Knavery Epitomized. Being an Answer to the Great Prognosticks, and Gross Predictions of Mr. Lillie, Mr. Culpeper, and the Rest of the Society of Astrologers, Concerning the Eclipse of the Sun, on Munday Last, Which (According to Their Calculation) Should Have Produced an Egyptian Darkness, and the Greatest That Hath Been Seen in This Latter Age...* (London: Printed for G. Whiting, 1652), 8.

43 Anon., *Black Munday Turn’d White*, 4–5.

44 Robert Alan Hatch, “Between Astrology and Copernicanism: Morin - Gassendi - Boulliau,” *Early Science and Medicine* 22, no. 5–6 (2017): 493–97.

vicious series of satirical pamphlets.<sup>45</sup> In the wake of the embarrassing episode of 1654 Morin found it expedient to disown careless predictions in order to vindicate astrological prognostication in general. In his *Remarques astrologiques* (1657) he heaped scorn on a pamphlet of 1654, whose author — falsely claiming to be the celebrated Italian astrologer Andrea Argoli — had prognosticated calamities as a result of the eclipse of that year. The problem from Morin’s perspective was not the conventional prediction of misfortunes as a result of an eclipse but that a hack prognosticator had attracted a disproportionate amount of public attention. Most importantly, the false Argoli with his “*ridicule manuscrit*” had offered an absurdly easy target for the critics of astrology to seize upon. In a printed scrutiny of the prophecy, an anonymous critic leapt upon the opportunity to generalise the intellectual flaws and contradictions of the fake Argoli to astrology as a whole.<sup>46</sup> What ensued was a very one-sided debate that Morin labelled the battle of “the giant against a runt”.<sup>47</sup> The “giant” marshalled his humanistic erudition to argue against the legitimacy of astrological disaster predictions, urging readers to avoid the fate of Pythius, “who died [...] from fear of death”.<sup>48</sup> The main thrust of the giant’s attack was that astrologers had no ability to read the stars, and God had never intended anybody to do so anyway. Surprisingly, he agreed that “[i]t is true that God has placed the stars in the Heavens in order to be the signs of storms & tempests”, but he nevertheless

---

45 Hatch, 495.

46 Morin, *Remarques astrologiques sur le Commentaire du Centiloque de Ptolémée, ou la seconde partie de l’Uranie de Messire Nicolas de Bourdin, marquis de Villennes, etc.*, 110–11.

47 Morin, 110.

48 “qui mourut [...] de crainte de mourir” Anon., *Examen du jugement de l’Argolin sur l’éclipse du mois d’août 1654*, 2. Here he was making a somewhat confusing allusion to an episode in Herodotus’ *Histories*, 7.38–40. As the Persian king Xerxes moved his army over the Hellespont to invade Greece an eclipse occurred. Troubled, the Great King asked his Magi for advice, and these assured him that it was an omen of victory for the Persians. However, Pythius of Lydia, unnerved by the eclipse, asked Xerxes to release his eldest son from fighting in the Persian army. The enraged Xerxes had the boy cut in half, and setting each half on opposite sides of the road, ordered his army to march between them.

insisted that there was no direct connection to human misfortune and nothing in them to warrant popular fear.<sup>49</sup>

The confrontation over the putative relationship of the eclipses to calamities should be viewed as part of the broader movement towards the critical scrutiny of prodigies in the sphere of disaster research. The astrological predictions of the 1650s opposed those trends in two main ways. In the first place, they continued to advance a heteroclitite concept of calamity that mingled civil and natural troubles, thus flying in the face of programmes (such as that of Gassendi) proposing a more systematic arrangement of phenomena. The French astrologer Mathurin Questier's eclipse predictions invoked a variety of "dire occurrences" (*sinistres accidens*), including "troubles & seditions in different parts of the world", epidemics of smallpox and even the proliferation of deadly salad vegetables — rendered toxic by the spit of snakes and "other venomous creatures".<sup>50</sup> Lilly claimed that an eclipse that took place when Saturn was predominant portended terrible storms, floods, cattle disease, food shortages and famines as well as "Fluxes, Quartane Agues, Banishments, Poverty, Miserie, Lamentation" and "stiff Law-Sutes".<sup>51</sup> Secondly, the predictions defied rigorous evidentiary standards because it was almost impossible to disprove a connection between disasters and prior celestial movements. Although astrologers purported to follow established rules in calculating those relationships, in practice the rules turned out to be highly malleable, allowing for events to be associated with a given eclipse, comet or conjunction months or in some cases years after its appearance, as well as for the modification of predictions after the fact by reference to

---

49 "Il est vray que Dieu a posé les astres dans le Ciel pour y estre des signes des orages & des tempestes, mais non pas des Causes funestes de nos disgraces & de nos malheurs". Anon., 5.

50 "troubles & seditions en divers endroits de la terre". Mathurin Questier, *L'astrologue incogneu ou Le speculateur universel des ephemerides celestes. Prédisant tous les bons-heurs & mal-heurs, qui peuvent arriver pendant le cours de l'année sainte 1650. Particulierement sur les divers climats françois, espagnols... & Liegeois. Où l'on remarquera des choses émerveillables, non veuës ny publiées* (Paris: chez Michel Ballagny, 1649), 102–3.

51 William Lilly, *An Easie and Familiar Method Whereby to Iudge the Effects Depending on Eclipses, Either of the Sun or Moon* (London: Printed for the Company of Stationers, and H. Blunden, 1652), 11–12.

intervening or interfering celestial influences, with the result that almost any calamity could be said to have been heralded by astral signs.

The emphasis of astral sceptics on preventing panics by decoupling calamities from eclipses suggested that disaster research had acquired a public mission that recalled the classical justifications for natural inquiry. Ancient Stoic and Epicurean philosophy had taught that the fear generated by earthquakes, storms and other destructive phenomena was an undesirable consequence of ignorance, and that once people understood the causes of disastrous occurrences they could face them down as easily and calmly as they did the mundane worries of their daily lives.<sup>52</sup> The argument against fear also drew Scriptural encouragement from Jeremiah 10:2 (“Learn not the ways of the heathen, and be not dismayed at the signs of heaven”).<sup>53</sup> These intellectual justifications joined with the political consideration that astrological disaster predictions constituted a threat to public governance by inciting panic and disorder. The wild predictions that attended comets in the sixteenth and early seventeenth centuries had occasionally caused concern for governments.<sup>54</sup> Besides their alleged connection to elemental disturbances, comets were widely understood to portend the deaths of monarchs, giving them an intrinsic political significance.<sup>55</sup> These worries about civil disorder had risen to a higher pitch by the 1660s in response to the turbulent public reactions to the eclipses of the previous decade. In England, the importance of astrological predictions as propaganda for each side in the Civil War led the Restoration regime in the 1660s to

---

52 Lucius Annaeus Seneca, *Natural Questions*, trans. Harry M. Hine (Chicago ; London: The University of Chicago Press, 2010), VI.3.1; Titus Lucretius Carus, *On the Nature of Things*, trans. W. H. D. (William Henry Denham) Rouse and Martin Ferguson Smith, Revised ed., Loeb Classical Library ; 181 (Cambridge, MA: Harvard University Press, 2014), III.91-93, I.102-148.

53 Quoted, for instance, in Gassendi, *The Vanity of Judiciary Astrology. Or Divination by the Stars*, 9.

54 See for instance Sara Schechner Genuth, *Comets, Popular Culture, and the Birth of Modern Cosmology* (Princeton, NJ: Princeton University Press, 1997), 83.

55 Schechner Genuth, 24–26; Geneva, *Astrology and the Seventeenth Century Mind*, 84–96.

keep a watchful eye on the prognostications that circulated among the populace.<sup>56</sup> After the coronation of Charles II in 1661, itself surrounded by subversive reports of omens indicating divine disfavour of the new reign, the incendiary potential of astrology and its association with radical politics became a matter of increasing concern.<sup>57</sup> This suspicion was particularly noticeable after the Great Plague of 1665 and the Great Fire of 1666, which followed comet sightings in 1664-65.<sup>58</sup> Lilly, the leading astrologer of his generation, had previously printed woodcuts in his *Monarchy or No Monarchy* (1651) which appeared to predict both the plague and the fire.<sup>59</sup> In late October 1666, a Parliamentary committee accordingly hauled him in for questioning. At the heart of the matter lay the suspicion that Lilly — a former parliamentarian — might have been part of a republican arson plot. The astrologer admitted to having foreseen the disasters but denied having caused them, and claimed that he had been unaware of the exact year in which they would occur.<sup>60</sup> Ashmole ultimately managed to rescue him by speaking with acquaintances on the examining committee.<sup>61</sup> Although this affair augmented Lilly's reputation for making accurate predictions, it was also an indication that ruling authorities were losing patience with the prophets of calamity.

Meanwhile, in France the increasingly strident criticism of astrological disaster prediction was for the first time accompanied by an institutional rejection of astrology. The Académie Royale des

---

56 William E. Burns, *An Age of Wonders: Prodigies, Politics, and Providence in England, 1658-1727* (Manchester, UK; New York: Manchester University Press, 2002), 14–15, 20.

57 For omens at Charles' coronation see Burns, 20. For the subversive associations of English astrology, see Curry, *Prophecy and Power*, 29–30.

58 For a dramatic reconstruction of the comet sightings and interpretation see Daniel Defoe, *A Journal of the Plague Year: Being Observations or Memorials of the Most Remarkable Occurrences, as Well Publick as Private, Which Happened in London during the Last Great Visitation in 1665*, ed. Louis A. Landa, Revised edition (London, New York: Oxford University Press, 2010), 18–20.

59 Image no. 13, for instance, was of a burning city. William Lilly, *Monarchy or No Monarchy in England...* (Printed for Humfrey Blunden: London, 1651).

60 William Lilly, *William Lilly's History of His Life and Times, from the Year 1602 to 1681. Written by Himself, in the Sixty-Sixth Year of His Age, to His Worthy Friend, Elias Ashmole, Esq.* (London: Reprinted for Charles Baldwin, 1822), 151, 213–20.

61 Ashmole, *Elias Ashmole (1617-1692)*, 158–59.

Sciences, founded with Louis XIV's permission in 1666, completely excluded astrology from its discussions, refusing even to acknowledge its existence as a coherent body of knowledge.<sup>62</sup> The *roi soleil* himself was particularly concerned about the potential for subversive astrological print to seize upon his own solar imagery.<sup>63</sup> After the appearance of the comet in 1664-65, he personally invited Pierre Petit, his *intendant* in charge of fortifications and a founding member of the Académie, to prepare a publication that would scotch panicked rumours of imminent dangers to the kingdom and its ruler. Petit's *Dissertation sur la nature des comètes* (1665) roundly refuted any possibility of meaningful astrological prediction of disaster. Reviewing the record of previous comets, what struck Petit was the immense diversity of opinion on the nature of the meteors. In the ensuing debates, "each person took a side" ("chacun a pris party") — wording strongly suggestive of a conflict between political factions.<sup>64</sup> Not only had the interlocutors opposed the views of Aristotle to those of modern thinkers like Descartes, but they also breathed new life into pre-socratic schools of opinion long thought to have been vanquished by the Stagyrte himself: those of "Pythagoras, Hippocrates, Diogenes, Artemidorus, the Chaldeans & many others".<sup>65</sup> By helping to unearth these myriad theories, the Renaissance humanists had effectively created a many-headed monster. Amidst a cacophony of theories, without any apparent means of testing their validity, the comets had become more mysterious than ever.

With an eye to that context of bewildering explanatory diversity, Petit described the belief in cometary signs of calamities as the product of intellectual confusion and the persistence of ancient prejudices. The "occult qualities" of celestial objects, by means of which disaster predictions were

---

62 Drévilion, *Lire et écrire l'avenir*, 213–14.

63 Drévilion, 236.

64 Pierre Petit, *Dissertation sur la nature des comètes ... avec un Discours sur les pronostiques des éclipses & autres matières curieuses*, par P. Petit, ..., 1665, 13.

65 Petit, 13.



launched, “are almost always the refuges of our ignorance”.<sup>66</sup> Rather than attributing such views to the rival tradition of astrology — which would have accorded it scholarly status — Petit implicitly ascribed them to a kind of simple piety and an over-willingness to believe in miracles. After all, the proponents of such views could not have been educated intellectuals, and since “this opinion is merely founded upon the weakness or upon the piety of those who follow it, I have nothing else to say against it, other than that miracles are not within the remit of [natural] Philosophy”.<sup>67</sup> To attribute comets to the agency of God was to liken the Lord to a base theatrical stage-manager, whose crude dramas needed a *Deus ex machina* to descend from the clouds in every performance.<sup>68</sup> On the other hand, the *intendant* hinted that even the piety of kings had been manipulated by charlatans claiming prophetic powers, through “the abuse of the people” and “deceit”. Whereas earlier ecclesiastical critics had often decried astrology as an illegitimate form of magic, Petit characterised it as an empty hoax that took advantage of pious minds. It was therefore a moral duty incumbent on those with expertise in this area to clarify the nature and causes of comets.<sup>69</sup> The role of the savant was thus to cut through the Babel of theories to the one true explanation, trading diversity for certainty and casting aside popular superstition.

However, as Petit was careful to demonstrate, a critique of religious disaster prediction based on comets did not equate to a denial of providential signs in the heavens. Petit affirmed that God had indeed sent comets as miraculous warnings in the past, just as Scripture recorded. He also credited Josephus’ claim that a fiery meteor had hovered above Jerusalem for an entire year, to presage the

---

66 “les qualitez occultes [...] sont presque toujours les aziles de nostre ignorance.” Petit, 13–14.

67 “comme cette opinion n'est fondée que sur la foiblesse ou sur la pieté de ceux qui la suivent, ie n'ay autre chose à dire allencontre, sinon que les miracles ne sont pas du ressort de la Philosophie [...]” Petit, 13–14.

68 Petit, 14.

69 Petit, 4.

destruction of the Temple and the city by the Roman emperor Titus.<sup>70</sup> On such occasions, comets were undeniable auguries of catastrophe. Nevertheless, he insisted, such incidents were very rare, and had no bearing on the general debate about the nature of comets. In his view, the fact that God used natural phenomena to work miracles from time to time should not impede the search for natural explanations. After all, “every time it thunders, and lightning falls, God is not angry; so much for the opinion that resorts to the Miraculous”.<sup>71</sup> Petit’s cautious manoeuvring constituted an attempt to prioritise the methods and standards of natural philosophical research over astrological tradition, while avoiding any contravention of Catholic doctrine. This entailed two tasks: the first was to detach astrological beliefs from the protection of theology, which he attempted to do by simultaneously recasting cometary piety as village ignorance and by characterising astrologers as charlatans. The second was to present the intellectual pluralism that was a hallmark of cometary learning as a hopeless muddle that needed to be clarified by a single correct explanation. That explanation, of course, would be provided by mechanical philosophy, with the royal seal of approval.

While Petit’s essay demonstrated his willingness to engage in political toadying and his unwillingness to challenge religious dogma, the attempt to link cometary interpretation with credulity manifested the same kind of suspicion that contemporary scholars like Rosales were showing elsewhere in regard to disaster prophecies and prodigies. Among the rhetorical tools that learned writers employed at this time to advance their arguments was the distinction of legitimate scholarly research from “vulgar” beliefs. The concept of vulgarity generally carried connotations of low social rank and folk tradition, but applying it to cometary interpretation also allowed astral sceptics to

---

<sup>70</sup> Petit, 14. Josephus, *The Jewish War*, VI.v.3.

<sup>71</sup> “toutes les fois qu’il tonne, & que la foudre tombe, Dieu n’est pas en colere, voila pour l’opinion qui a recours au Miracle”. This may well have been inspired by Lucretius’ ridicule of the attribution of thunder and lightning to divine anger. Petit, 14.

police the standards of disaster research among the ranks of the well-educated. The key to cementing the vulgarity of disaster predictions lay in the collection of condescending ethnographic accounts of the responses of foreign peoples to comets, eclipses and other celestial phenomena. In late 1663 Samuel Collins, the English physician to the Tsar Alexis Romanov, wrote to Robert Boyle from Vologda describing the dramatic reactions of locals to “a dreadfull blazing starre” accompanied by an earthquake “(hardly ever Knowne in these parts)”. According to Collins, “some people were cast downe to the earth and one woman, <stricken> blind, deafe and dumb for some dayes and recovering her senses and speech foretold a vision which the hearers stopd their eares att, or tongues att least, being of too dangerous consequence to <bee> reveald. all which things amaze the graver sort of people & want onely the event to make them either authenticke or fabulous”.<sup>72</sup> The vulgarity of a belief in portents became closely linked to the fear that supposedly accompanied a lack of natural philosophical knowledge. Thomas Smith, chaplain to the English ambassador in Constantinople, spelled this out in his account of an earthquake of 1669: “The Turks look upon earthquakes as ominous, as the vulgar do upon eclipses, not understanding the philosophy of them”. Cultivating an air of moral and intellectual superiority, Smith claimed that the English contingent “were soon rid of the fears in which this frightful accident had cast us” while the Turks “made direful reflections on it, as if some calamity would inevitably fall upon the empire”.<sup>73</sup> The Jesuit

---

72 Samuel Collins to Robert Boyle, 20 November 1663, Robert Boyle, *The Correspondence of Robert Boyle*, ed. Michael Hunter, Antonio Clericuzio, and Lawrence Principe, The Boyle Project edition (IntelLex Corporation) (Charlottesville, VA: IntelLex Corporation, 2004), vol. 2, 206. Boyle noted the report of the earthquake in his work diary: Royal Society BP 27, p. 96; transcribed in *The work diaries of Robert Boyle*, Work diary 21, <http://www.livesandletters.ac.uk/wd/view/view.html>. He conveyed the news of the comet and earthquake to the Royal Society at a meeting of 23 March 1664. Thomas Birch, *The History of the Royal Society of London for Improving of Natural Knowledge, from Its First Rise. In Which the Most Considerable of Those Papers Communicated to the Society, Which Have Hitherto Not Been Published, Are Inserted in Their Proper Order, as a Supplement to the Philosophical Transactions* (London: Printed for A Millar, 1756), vol. 1, p. 402.

73 Thomas Smith, “Historical Observations Relating to Constantinople, by the Reverend and Learned Tho. Smith, D.D. Fellow of Magd. College Oxon. and of the Royal Society,” in John Ray, *Travels through the Low Countries, Germany, Italy and France....*, second edition (London: Printed for J Walthoe, et al., 1738), vol. 2, pp. 391–92.

missionaries in Canada claimed that their ability to predict eclipses by using astronomy “astonished” the Iroquois and other tribes, undermining their belief in the divinity of the sun and moon.<sup>74</sup>

Stereotypical depictions of the awe that comets and eclipses inspired among peoples not versed in modern natural philosophy helped to delegitimise disaster prediction in Europe, since it transformed what might otherwise have been learned commentary or pious contemplation into vulgar superstition. Thus in a manuscript essay of 1674 the English astronomer John Flamsteed dismissed astrologers’ “vaine, often pernicious predictions of the Weather, & State affaires” by presenting them as a kind of heathen idolatry: “the Vulgar have esteemed them as the very oracles of God”.<sup>75</sup>

However, the vulgarisation of astral disaster prediction in England and France was heavily contested elsewhere. At much the same time as Petit was trying to disassociate a pious expectancy of disaster from the comet of 1664-65, commentators in New England conversely attempted to deepen those religious associations and make them compatible with developments in natural philosophy. Samuel Danforth, a congregationalist minister in Roxbury, Massachusetts, demonstrated remarkable flexibility by incorporating into his printed tract on the phenomenon both an “Astronomical Description” of the comet and a “Theological Application” of its significance for the world. Like many (but not all) of his contemporaries, Danforth did not see a purely rational account of the comet as in any way precluding a theological interpretation. Indeed, the two sections mirrored Danforth’s own dual commitments: in addition to his preaching duties as Pastor at the First Church of Roxbury, he also cultivated astronomical interests, and by the 1640s he had published some of

---

74 “This has gone so far that, when one of our fathers, some years Ago, predicted to the Iroquois an eclipse, Those Barbarians desired The Father to tell Them the position of an army of Their Enemies, which, as they had heard, was marching Against them. ‘Since thou knowest all that passes in the Sky,’ They said to Him, ‘thou canst not be ignorant of what passes on earth.’” Father Thierry Beschefer to the Father Provincial in France, 21 October 1683. Reuben Gold Thwaites, ed., *The Jesuit Relations and Allied Documents; Travels and Explorations of the Jesuit Missionaries in North America (1610-1791)*, trans. Finlow Alexander et al. (Cleveland, OH: The Burrows Brothers Company, 1899), vol. 62, pp. 199–201.

75 CUL RGO MS 1/76, no. 5, f. 69r.

New England's first almanacs.<sup>76</sup> In the astronomical section of his tract, Danforth tried to assemble all of the observational data available to him. These included his own observations — although he worried that his “want of Astronomical Instruments” might have lessened their accuracy — as well as reports of comet sightings from Virginia, Jamaica, St Martha, Cartagena and Barbados.<sup>77</sup> From these observations he speculated on the physical nature of comets. Contrary to Aristotle, he insisted that the recent comet was neither sublunar — otherwise it could not have been visible in such disparate regions — nor the product of earthly exhalations. He also reasoned that the comet's tail was not a flame but radiated light from the sun. He was particularly interested in the comet's movement, from which he gathered that it was not a fixed star but a “Planetick or Erratick Body”, perpetually travelling around the firmament.<sup>78</sup> Its disappearance was not a consequence of it having dissipated (as it would have done if it were a vapour), but rather its moving out of sight. Danforth also traced its detailed route through the zodiac — something that held great significance for astrologers. Moreover, he pointed out that comets often follow a “superior conjunction” of the planets; this one had been preceded by a conjunction of Saturn and Jupiter.

To these astronomical observations Danforth added his theological interpretation. Printed on the frontispiece itself were verses derived from the sixteenth-century French poet Guillaume de Saluste Du Bartas:

There, with long bloody Hair, a Blazing Star

Threatens the World with Famine, Plague & War:

---

76 David D. Hall, *Worlds of Wonder, Days of Judgment: Popular Religious Belief in Early New England* (New York: Knopf, 1989), 58–59.

77 Samuel Danforth, *An Astronomical Description of the Late Comet or Blazing Star as It Appeared in New-England in the 9th, 10th, 11th, and in the Beginning of the 12th Moneth, 1664: Together with a Brief Theological Application Thereof* (Cambridge, MA: Printed by Samuel Green, 1665), 8.

78 Danforth, 5.

To Princes, death; to Kingdomes many crosses:

To all Estates, Inevitable Losses:

To Heardmen, Rott: to Plow-men hapless Seasons:

To Sailors, Storms: to Cities, civil Treasons.<sup>79</sup>

Even though Danforth did not frame his text in the form of an astrological prognostication (and attributed the observation on conjunctions to “Astronomers”),<sup>80</sup> it would be difficult to find the conventional astrological interpretation of the terrestrial effects of comets more concisely represented, or to locate a more prominent place in the text to present it to the reader. To arrive at the meaning of the comet, Danforth consulted both the authority of Scripture (according to which comets are “*Portentous and Signal of great and notable Changes*”), and historical records, enclosing a list of past comets which had been attended by calamities, stretching from antiquity (for which he drew upon Seneca) to 1652.<sup>81</sup> He acknowledged that some comets had been thought to herald good things, as with those that preceded the reformations of Wycliffe and Luther, “but most commonly they are observed to precede if not portend great Calamities”, including earthquakes, plagues and wars.<sup>82</sup> However, it would have been problematic for Danforth to hold that such calamities occurred automatically upon the appearance of the comet, because this might have suggested that God’s hands could be bound, and His ability to intervene directly in the world foreclosed. It would also have implied that the disasters were caused by the comet rather than the Lord — a clear

---

79 From “The Second Daie of the First Week”, in Guillaume de Saluste Du Bartas, *Du Bartas His Devine Weekes and Workes Translated*, trans. Joshua Sylvester (London: Humfrey Lounes, 1611), 42. The original verses are in Guillaume de Saluste Du Bartas, *La Sepmaine, Ou Création Du Monde, de G. de Salluste, Seigneur Du Bartas* (Paris: Chez Jean Feurier, 1578), 48. Sylvester’s version made substantial creative alterations: the allusions to famine, plague, war, the death of princes, mortalities in kingdoms, financial losses, cattle disease and poor growing seasons were all new additions. The original French version merely indicated that comets threatened hail, pillage of flocks, urban revolts and sea storms.

80 Danforth, *An Astronomical Description of the Late Comet*, 16. Of course, he may simply have used the same term for both astrology and astronomy, or believed that there was no distinction between the two.

81 Seneca, *Naturales quaestiones*, VII.28.

82 Danforth, *An Astronomical Description of the Late Comet*, 18.

contravention of Church doctrine, which upheld the importance of providence in disaster causation. To get around these difficulties Danforth indicated that the comet was merely a conditional “Communication of wrath” from God, who reserved the ability to revoke His decision to inflict calamities if the sinners who had incited His anger repented in the meantime.<sup>83</sup> Even that dextrous reasoning could have been contentious for some Protestant readers, since it seemed to suggest that God did not already have a predetermined plan and was rather acting in a spontaneous fashion in these momentous interventions. What helped to make the comet a clear signal of God’s intentions for Danforth was that it appeared to coincide with several other divine tokens that had been recently witnessed in New England: earthquakes, the deaths of some New England leaders, crop disease, drought and early frosts. The accumulation of these woes alongside the comet was a clear sign, “[b]y all which doubtless the Lord calls upon New-England to awake and repent”.<sup>84</sup> Danforth concluded with a coruscating astral metaphor, comparing sinners to wandering stars in the darkness, and pure individuals to shining fixed stars, illumined by the solar rays of God’s grace.<sup>85</sup>

Danforth’s commentary, despite its hybridisation of astrological and theological reasoning, seems to have attracted some interest and approbation from natural philosophers. John Winthrop the Younger, governor of Connecticut, for instance, sent a copy of Danforth’s tract to the naturalist Robert Boyle.<sup>86</sup> The timing — two months after the Great Fire of London — may well have been coincidental, but given the doleful cometary speculation in England, and William Lilly’s interrogation

---

83 Danforth, 19.

84 Danforth, 21.

85 Danforth, 22.

86 "I have one of those little tracts about the comett which I heirewith make bold to present to your honour": John Winthrop the Younger to Robert Boyle, 29 October 1666. Robert Boyle, *The Correspondence of Robert Boyle*, ed. Michael Hunter, Antonio Clericuzio, and Lawrence Principe, The Boyle Project edition (Charlottesville, Va: InteLex Corporation, 2004), vol. 3, 258-59. Winthrop also mentioned the tract in a second letter dated 25 July 1668, in which he expressed uncertainty as to whether his previous correspondence had reached Boyle. *The Correspondence of Robert Boyle*, vol. 4, 80-84. Winthrop was in England in the 1660s obtaining a charter for Connecticut and managed to gain acceptance to the Royal Society as a Fellow, contributing two papers on natural curiosities in New England and the uses of maize. It was probably at this time that he made the acquaintance of Boyle.

about the Great Fire, this was certainly a time of fervid speculation on the relationship between disasters and the heavens. Indeed, the tract proved interesting enough to be reprinted in London, with a short preface by John Booker, who praised Danforth's skillful observations. Booker allowed that "every man is left to his own opinion" as to the comet's "Judicatory" significance, but added (rather carefully) that he believed "That God hath sent it as an Heralld, to proclaim great and wonderful mutations to happen in the World".<sup>87</sup> In New England, Danforth's pamphlet inspired other writers to assemble lists of disasters following comets. In 1669 the separatist Secretary of Plymouth Colony, Charles Morton, added to the examples "which Mr. Samuel Danforth hath Religiously observed" a number of calamities attending comets in the fifteenth and sixteenth centuries, when a major earthquake struck Lisbon, "sundry unheard-of Diseases were felt, Rivers dried up, and Plagues were increased".<sup>88</sup> In addition, by the time of writing Morton felt able to verify Danforth's predictions from the 1664 comet in the calamities of the intervening period: the Great Plague, the Anglo-Dutch war and the capture of St Kitts by the French, along with storms, drought and crop disease in New England itself.<sup>89</sup> John Josselyn's *Chronological Observations of America* (1674) concurred in the "many sad effects" the comet had produced in New England's agriculture.<sup>90</sup>

In late 1680 and early 1681 further comet sightings caused widespread anxiety and engendered another set of woeful predictions from astrologers and churchmen. The debates that ensued were both heated and vast in scale: across the Atlantic world scholars argued about what the comet was, if

---

87 Samuel Danforth, *An Astronomical Description of the Late Comet or Blazing-Star: As It Appeared in New England in November, December, January, and in the Beginning of February 1664 : Being the First and Greatest of the Three Comets Which Was Seen at London and Elsewhere in Europe : Together with a Brief Theological Application Thereof* (London: Printed at Cambridge in New England, and now re-printed at London for Peter Parker, and are to be sold at his first shop, 1666), A2r-v.

88 Nathaniel Morton, *New-Englands Memoriall, or, A Brief Relation of the Most Memorable and Remarkable Passages of the Providence of God Manifested to the Planters of New-England in America with Special Reference to the First Colony Thereof, Called New-Plimouth* (Cambridge, MA: Printed by S.G. and M.J. for John Usher of Boston, 1669), 170–71.

89 Morton, 172.

90 John Josselyn, *Chronological Observations of America, from the Year of the World to the Year of Christ, 1673* (London: Printed for Giles Widdowes, 1674), 392.



it was a single comet or two, how it came about and what (if anything) it portended. In New France, the “extraordinary prodigy which appeared in the sky once more disturbed people's minds” with fears of calamity, especially in the context of rumours about imminent warfare.<sup>91</sup> In England, the astrologer John Goad wrote to Ashmole predicting an “Earthquake which I believe will be felt in some parts of Europe [...] the Gazets may bring us news of it a month after”.<sup>92</sup> The naturalist John Evelyn could not decide how to interpret the comets, “which though I believe appear from natural causes, and of themselves operate not, yet I cannot despise them. They may be warnings from God, as they commonly are forerunners of his animadversions”.<sup>93</sup>

In New England, Increase Mather preached two sermons on the subject in 1681 and 1682, in which he warned his congregation that the comet was a dire admonition from God for the sins of the world.<sup>94</sup> Not even “the Lords People” would be exempt from the calamities portended by the comet, since they had not sufficiently separated themselves from the “evil world”.<sup>95</sup> But Mather cautioned that it was impossible to identify the specific types of calamities that would occur or their specific victims:

We must not be particular & positive in interpretations of things of this nature [...] to make a particular and absolute determination, that such a place, or such a person, or such a Judgment, is certainly intended thereby, is

---

<sup>91</sup> Thwaites, *The Jesuit Relations and Allied Documents; Travels and Explorations of the Jesuit Missionaries in North America (1610-1791)*, vol. 63, pp. 222–23.

<sup>92</sup> John Goad to Elias Ashmole, December 1680. Bodleian MS Ashmole 368, f. 89r.

<sup>93</sup> John Evelyn, *The Diary and Correspondence of John Evelyn*, ed. William Bray, New edition (London: George Bell and Sons, 1908), vol. 2, pp. 154–55. In the same diary entry Evelyn noted “a meteor of an obscure bright colour, very much in shape like the blade of a sword, the rest of the sky very serene and clear. What this may portend, God only knows; but such another phenomenon I remember to have seen in 1640, about the trial of the great Earl of Strafford, preceding our bloody Rebellion. I pray God avert his judgments!”

<sup>94</sup> Increase Mather, *Heavens Alarm to the World, or A Sermon Wherein Is Shewed, That Fearful Sights and Signs in Heaven Are the Presages of Great Calamities at Hand*. (Boston: Printed by John Foster, 1681). The second edition also included the second sermon: Increase Mather, *Heaven's Alarm to the World, or A Sermon Wherein Is Shewed That Fearful Sights and Signs in Heaven Are the Presages of Great Calamities at Hand*, The second impression (Boston in New-England: Printed for Samuel Sewall and are to be sold by Joseph Browning at the corner of the Prison-Lane next the Town-House, 1682).

<sup>95</sup> Mather, *Heavens Alarm to the World*, 1681, A2v.

too much boldness. In general, we may safely say, that there is just cause to expect; that great calamities are at hand, but what persons or places shall more eminently fall under those Judgments, is not for us to determine, but we must leave that to God, who best knows himself what to do.<sup>96</sup>

This restraint in part reflected a need to avoid the theological problem of limiting providence. Such disclaimers were not sufficient for Increase's brother, Nathaniel, who wrote from Dublin that cometary predictions in general were "extremely idle & vayne even like the rest of such astrologers predictions: For I am perswaded Comets doe no more portend the Eclipses & Eclipses no more than the constant conjunctions of the sun & moon that is just nothing at all, save onely [sic] as they may be well causes of alterations of ayr or wether [...] if they foreshignify they doe it *ex Natura* or *ex instituto*". According to Nathaniel, it was possible to make predictions of earthly tumults only from legitimate prophecy, which was to be found exclusively in the Scriptures. As for comets, it was not appropriate to read too much into them, although he also decried the "profanenes of some to jest & mock at them". Like hurricanes, earthquakes and other "works of wonder, & unusuall impositions of his power in the frame of Nature", comets should inspire a holy dread of God. "But to make any of these things teachers from God to ourselves of what is in Gods purpose to doe in the world is not I think a sanctifying of him in those works of his but rather abusing and perverting them & so a taking of his name (which is upon them) in vayne, and also a sin against the second commandment in devising to ourselves a means of knowledge & teaching which God never ordeyned to that end".<sup>97</sup>

His brother's cantankerous response indicated the delicate balance that Mather's cometary interpretations needed to find in negotiating the theological landscape. Expanding the topic of the sermons into a full-scale book project, printed in 1683 under the title *Kometographia*, Mather

---

96 Mather, 7–8.

97 Nathaniel Mather to Increase Mather, Aug 13 1683, BPL MS Am 1502 vol. 5, no. 33, ff. 1v-2r.

endeavoured to fuse providential theology with natural philosophy, astrology and apocalypticism. Like Danforth, whose tract he read, Mather cultivated natural interests.<sup>98</sup> He drew on all the astronomical texts he could obtain in Boston, including the works of Hevelius, Kepler and Riccioli, to elucidate the physical nature of comets. However, he argued against astral sceptics by pointing out that the fact that comets were natural phenomena did not invalidate their ability to act as portents.<sup>99</sup> While Mather scorned astrology, his main criticism of astrological disaster predictions was that they were too specific about the phenomena, individuals and locations involved. Such certain prognostications were often false because “a man cannot tell what shall be” (Ecclesiastes 10:14).<sup>100</sup> He considered Lilly “a blind but insolent Buzzard” for his 1652 predictions.<sup>101</sup> Nevertheless, Mather accepted many astrological ideas on the significance of comets and planetary conjunctions. He reconciled these positions by suggesting that writers could make only *general* predictions about what is *likely* to happen after a comet or conjunction, based on the weight of past experience, which could be obtained through historical research.<sup>102</sup> Importantly, Mather distinguished between destructive natural phenomena and calamities in human affairs: he claimed that comets (through the action of occult qualities) could cause droughts, floods, storms and earthquakes but they could only be portentous signs with respect to wars, persecutions, heresies and the deaths of kings.<sup>103</sup>

---

98 Mather referred to Danforth as “A Reverend and worthy Person amongst our selves (who is now ascended above the Stars)”. He also reproduced the translated verses of Du Bartas at the end of his work. Increase Mather, *Kometographia. Or A Discourse Concerning Comets: Wherein the Nature of Blazing Stars Is Enquired into: With an Historical Account of All the Comets Which Have Appeared from the Beginning of the World unto This Present Year, M.DC.LXXXIII...* (Boston: Printed by S[amuel] G[reen] for S[amuel] S[ewall] And sold by J Browning at the corner of the Prison Lane next the town-house, 1683), 113–14, 143.

99 Mather, 18.

100 Mather, 141–42.

101 Mather, 111–12.

102 Mather, 142.

103 Mather, 132–34.

Mather's hybrid analysis allowed him to produce a multi-layered reading of the comets of 1680-81 and 1682. On the one hand, he saw the comets as having a special significance for New England: they were a continuation of the sequence of judgements of the 1670s (King Philip's War, fires in Boston, storms in Connecticut and smallpox), signalling that worse calamities were to follow.<sup>104</sup> But he also thought the comets were warnings to the whole world about a "Day of Trouble" that would bring forth many kinds of disasters.<sup>105</sup> Already the 1680 comet had produced great floods in the Netherlands, storms in Sicily and fires in Moscow and Pskov.<sup>106</sup> Finally, the apparently increasing frequency of comets constituted a sign that the End Times were approaching, since the Bible had prophesied "fearful sights and great signs" in the heavens as heralds of the Apocalypse.<sup>107</sup> He thought the apocalyptic significance of the 1682 comet in particular was confirmed by its coincidence with important conjunctions of the superior planets.<sup>108</sup> Among other things, Mather suggested that the recent comets could portend the marching of a huge Turkish army against the Holy Roman Empire and the last sounding of the second trumpet mentioned in Revelations.<sup>109</sup>

Moreover, Mather followed Danforth in attempting to ground his interpretation of the comet as a portent on solid evidentiary ground, by collecting examples of comets and their attendant calamities. In *Heaven's alarm*, he claimed that there had been 158 comets up to 1680 (of which only about a dozen occurred before Christ) but additional research allowed him to revise the number up

---

104 Mather, *Heavens Alarm to the World*, 1682, 29–30; Increase Mather, *The Latter Sign Discoursed of, in a Sermon Preached at the Lecture of Boston in New-England; August, 31. 1682. Wherein Is Shewed, That the Voice of God in Signal Providences, Especially When Repeated and Iterated, Ought to Be Hearkened Unto* (Boston: Printed for Samuel Sewall, 1682), 27–29.

105 Mather, *Heavens Alarm to the World*, 1682, 28–29.

106 Mather, *Kometographia*, 124–28.

107 Luke 21:11. Mather, *Heavens Alarm to the World*, 1682, A3v.

108 Mather, *Kometographia*, 136–38.

109 Revelations 8:8 ("And the second angel sounded, and as it were a great mountain burning with fire was cast into the sea: and the third part of the sea became blood"). Mather, 121–22. Mather claimed (pp. 47-48) that the second angel had previously sounded his trumpet to announce the fall of the Roman Empire.

to 415 in the *Kometographia*.<sup>110</sup> For those that had occurred in the past, he searched histories and encyclopedic works, including those of Johann Heinrich Alsted, as well as existing cometary compilations such as Govaart Wendelen's *Teratologia cometica* (1652). From these sources Mather was able to produce an extremely detailed chronology of comets and the notable events that followed them. Highlights included the Biblical Deluge, the destruction of Jerusalem in 70 CE, the Black Death of the 1340s and the Turkish capture of Constantinople in 1455.<sup>111</sup> More recently, he thought that the comet of 1664-65 had heralded the Great Plague and the Great Fire.<sup>112</sup> He combined this research with information from his large network of correspondents in New England and elsewhere. In 1681 John Russell, a minister at Hadley, furnished an account of "that awfull stretching out of [God's] sword over us in the latte Comatt", giving some brief observational notes and connecting it to "other portentous warnings the Lord is giving us" in the form of mysterious sounds of gunshots and drums.<sup>113</sup> Edward Taylor, minister at Westfield, supplied a detailed report of a blazing star and a black streak in the sky.<sup>114</sup> Others speculated on different astral portents: the preacher Thomas Cobbet described a cross through the moon on Christmas Day 1681, which he took as a portent for the "spread of popery east west north & south".<sup>115</sup> With a view to the standards of credibility that he knew were needed in establishing the truth of accounts of wonders, Cobbet checked his observations against those of fourteen "credible persons".<sup>116</sup> The *Kometographia* thus represented an important attempt to combine several traditions: the theological reading of signs, apocalyptic prophecy, natural astrology and modern astronomy. Above all, it tried to reconcile an interpretation

---

110 Mather, *Heavens Alarm to the World*, 1681, A2r; Mather, *Kometographia*, A4v.

111 Mather, *Kometographia*, 24–25, 39–40, 82, 88–89.

112 Mather, 118–19.

113 John Russell to Increase Mather, March 28, 1681, BPL MS Am 1502 vol. 4, no. 6.

114 Edward Taylor to Increase Mather, March 22, 1683 (N.S.), BPL MS Am. 1502 vol. 5, no. 6.

115 Thomas Cobbet to Increase Mather, February 19 1682, BPL MS Am 1502 vol. 5, no.s 4-5.

116 Russell reported the same sight at Hadley: "what it may portend I know not". John Russell to Increase Mather, 20 February, 1682 (NS), BPL MS Am. 1502 vol. 4, no. 32.

of comets as portents with recent currents in disaster research: the comprehensive collection and compilation of data, the exploitation of correspondence networks and an attention to standards of credibility.

The 1680s was also a crucial decade for astral speculation in Spain. One anonymous Spanish writer, for instance, insisted in a handwritten prophecy that the comet of 1680-81 heralded massive divine punishments, but curiously thought that these would not happen immediately: the delayed effects of the comet would combine with the fatal influences of later eclipses and powerful conjunctions in the years 1682-83, and these combined malefic energies would generate mega-disasters that would together reshape the world. Ice, intense heats and great droughts would in turn bring about epidemics and infections of the air. Wars, desolations and Turkish invasions would follow, along with rebellions, dissensions, conspiracies, the deaths of great men and women, great alterations in religions and the emergence of a new sect. An entirely new monarchy would be created, "not without wars and great effusion of blood".<sup>117</sup> These sorts of alarming predictions generated a large debate in Spain over both the legitimacy of astrological cometary interpretation and the credibility of astrology in general.<sup>118</sup> Vicente Montano argued in two tracts that the comets followed a supralunar path set by God (thereby contradicting Aristotle), and that they accordingly had nothing to do with terrestrial events. Meanwhile, the doctor Gaspar Bravo de Sobremonte directly attacked astrology, pointing out that it made no sense to associate disasters with comets,

---

117 "[...] no sin gurras [sic] y gran efusion de sangre". "Difinicion [sic] del cometa del ano de 1680", BL Add MS 14002, ff378r-379r. For the quote see f. 379r.

118 Some of the key texts in the debate were: Vicente Montano, *Discurso astronomico que dedica al Excelentissimo señor Duque de Alburquerque ... del Consejo de Estado, y Capitan General de la Armada, y exercito del Mar Oceano* (n.p.: n.p., n.d.); Montano; Andrés Dávila y Heredia, *Respuesta a la piedra de toque, en que se descubren los quilates de los Pareceres sobre el Cometa que se ha visto en el mes de Diziembre passado de 1680, Escrito por el Abad Don Iuan Brano de Sobre-Monte* (Madrid: n.p., 1681); Miguel de Yepes, *Discurso theologico y filosofico contra la Astrologia, y los que la professan, y juizio de el Cometa que se ha visto en este Orizonte de Madrid, desde 23. de diziembre de el año passado de 1680. hasta el dia de oy 11 de enero de 1681* (n.p.: n.p., n.d.); Anon., *El Pobre del Carreton, contra los Papeles, que han salido a luz con nombre de Don Andres Davila y Heredia, Señor de la Garena, Capitan de Cauillos, è Ingeniero Militar - Fondos Digitalizados de la Universidad de Sevilla* (n.p.: n.p., n.d.).

since if every calamity had a comet there would be more of them in the sky than stars. On the other side, the military engineer Andrés Dávila y Heredia and the military officer Alonso de Zepeda y Adrada both defended the status of astrology as a predictive science. One possible interpretation of this debate is to read it as an indication of a wider crisis in astrology, perhaps incited or aggravated by the broad programme of the *novatores* — Spanish intellectuals concerned to import and assimilate modern natural philosophy.<sup>119</sup> However, it is difficult to distill such a concrete position from the texts. The terms of the debate in Spain at this time were quite different to those in France and England, because they tended to turn on the correct interpretation of Aristotle, the accuracy of astrologers' predictive claims, and the theological status of astrology. As such, they embodied a scepticism that was rational but not necessarily commensurable to the dominant currents in natural philosophy outside Spain.

It was the anticipated threat to existing monarchs that energised other Spanish writers, given the traditional association of comets with the deaths of kings. One pamphlet by Luis de Aldrete (or Alderete) y Soto set out to prove that this was merely a misunderstanding, and that a comet such as this could actually be a *positive* augury for (Catholic) rulers. Aldrete was a permanent councillor (*regidor perpetuo*) in Málaga and also the city's chief lawyer (*procurador mayor*), as well as a chief bailiff (*alguacil mayor*) of the Spanish Inquisition, and wrote widely on alchemy, medicine and astrology. Most controversially, he claimed to have discovered a panacea that he called the "water of life". His successful advertisement of this cure-all led to a serious confrontation with prominent Spanish doctors, and he may even have significantly shortened his life through ingesting the concoction

---

119 This is the interpretation advanced in Navarro Brotóns, "La astronomía," 315. However, Navarro Brotóns also points out that not all the participants of the debate were proponents of the new cosmology or were willing to deny celestial influences entirely.

himself.<sup>120</sup> Aldrete began his interpretation of the 1680 comet by insisting that there were no straightforward lessons to be derived, since “[t]here is nothing more difficult than the interpretation of Comets”.<sup>121</sup> This difficulty arose firstly because the point of origin of comets was unknown, or could only be conjectured, and secondly because their moral significance was ambiguous: God could use them both to punish and reward, and a given comet might indicate the punishment of some people and the reward of others.<sup>122</sup> When comets presaged wars, some gained from them and others lost out.<sup>123</sup> Aldrete went so far as to reverse the usual providential interpretation of these phenomena: where other interpreters suggested that comets were sent directly by God to scourge sinners, here he argued that providence actually intervened to temper the natural fatal influences of comets.<sup>124</sup> For instance, Tycho Brahe had been correct in interpreting the comet of 1572 as the augury of the birth of a great prince who would conquer all of Europe, but since this prince turned out to be a Protestant heretic — the Swedish king Gustavus Adolphus — God would not allow the prophecy to come to pass, and so directly intervened to arrange Gustavus’ death before it could be fulfilled.<sup>125</sup> Comets were certainly divine warnings and instructions for moral reformation, but they

---

120 José María Laza Rojas, “Nuevos Datos Acerca de Luis de Aldrete y Soto,” *Boletín de La Sociedad Española de Historia de La Farmacia* 7 (1956): 68–73; Julio Mathias, *Don Luis de Aldrete y Soto, regidor perpetuo de Málaga, alguacil mayor de la Inquisición y curandero; notas para un estudio biográfico*, Edición Angel Caffarena (Málaga: Librería Anticuaria El Guadalhorce, 1965). For the Paracelsian elements of his medical ideas, see J. M. López Piñero, “Paracelsus and His Work in 16th and 17th Century Spain,” *Clio Medica* 8, no. 2 (1973): 133–34; Miguel López Pérez, “Los hijos de Paracelso,” *Studia Hermetica Journal* 6, no. 2 (2016): 72, 76.

121 “No ay cosa mas dificultosa, que el juicio de los Cometas”. Luis de Aldrete y Soto, *Discurso del cometa del año de 1680* (n.p.: vendese en la imprenta de Lucas Antonio de Bedmar, 1681), A1v–2r. The copies of the text held by the Biblioteca Nacional de España, the Real Academia de la Historia and the British Library all lack title pages and prefatory licensing and censorship material. I have followed the general practice of citing the short title, but the long title, as signalled at the end of the text, probably began: “Lus, Telo, y Trono de Dios”. This is indeed how Aldrete referred to the pamphlet himself later: Luis de Aldrete y Soto, *Discurso del cometa deste año de 1682 ...: en que se explica la significación y aparato que trae en execucion del antecedente del año passado de 1680 ..* (Madrid: vendese en la imprenta del Reyno de Lucas Antonio de Bedmar, 1682), 2.

122 Aldrete y Soto, *Discurso del cometa del año de 1680*, A1v–2r.

123 Aldrete y Soto, A3r.

124 Aldrete y Soto, A3r.

125 Aldrete y Soto, A4v.



did not have power independent of the divine will, nor could they cause or portend the death of the rulers whom God favoured.

On the other hand, Aldrete thought that the physical characteristics of the comet (for instance, the size of its tail and its colour), combined with the effects of the conjunction of Saturn and Mars and the influences of other planets, did indeed augur a hail of disasters. The fact that the comet was in an aqueous sign (Cancer) meant that there would be frequent floods, insecure navigations, death and scarcity of fish, extreme winds, sea storms, shipwrecks and unseasonable rains. Watery signs such as this also engendered heresies and the growth of Islam.<sup>126</sup> Because Cancer was a feminine sign, it promised the death or fall of a great lady, while the dominion of Mars augured "*cruelissimas*" wars and plagues.<sup>127</sup> The participation of Venus in this particular combination and location promised new heresies and "distress to Mortals", rebelliousness of subjects, and bad harvests.<sup>128</sup> Finally, the eastern origin of the comet signified conflicts between kings, the fall of many magistrates, locust swarms, and worm infestations in fruit trees.<sup>129</sup> The good news was that Spain would be in large part immune to these terrible things, because it was the "Column of Faith", and therefore afforded special protection by providence.<sup>130</sup> Since God had overcome the effects of the 1572 comet by killing Gustavus Adolphus in order to strengthen the Catholic Church, He would again intervene to bend the natural effects of the present comet and deliver the champion of the Church from ruin. Instead, the devastation would particularly affect areas to the north (vertical to the path of the comet), and regions where the sign of Cancer predominated. Hungary, France, Bohemia and Italy would suffer, and "the Imperials [i.e. Germans] will have to wring their hands" in

---

126 Aldrete y Soto, A2r-v.

127 Aldrete y Soto, A2v.

128 "angustias à los Morteles" Aldrete y Soto, A2v.

129 Aldrete y Soto, A2v.

130 "la Coluna de la Fè" Aldrete y Soto, A4r.

consternation.<sup>131</sup> In fact, when filtered through the matrix of Aldrete's apocalyptic thought, the blazing star was a positive sign for Spain: Aldrete applied the prophecy of Saint Malachias (allegedly medieval in origin) to the comet to suggest that the Spanish king would have a son, who would defeat the Northern powers and the enemies of the Catholic faith, and extend his dominion to the entire geographical region that lay under the shadow of the tail of the comet.<sup>132</sup>

Like Mather, Aldrete combined several traditions in his astral interpretations, and in doing so he seems to have been attempting to pioneer a reformed version of astrology. Aldrete's method mingled traditional astrology with the interpretation of prophecy, Spanish royal propaganda, a belief in universal monarchy, faith in God's direct providence and millenarianism. His position at the Inquisition may have given him a familiarity with the kinds of astrological prediction that could be safely expressed publicly, and this caution contributed to his emphasis on the limits of astral determinacy. In a text printed in the following year in which Aldrete mounted a defence of astrology, one of his ecclesiastical censors, Manuel de Guerra y Ribera — a professor of philosophy at the University of Salamanca — praised him for having elucidated once and for all the "*Astrologia Permitida*". Aldrete had finally, according to the professor, brought about the separation within astrology of "the vain from the solid, the impure from the pure, and the superstitious from the permitted".<sup>133</sup> De Guerra, whose university had a long tradition of teaching astrology,<sup>134</sup> expressed delight at reading Aldrete's tract, since "it caused me pain to see that, without distinguishing between Abuse and [genuine] Practice, between Prudent Conjectures and Rash Credulities, a Science should

---

131 "los Imperiales necesitaràn de menear las manos". Aldrete y Soto, A2r.

132 Aldrete y Soto, A4r.

133 "lo vano, de lo solido; lo impuro, de lo puro; y lo supersticioso, de lo permitido": 'Aprobacion del Reverendissimo Padre Fray Manuel de Guerra y Ribera...', no signature. Luis de Aldrete y Soto, *Defensa de la la astrologia, y conjeturas por el Apocalypsi de los años en que se extinguira la secta mahometana, y año en que nacera el Ante-Christo ...: y explicación de las profecias que acerca desto predicó San Vicente Ferrer* (Madrid: por Lucas Antonio de Bedmar, 1681).

134 Navarro Brotóns, "La astronomía," 294.

be generally condemned, to which the Universities have opened their Doors, and whose rites many Savants perform”.<sup>135</sup> In a briefer note of approval, Lucas Loarte, a preacher, theology teacher and resident of the Convento de Santo Tomás in Madrid, congratulated Aldrete on having taken labours to become acquainted with “the proper use of the Good Astrology, and to distinguish it from the Judicial type”.<sup>136</sup>

Unlike Mather, however, and despite mentioning Tycho, Aldrete displayed little awareness of or interest in current astronomical work. De Guerra’s comments hinted at a growing antagonism to astrology in Spain at this point, but whereas in England one response to that growing scepticism was the production of a “rational” astrology along the lines of mechanical philosophy, for both de Guerra and Aldrete the answer lay in more securely fusing astral prognostication with Christian doctrine. Nevertheless, like other astrological writers of his time, Aldrete felt under pressure to prove the relationship between comets and terrestrial events, rather than simply proclaiming it or referring to textual authorities. In a pamphlet of 1682 he compiled a list of comets and their succeeding effects — both calamitous and beneficial. In some cases he felt confident in linking the astral location and properties of a given comet with the events it heralded, thereby extracting general principles. He revealed that a comet in 1264, for instance, preceded the defeat of Manfred, king of Sicily, Moorish incursions in Spain and the invasion of Christian Armenia by the “king of the Babylonians and the Assyrians”. The comet of 1516 “denoted the War that the Heretic Luther was

---

135 “me causò dolor, ver, que sin distinguir entre Abuso, y Exercicio; entre Prudentes Conjecturas, y Temerarias Credulidades, se condene una Ciencia en general, que las Universidades la abren sus Puertas, y muchos Sabios la consagran sus Vigilias”. Aldrete y Soto, *Defensa de la la astrologia, y conjecturas por el Apocalypsi de los años en que se extinguira la secta mahometana, y año en que nacera el Ante-Christo ...*

136 “conocer el uso de la Buena Astrologia, y distinguirla de la Iudiciaria”: ‘Aprobacion del muy Reverendo Padre Presentado Fray Lucas Loarte...’, no signature. Aldrete y Soto.

to make against the Church”.<sup>137</sup> The 1680 comet, meanwhile, had presaged a major earthquake that October in Málaga, sicknesses, arthritis, apoplexies, financial fraud, and many other misfortunes.<sup>138</sup> Aldrete’s counsel was to heed the comets as “extremely clear Signs, that the Most High stamps on the Firmament”.<sup>139</sup> Just as the Lord’s perfect justice meted out both mercy and severe correction, comets represented “the Hieroglyphic Light of Reward and Punishment”.<sup>140</sup> He advised speedy repentance and moral reform in order to avoid a further divine warning, and to encourage God to incline towards mercy rather than chastisement by means of earthly calamities.<sup>141</sup>

Where Aldrete tried to show that the comet of 1680-81 would have no injurious effect on his own country, other writers denied that it would produce any harm at all. The most powerful and audacious criticism of the connection between comets and disasters came in the *Pensées diverses sur la comète* (three editions: 1682, 1683 and 1699) by the Huguenot Pierre Bayle.<sup>142</sup> Initially published anonymously, the *Pensées diverses* trod a thin line between sceptical philosophy and heterodoxy. Following the model of Pierre Petit, Bayle decided not to formulate his text as a diatribe against astrology but against an incorrect providential reading of comets. It may be that he considered French astrology to be so discredited among intellectual circles by this point as to make further attack superfluous, or that confronting pious myths better conformed to his ulterior motive to attack religious superstition. In any case, Bayle’s depiction of the strength of his opposition indicates that the expectation of disaster as a consequence of comets and eclipses was still a powerful intellectual

---

137 “denotó la Guerra que el Herege Lutero avia de hazer à la Iglesia”. Aldrete y Soto, *Discurso del cometa deste año de 1682 ...*, 2.

138 Aldrete y Soto, 2–6.

139 “Los Cometas son evidentissimas Senales, que estampa el Altissimo en esse Firmamento”. Aldrete y Soto, 1. This message seems to contradict that of the earlier text, in which Aldrete described the omens presented by comets as very complex and difficult matters.

140 “Es la Luz Hyeroglífico del Premio, y del Castigo”. Aldrete y Soto, 1.

141 Aldrete y Soto, 9.

142 Pierre Bayle, *Pensées diverses sur la comète*, ed. Hubert Bost and Joyce Bost (Paris: Flammarion, 2007).

force at this point. Whatever the status in France of the older strains of Ptolemaic astrology and the various flavours of reformed astrology by the 1680s, it is clear that a Christian brand of cosmological interpretation exerted a significant hold on the educated public. According to a biographer, Pierre des Maizeaux, Bayle was motivated to write the *Pensées diverses* by a desire to address the public alarm about the comet, since “[t]he people, that is to say, almost everybody, was seized with terror and astonishment on account of it”.<sup>143</sup> In the course of his debates on the best way to interpret the phenomenon, Bayle claimed to have made no headway using “philosophical reasoning”, and attributed this to the deeply entrenched connection within the popular mind between astral interpretation and providentialist doctrine.<sup>144</sup> He complained that he found it useless to try to persuade people that comets could not physically cause or signify dire events on earth, because they simply replied to his arguments that God intended them as warnings: “[y]ou may reason as best you can with people entertaining these thoughts: you will never gain anything thereby. The more your reasons drawn from philosophy shall be convincing, the more it will be imagined that they are subtleties wantonly invented to play with the truth and to embarrass good souls”. As a result, the wily critic decided that his best course of action was to meet his interlocutors on their own turf and use “against the presages of comets, the same weapons belonging to piety and religion that have been used until now in favour of these presages”.<sup>145</sup>

As with earlier sceptical attacks, the outward justification for Bayle’s work was to relieve the populace of a great fear that had arisen purely from error. Bayle acknowledged that some errors were socially useful, since they led people to pious acts. But he argued that the error of connecting

---

143 “Le peuple, c’est-à-dire, presque tout le monde, en étoit saisi de frayeur & d’étonnement”. Pierre des Maizeaux, *La Vie de Mr Bayle*, Nouvelle édition, vol. 1 (La Haye: Chez P. Gosse & J. Neaulme, 1732), 63.

144 “les raisonnemens philosophiques” Des Maizeaux, 1:63.

145 Pierre Bayle, *Various Thoughts on the Occasion of a Comet*, trans. Robert C. Bartlett (Albany: State University of New York Press, 2000), 4–5.

comets to disasters and other misfortunes was useless for producing moral reformation. The reason for this was that the threat they offered was not specific enough.<sup>146</sup> In an attempt to respond systematically and definitively to the proposition that comets caused or signified terrestrial *malheurs* (misfortunes or calamities), Bayle compiled a whole list of fortunate events that had occurred after comets in the past, and conversely prepared a list of *malheurs* that happened in periods when no comets had been seen.<sup>147</sup> His conclusion was that comets had no noticeable impact on the number or intensity of *malheurs*. In addition, he declared that many of the misfortunes that astrologers predicted were reliant on a vast array of contingencies.<sup>148</sup> Wars required not just a celestial movement but the active intention of belligerent parties. The problem was that comets threatened calamity “only in a vague and confused way”, and that lack of specificity was useless for grounding any kind of constructive response.<sup>149</sup> The implication was that the category of *malheur* itself made no sense: it was too diffuse, the causative nature of its components so hopelessly diverse that they did not belong together. Bayle himself provided no alternative, however: his own catalogues of fortunes and misfortunes took the basic concepts of *bonheur* and *malheur* at face value. But by eviscerating the notion of cosmic movements as the causes or signifiers of the wide spectrum of terrestrial events, he suggested that destructive phenomena should be considered in the light of their earthly causes alone. In a long digression from the subject of comets, Bayle considered the relationship of religion and virtue in human actions. The implicit lesson from this analysis was that calamities that could be said to have human causes — wars, rebellions, assassinations, religious tumults etc. — should be detached from a unitary category of misfortunes. By effectively robbing natural astrology of the

---

146 Bayle, 8.

147 Bayle chose an arbitrary period of seven years as the maximum time in which a comet could reasonably be said to exercise influence.

148 Bayle, *Pensées diverses sur la comète*, 312–15.

149 Bayle, *Various Thoughts on the Occasion of a Comet*, 8.

ability to explain societal misfortunes, he turned *malheur* either into a class of events about which nothing could be said certainly (when considered as a unity), or one that should be separated into human and natural domains. The first domain should be the purview of philosophers or theologians, the other of natural philosophers.

Bayle's assault on cometary predictions was only one of many contemporary critiques. In 1680 the French periodical the *Mercure Galant* announced that "it is always certain that in the most frightening Comets there is nothing that should make us afraid, & that they are merely the games of Nature, that our ignorance alone renders terrible".<sup>150</sup> By 1682 French royal propaganda had deprived the comets of any relationship with disasters and recast them as propaganda, by using them as auguries of an illustrious future for the newborn grandson of Louis XIV.<sup>151</sup> As astrologers came under increasing fire for their disaster predictions by critics they sought ways to reformulate their epistemology in a more defensible fashion. One response in England was the creation of a reforming project that attempted to purge astrology of its "superstitious" and magical elements and make it conformable to the rational principles of modern natural philosophy. This programme was not the final, futile gesture that some historians have claimed.<sup>152</sup> Astrology was hardly a static science in the first place: it had undergone major adaptations in the journey from pagan antiquity to Christian Europe via the Muslim world, and again when its practitioners switched from providing advice to princes to printing prognostications. Now several leading astrologers made serious attempts to bring their craft into line with emerging standards of credibility and with an emphasis on hard observational data and comparative analysis. Part of the reforming project included a new

---

150 "Quoy qu'il en soit, il est toujourn certain que les Cometes les plus affreuses n'ont rien qui nous doive épouvanter, & que ce ne sont que des jeux de la Nature, que nostre ignorance seule nous représente terribles". *Mercure Galant*, December 1680, pp. 176-277.

151 *Mercure Galant*, December 1682, p. 225.

152 Geneva, *Astrology and the Seventeenth Century Mind*, 282.

emphasis on natural astrology, which was to be at the heart of a “sane” or “healthy” astrology. One of the chief tasks of the new rational astrology would be to provide robust, accredited explanations and predictions of disasters. But in the critical atmosphere of the 1680s that wide ambit seemed problematic: natural astrology had always claimed the ability to predict human commotions, but now it seemed wise to some practitioners to minimise potential criticisms by restricting its remit to an astrally-informed version of classical meteorology. In his *Cardines Cæli* (1684), the English astrologer John Gadbury set out six kinds of astral interpretation, ranked in order from least to most technically demanding and important. On the lowest tier he placed the rustic forecasting of shepherds and country-folk, on the third the astronomers who merely observed the planetary movements and calculated the times of eclipses. The highest gradient was genethliac astrology — the judicial interpretation of genitures (nativities). Just beneath that lay astral meteorology, the science of explaining and predicting disasters. Here he invoked the figure of “the happy *Meteorologist*, who consults all the *various motions* of the *Air, Winds, and Seas* [...] and thence acquaints us with *Tempests, Lightnings, Thunders, Earth-quakes, Inundations, Plagues, &c.*”<sup>153</sup> He made no mention of the “civic” disturbances of wars, rebellions and schisms that had been such an important part of natural astrology in the past — in his view, practitioners of astral meteorology evidently did not concern themselves with calamities in the human realm. However, Gadbury neither abandoned judicial astrology completely nor restricted its truths to those observable through empirical work alone. He knew that the existence of a large and ancient corpus of textual authorities continued to form a powerful argument for the validity of astrology. He was equally happy to draw on this source of validity to confound an opponent: “[t]he several large Tomes of Ptolemy, Gauricus, Cardan, [etc....]

---

153 John Gadbury, *Cardines Cæli, or, An Appeal to the Learned and Experienced Observers of Sublunars and Their Vicissitudes Whether the Cardinal Signes of Heaven Are Not Most Influential upon Men and Things...* (London: sn, 1684), 40.



are not to be blown away with so light a breath, as this my Antagonist imagines. The weighty and excellent Reasons of these Learned Men will not be overcome, or fall into a Swoun, at the Scent of his Perfum'd Socks".<sup>154</sup>

The new rational astrology achieved its peak of sophistication in the work of John Goad, whose massive *Astro-meteorologica* (1686) presented a pioneering attempt to turn natural astrology into a credible, empirical science.<sup>155</sup> Goad employed a raft of techniques to achieve this goal. Firstly, he combed through news reports and histories for the most accurate reports he could find on disastrous phenomena. To these he added what he considered an authoritative source, the diary of Johannes Kepler, as well as several decades of his own observations. From this voluminous assemblage of evidence he extracted long lists of the dates of earthquakes, storms, floods and epidemics, as well as rains, winds and other phenomena, which he presented in tables alongside the planetary conjunctions present at their occurrence. He explained the connection between comets and catastrophes neither through correspondences and occult qualities nor the theological language of divine signs, but rather by arguing that both the terrestrial and celestial phenomena shared a single set of mechanical causes, which could be traced to planetary origins. This was the reason, for instance, that comets were variously followed by earthquakes, floods and epidemics.<sup>156</sup> Goad also made some attempt to be cautious not to claim more than the evidence allowed. For instance, he acknowledged uncertainty about Ptolemy's claim that the opposition of Saturn and Mars caused major fires. Goad concluded that the only way to link the two was to limit the conflagrations to

---

154 Gadbury, 41.

155 John Goad, *Astro-Meteorologica, or Aphorism's and Discourses of the Bodies Coelestial, Their Natures and Influences: Discovered from the Variety of the Alterations of the Air, Tempeperate [Sic], or Intemperate, as to Heat or Cold, Frost, Snow, Hail, Fog, Rain, Wind, Storm, Lightnings, Thunder, Blasting, Hurricane, Tuffon, Whirlwind, Iris, Chasme, Parelj, Comets Their Original and Duration, Earthquakes, Vulcano's, Inundations, Sickness Epidemical, Maculae Solis, and Other Secrets of Nature* (London: Printed by J Rawlins for Obadiah Blagrove, 1686).

156 Goad, 149.

wildfires that were started by excessive heat, and to house fires begun by lightning strikes, suggesting that other instances (where human activity was involved as a causative agent) would relate to direct divine providence. Of this latter he noted: “I am not engaged to meddle in it; nor do I believe it can, or will be ever made out: The Effects which we teach have a *natural* dependance on their Causes; as Rain depends on Heat, as the Colour of the Rainbow depends on Light”.<sup>157</sup> However, he was not slow to emphasise the practical utility of his astro-meteorology in connection with disasters, which he thought far exceeded that of the speculative discussions of natural philosophers. Since disasters, like other natural phenomena, obeyed regular laws, the skilled practitioner could detect the processes that produced them and offer advance warning. Goad claimed to be able to predict not only comets but also epidemics and earthquakes, though he suggested that the complexity of their causes deserved three additional treatises.<sup>158</sup> However, he criticised the parochial nature of his contemporaries’ concerns with epidemics, and instead urged them to extend their awareness to a global scale:

We can easily believe that *Constantinople*, or *Grand Cairo* is never free [from disease], yet we are not troubled at the report. But if we are concerned, as I think we ought, for those that are *abroad* also; and if we keep Correspondence in most parts of the World, whether we like it, or no, we shall find, that somewhere or other, some Sickness, not unworthy the Note of the Curious, is brisk upon our Mortal Bodies”.<sup>159</sup>

In response to the criticism that astrology perpetuated fear and panic, Goad upheld the conventional reasoning (rejected by Bayle) that fear had religious utility, since meteorological phenomena such as thunder served as physical sermons to convert unbelievers through terror:

---

157 Goad, 402–3.

158 Goad, 11.

159 Goad, 387.

“[s]uch a rowsing Lesson may shake even an *Epicurean* into a Religious Horror; much more the plainer *Vulgar*, who are happy in this, that they have no blind *Biass* [sic] to counter-sway them from the belief of a Deity”.<sup>160</sup> In addition, however, he audaciously appropriated the same argument that natural philosophers used to safeguard their epistemology from ecclesiastical criticism, that increasing the body of knowledge about nature would increase people’s love and gratitude for the divinely created order.<sup>161</sup> But for Goad, that effect would occur because people would see with what ease the planets caused “[d]estructive Tempests, Hurricanes, vast Deluges, Lightnings, Rain, Comets, Earthquakes, Dismal Darkness, Heat and Drought extream and intollerable”, and they would therefore realise that only God’s benevolent providence kept them from living in a perpetual state of suffering.<sup>162</sup> Goad went so far as to accuse natural philosophy and “the unlucky Principle of Mechanism amongst the Learned” of limiting the potential for natural inquiries to benefit religion.<sup>163</sup> He was referring in particular to Cartesianism, “a Forein Mode of Philosophy”, which would “debauch the present Generations, defraud us of Arguments for God's Illustrious Providence, [...] and unhinge us from the Knowledge of the Creator”.<sup>164</sup> He did not necessarily extend this stern disapproval to Baconian natural philosophy. In fact Goad was a friend and regular correspondent of Elias Ashmole, to whom he sent frequent weather diaries and prognostications for the rest of his life.<sup>165</sup> But he rejected the critiques of sceptics who would empty the meaning out of astral phenomena such as comets: “[w]e are Superstitious (forsooth) if we are troubled at a Comet, because 'tis Natural; It may Portend, for all that”.<sup>166</sup> Prodigies such as the apparition of armies in the

---

160 Goad, A3r.

161 Goad, A3r.

162 Goad, 156–57.

163 Goad, A3v.

164 Goad, A3v.

165 These are to be found in Bodleian MS Ashmole 368.

166 Goad, *Astro-Meteorologica*, A3v.

air were eminently possible in Goad's world, and the only reason natural philosophers denied them was because they could not explain them.<sup>167</sup> This was an argument that on the one hand sought to set boundaries on the authority of natural philosophy, and on the other defended the diversity of a pluralistic intellectual world: there should be a legitimate and autonomous place for a rational astrology because it considered things that were simply beyond the reach of naturalists.

The long-term influence of the reformers on astrology needs to be assessed carefully, and still awaits more detailed study. There were never enough astrological reformers in Goad's time to allow an *astrologia sana* to compete effectively with natural philosophy in the interpretation of disasters. Although astrologers had their own equivalent of a scientific institution, the Society of Astrologers, which was revived several times and included among its core members the naturalist Elias Ashmole, the number of participants decreased over time and it had neither a royal charter nor a periodical to match the Royal Society's widely-disseminated *Philosophical Transactions*.<sup>168</sup> On the other hand, astro-meteorology did not encounter the scale of opposition that judicial astrologers had faced, and it seems that its fusion of astrology with natural philosophy did succeed in winning it a considerable degree of intellectual legitimacy, especially in dealing with weather-related matters. Astro-meteorology subsequently played a central role in the development of weather forecasting in the nineteenth century.<sup>169</sup> Its independent claims to authority in interpreting disasters, though never as strong as those of natural philosophy, managed to win a degree of international recognition even in ecclesiastical circles. Moreover, there is evidence to suggest that astrologers in the 1680s, at least, continued to be consulted to interpret celestial phenomena and to elucidate the relationship between

---

167 Goad, A3v.

168 See for instance Ashmole's reference to participating at "The Astrologers Feast at Painters Hall" on 1 August 1649: Ashmole, *Elias Ashmole (1617-1692)*, vol. 2, p. 492; Keith Thomas, *Religion and the Decline of Magic: Studies in Popular Beliefs in Sixteenth and Seventeenth-Century England*, New edition (London: Penguin UK, 1991), 361.

169 Katharine Anderson, *Predicting the Weather: Victorians and the Science of Meteorology* (Chicago: University of Chicago Press, 2005), 52–54.

them and terrestrial calamities. William Lilly had received letters requesting his interpretation of heavenly portents in the 1640s and '50s, and the practice apparently continued with his student Henry Coley. In January 1681 one Hosiah Heathfield wrote to Coley to report that an earthquake had coincided with the appearance of “that light in the firmament which I beleve you have seen: sum say it is a blazing star others say noe”. He entreated Coley to “give me your sereoues [serious] Judgment in these things” — by which he meant both the comet and the earthquake — from “that nobel & kingly art of astrologie”.<sup>170</sup>

The debates over the comet of 1680-81 raged not only in Europe and North America but also in the Spanish American colonies. One particularly important instance of this occurred in New Spain between the creole scholar Carlos de Sigüenza y Góngora and the Austrian Jesuit Eusebio Kino. Sigüenza had written a *Manifiesto* that explained in rational terms why the comet could not cause widespread calamity. He presented himself as performing a public service, destroying the comets’ “empire [...] over the timid”.<sup>171</sup> The recently-arrived European, however, brushed aside Sigüenza’s argument and published his own short pamphlet, in which he gave the familiar interpretation of the comet as an augury of disaster.<sup>172</sup> Sigüenza responded angrily with another publication, *Libra Astronómica y Filosófica* (“*Astrological and Philosophical Balance*”), which refuted Kino’s claims and strongly denied any connection between disasters and comets.<sup>173</sup> In 1692 the Creole scholar had the

---

170 Hosiah Heathfield to Henry Coley, January 17 1681 (N.S.), BL Sloane MS 3822 ff. 170r-v.

171 The title of this text was *Manifiesto filosófico contra los cometas despojados del imperio que tenían sobre los tímidos* (“Philosophical manifesto against comets, dispossessing them of the empire they have over the timid”). It was printed in Sigüenza’s later *Libra Astronómica y Filosófica* (cited below).

172 Eusebio Francisco Kino, *Exposicion astronómica de el cometa, que el año de 1680 por los meses de noviembre, y dizziembre, y este año de 1681, por los meses de enero y febrero, se ha visto en todo el mundo, y le ha observado en la ciudad de Cadiz* (Mexico: Por F Rodríguez Lupercio, 1681).

173 Carlos de Sigüenza y Góngora, *Libra astronómica y filosófica*, Nueva biblioteca mexicana ; 2 (México: Centro de Estudios Filosóficos, Universidad Nacional Autónoma de México, 1959). For whatever reason, Sigüenza decided not to publish the work immediately. Instead, he gave it to his friend Sebastián Guzmán y Cordova, who finally published it in 1690, after another comet had alarmed the population of New Spain. Anna More, “Cosmopolitanism and Scientific

opportunity to give his opinion on celestial superstitions once again, when massive riots took place in Mexico City, during the course of which shops were looted and government buildings set on fire. Discussing the causes of the disorders in a letter to the admiral Andrés de Pez in Madrid, he noted that the period immediately leading up to them had been marked by a series of dismal events: intense storms, flooding and infestations of crop weevils. Moreover, as the prognostications and almanacs had predicted, there was a solar eclipse for almost a quarter of an hour. The darkening of the sky had by itself caused an enormous sense of alarm:

As we did not expect it to be quite like this, as soon as the light failed [...] the Dogs [began] howling, the Women and Boys crying out, the Indians abandoning their stalls in the square where they sold fruit, vegetables and other trifles, to get themselves at full speed to the Cathedral, and the bells were rung for rogation at the same moment, not only there but in most of the Churches of the City. It really caused such sudden Confusion and Commotion that it brought shivers of terror.<sup>174</sup>

To this scene of irrational panic Sigüenza contrasted his own response: he was “extremely happy and giving repeated thanks to God for having allowed me to see what happened so rarely in a given place, and for which there are so few observations in the [astronomical] books”.<sup>175</sup> While the

---

Reason in New Spain: Carlos de Sigüenza y Góngora and the Dispute over the 1680 Comet,” in *Science in the Spanish and Portuguese Empires, 1500-1800*, ed. Daniela Bleichmar (Stanford, Calif: Stanford University Press, 2009), 117.

174 “Como no Se esperaba tanto Como Estto, al mismo instante que Faltto la luz, Cayendo Selas a Ves que iban Volando, aullando los Ferros, gritando las Mugerres, y los Muchachos, desamparando las indias Sus puestos en que Vendian en la plasa fruta, Verdura y otras Menundencias, por entrarse a toda Carrera en la Catedral y, tocandoSe arrogativa al mismo instante, no Solo en ella Sino en las mas Iglesias de la Ciudad, Se Causso de Todo Tan repentina Confución y Alboroto que Caussava grima.” Carlos de Sigüenza y Góngora, *Alboroto y motín de México del 8 de junio de 1692. Relación de Don Carlos de Sigüenza y Góngora en una carta dirigida al Almirante Don Andrés de Pez*, ed. Irving Albert Leonard (México: Talleres gráficos del Museo nacional de arqueología, historia y etnografía, 1932), 43–44.

175 “Yo en este interim en extremo alegre y dandole a Dios gracias Repetidas por haverme Consedido Ver lo que Susede en Un Determinado lugar tan de Tarde en Tarde, y de que ay en los libros tan pocas obServaciones, que estuve Con mi quadrante, y antoJo de larga Vistta contemplando al Sol.” Sigüenza y Góngora, 43–44.

populace gibbered in terror, he eagerly examined the eclipsed sun with his quadrant and telescope.<sup>176</sup> Sigüenza acknowledged that the eclipse was one of a number of factors that made the situation in the Valley of Mexico so volatile, but in his view it had no causative or monitory relationship either to the riots or to the extreme weather and other misfortunes that preceded them. Instead, he thought that the chief significance of the eclipse for Mexican society lay in the fact that the superstitious credulity of the vulgar meant that they were all too easily inflamed to dangerous disorders. Sigüenza also echoed Bayle and other French critics in assimilating astrological prognostication to a crude and ill-informed popular piety. Here he noted in particular the widespread interpretation among the *vulgo* of the storms, floods and agricultural damage as a divine punishment for recent lavish festivities in Mexico City. Since these had been organised by the Viceroy in celebration of Charles II's marriage to Maria Anna of Neuburg, the rumours of a divine judgement contained an element of sedition. Nevertheless, those who insisted on connecting the celebrations to the subsequent misfortunes reflected that past festivities in 1611 and 1676 had coincided, respectively, with earthquakes and a fire. Set beside Sigüenza's ridicule of popular reactions to the eclipse, his attitude to these providential views seems more muted and ambiguous. He seems to have been unsure whether such moral interpretations of catastrophes were in general "respectable or contemptible".<sup>177</sup> He praised the prudence of the Viceroy in the 1676 case, since on hearing the rumour that the fire had been a divine judgement he had brought the celebrations on that occasion to a close and dismantled the scaffolding in the Plaza del Volador, thereby calming popular anxieties.<sup>178</sup> Nevertheless, whatever his views on providential interpretations of disaster more generally, Sigüenza

---

176 For the way Sigüenza used scientific instruments to distance himself from the rest of the population, see Anna More, *Baroque Sovereignty: Carlos de Sigüenza y Góngora and the Creole Archive of Colonial Mexico* (Philadelphia: University of Pennsylvania Press, 2012), 175.

177 "No se si las llame venerables o despreciables". Sigüenza y Góngora, *Alboroto y motín*, 35–36.

178 Sigüenza y Góngora, 35–36.

regarded the fusion of providentialist beliefs with astrological predictions in the minds of the credulous and easily excitable *vulgo* as a recipe for social disorder on an extreme scale.

At first sight, Sigüenza's rejection of the link between comets and eclipses and calamities seems to represent a clear rejection of astrology as an illegitimate type of knowledge. Indeed, his *Libra astronómica* has been interpreted exactly this way by several generations of scholars. Early historical interpretations presented Sigüenza as a scientific moderniser, using the debate over the comet as a means to rescue colonial Latin America from its place of obscurity within the history of science and reinstating it firmly within the narrative of scientific progress.<sup>179</sup> More recently, others have sought to show that Sigüenza's conflict with the European *Kino* constituted the self-conscious assertion of a nascent creole identity and a vindication of the intellectual gravitas of the Mexican educated elite.<sup>180</sup> However, once we set the *Libra astronómica* within Sigüenza's wider *oeuvre*, its apparently clear articulation of a rational and secular astronomical position becomes rather murky. In fact, Sigüenza was not the American Bayle, but a former Jesuit who strenuously tried to avoid any appearance of conflicting with his old order,<sup>181</sup> and whose views on the power of providence are far from clear. More importantly, as part of his role as a university professor of mathematics and New Spain's chief cosmographer (*cosmógrafo mayor*), Sigüenza produced a series of almanacs in which he offered predictions of storms and illnesses in line with the principles of natural astrology. These publications have seldom been studied in detail and they are difficult to reconcile with his critique of

---

179 This was the interpretation conveyed in a highly influential biography in the early twentieth century: Irving A. Leonard, *Don Carlos de Sigüenza y Góngora: A Mexican Savant of the Seventeenth Century* (Berkeley: University of California Press, 1929). See also the critique in Kathleen Ross, *The Baroque Narrative of Carlos de Sigüenza y Góngora: A New World Paradise* (Cambridge (UK); New York: Cambridge University Press, 1993), 36–37.

180 More, "Cosmopolitanism and Scientific Reason in New Spain: Carlos de Sigüenza y Góngora and the Dispute over the 1680 Comet"; Anna More, "Thinking with the Inquisition: Heretical Science and Popular Knowledge in Seventeenth-Century Mexico," *Romantic Review* 103, no. 1/2 (2012): 111–32.

181 More, "Cosmopolitanism and Scientific Reason in New Spain: Carlos de Sigüenza y Góngora and the Dispute over the 1680 Comet," 125–26.



astrology in the 1681 comet debate. The rather convoluted argument that Sigüenza used the almanacs “to question astrology before a more popular audience”, thus “fighting against the astrological practices on which they were based” is as unconvincing as the more positivistic interpretation of the almanacs as part of an astrological roadblock in the path of Western science.<sup>182</sup> In fact, the annual prognostications indicate that Sigüenza, like many of his contemporaries, entertained contradictory views on the utility and reasonableness of astrological prediction, and he was able to switch between criticising and practising astrology on different occasions and for different audiences. In the almanac for 1692 he confirmed that the planetary preconditions of torrential rains set out by the Persian astrologer Abū Ma'shar and the Italian Franciscus Junctinus accorded with Mexico's great floods of 1625-29.<sup>183</sup> Sigüenza's prognostications covered the usual components of natural astrology: for 18 January 1692, for instance, he predicted sicknesses and storms.<sup>184</sup> In addition, he pointed out the astral conditions that favoured medical interventions: 17-19 July, for example, would be good for “medical treatments, surgery and phlebotomy, and also baths”.<sup>185</sup> Furthermore, Sigüenza's almanac for 1693 contained a discussion of eclipses which stated that calamitous periods were the joint outcome of human sins and stellar influences. While disasters were always caused by divine providence and not by the “chimerical and fantastical principles of Astrology”, God sometimes made use of the stars to punish the impious, and had preordained the days on which those judgements would take place.<sup>186</sup> Here Sigüenza stated unequivocally what he

---

182 The former argument is in More, *Baroque Sovereignty*, 247. For the latter interpretation see A. Margarita Peraza-rugeley, *Llámenme “El Mexicano”: Los Almanagues y Otras Obras de Carlos de Sigüenza y Góngora* (Peter Lang Ag, 2013), 31.

183 Carlos de Sigüenza y Góngora, “Almanaque 1692,” in *La Astrología En La Nueva España En El Siglo XVII - de Enrico Martínez a Sigüenza y Góngora*, ed. José Miguel Quintana (Mexico: Bibliófilos mexicanos, 1969), 197.

184 Sigüenza y Góngora, 201.

185 “[...] “obras de medicina, cirugía y flebotomía, y también baños”. Sigüenza y Góngora, 206.

186 “[...] principios quiméricos y fantásticos de Astrología [...]” Carlos de Sigüenza y Góngora, “Almanaque 1693,” in *La Astrología En La Nueva España En El Siglo XVII - de Enrico Martínez a Sigüenza y Góngora*, ed. José Miguel Quintana (Mexico: Bibliófilos mexicanos, 1969), 227–28.

had left ambiguous in the account of the 1692 riots that he sent to Pez: that the troubles of New Spain were the result of a divine *castigo*. However, while he made it clear that providence always trumped stellar influence, he also suggested that the solar eclipse of that year had directly contributed to the climatic deterioration behind the crop failures, as well as the extreme rainfall and a devastating measles epidemic. Overall, Sigüenza's complex attitude to disaster prediction suggested that the intellectual culture in New Spain allowed for both the development of an increasingly confident astrological scepticism *and* the persistence of astral interpretation. This eclectic mixture of ideas continued to characterise Mexican disaster knowledge well into the next century.<sup>187</sup>

The picture is similarly complicated in Peru, where an extremely syncretic natural philosophy of disaster seems to have coalesced around the middle of the seventeenth century. Most important in this respect were discussions over the causes of earthquakes, which writers explained by deploying a highly eclectic combination of intellectual traditions: direct divine providence, astrology, Hippocratic climatic notions, classical meteorology and modern natural philosophical theories. In choosing from this *mélange* of ideas, *peruanos* appear to have regarded their own country as having unique qualities that gave rise to earthquakes. From the 1630s onwards Peruvians debated whether even the celestial influences themselves were different in the new hemisphere — therefore necessitating a new “southern Astrology”.<sup>188</sup> In the second half of the century most writers denied that claim, but nevertheless pointed to the special factors that needed to be taken into account in Peru, where great topographical variation and indigenous bodies complicated the practice of natural and medical

---

187 For the continuing importance of stellar influences and divine providence in explanations for epidemics in the eighteenth century, see Donald B. Cooper, *Epidemic Disease in Mexico City, 1761-1813; an Administrative, Social, and Medical Study*, University of Texas. Institute of Latin American Studies. Latin American Monographs ; No. 3 (Austin: Published for the Institute of Latin American Studies by the University of Texas Press, 1965), 195.

188 Cañizares Esguerra, “New World, New Stars”; Claudia Brosseder, “Reading the Peruvian Skies,” in *A Companion to Astrology in the Renaissance*, ed. Brendan Maurice Dooley (Boston: Brill, 2013), 147.

astrology. Explanations that worked well in Italy or in Spain could not be assumed to be suitable in South America, and it therefore made little sense to Peruvian intellectuals to be dogmatic in constructing a causative analysis. The result was the construction over time of climatic theories that borrowed from parts of many of the available theories. The basis of selection seems to have been the pragmatic motive of finding explanations that made sense without attacking or dismissing ecclesiastical doctrine and Aristotelian principles, and that could be consistently applied to all occurrences. Unlike writers in France and England, Peruvian intellectuals possessed a long and detailed recorded history of earthquakes in their own country, against which they could test hypotheses. The Cusco disaster of 1650 offered one such case study, and an anonymous writer a century later still thought it was significant that the catastrophe took place under a conjunction of the moon and Aries.<sup>189</sup> For the rest of the seventeenth century astrology played a prominent role in causative analyses, for four main reasons. Firstly, it was sufficiently widely known among scholars in the viceroyalty to allow for collaborative work. Secondly, it offered a set of ready-made explanations, which Peruvian writers could adapt as it suited them. Thirdly, it emphasised the practice of making connected observations — of precise time, planetary conjunctions and atmospheric conditions — which could later be used to test the reliability of an explanation, or more importantly, to indicate how different explanations might need to be combined to cover all cases. Finally, astrology's traditional openness to syncretism (as a motley blend of Babylonian, Egyptian, Aristotelian, Neoplatonic, Roman, Arabic and Renaissance ideas) made it well-suited to function as a flexible framework that could be grown and adapted over time.

A few years after the Cusco disaster, the astrologer Juan de Figueroa demonstrated the power of this adaptive approach, by elaborating a detailed theory of earthquake causation. In the first place he

---

189 Anon., *Anales del Cuzco, 1600 á 1750*, ed. Ricardo Palma (Lima: Imprenta de "El Estado," 1901), 99.

drew heavily upon the conventional Aristotelian wisdom: that the sun's heat drew forth exhalations from the earth, which then became trapped in underground caverns and needed to force their way out, thereby causing convulsions.<sup>190</sup> He integrated this theory with Seneca's hypothesis that subterranean winds ignited sulphur and other combustible materials.<sup>191</sup> This union led Figueroa towards the kind of holistic explanation that characterised subsequent intellectual discussion in Peru. Earthquakes were so difficult to predict, he noted, because they required three sorts of preconditions: certain configurations of the planets and stars were crucial, but so was the accumulation of exhalations and flammable materials in the first place, which depended on "universal causes". Finally the actual occurrence of the earthquake needed a further set of "particular" causes.<sup>192</sup> We are left with a series of causative layers, each of which could conceivably involve an interaction of natural forces with direct divine providence. In general, Figueroa noted, Saturn, Mars and Mercury were the planets that ruled earthquakes, but in order to gauge their influence accurately one also needed to take into account geographical location, regional climate and current atmospheric conditions — some regions were more likely to feel commotions in the ground than others, while a dry spell followed by heavy rains offered a fairly reliable forecast of seismic activity.<sup>193</sup> The triangular link between earthquakes, celestial movements and meteorological

---

190 Aristotle, *Meteorologica*, II.7. Juan de Figueroa, *Opusculo de astrologia en medicina, y de los terminos, y partes de la astronomia necessarias para el uso della* (Lima: Observatorio de marina de San Fernando, 1660). Although it was printed in 1660, the prefatory materials make it clear that the work passed the censors and was licensed for printing in 1655.

191 Seneca, *Naturales quaestiones*, V.14.4. Aristotle also maintained that subterranean exhalations could be ignited through percussion, but his account did not envision the presence of flammable minerals: *Meteorologica*, II.viii.367a. Moreover, neither authority linked earthquakes to planetary conjunctions.

192 Figueroa, *Opusculo de astrologia en medicina, y de los terminos, y partes de la astronomia necessarias para el uso della*, 330, 332.

193 In emphasising the importance of rainfall and dry periods to earthquakes Figueroa was again following Aristotle (*Meteorologica*, II.viii.366b). This connection was widely accepted in the seventeenth century, including by leading natural philosophers in England such as John Ray and Robert Hooke, but the reason for the connection was debated.

conditions allowed for a recursive explanation: the same heavy rainfall that heralded tremors could also be the product of astral conjunctions, such as that of Saturn in Aquarius.<sup>194</sup>

The syncretic explanations of earthquakes and other disasters in Peru continued to contain a strong astrological element through the eighteenth century. One very widely circulated and reprinted account of the massive earthquake that occurred in Lima in 1746 emphasised that the catastrophe occurred while the sun and moon were nearly in opposition, the one close to the sign of Scorpio and the other to Taurus. Reflecting on the detailed physical and celestial reporting that the viceroyalty's syncretic earthquake science encouraged, its anonymous author pointed out that "[t]his Aspect [i.e. celestial configuration] has, through continual unhappy observation, always been experienced as fatal in this Climate, because within it such [seismic] movements ordinarily happen, and although they are often sluggish, sometimes their violence is truly terrifying".<sup>195</sup> The culmination of Peruvian syncretism by the end of the early modern period can be seen in Hipólito Unanue's *Observaciones sobre el clima de Lima* (1806), in which the author explained earthquakes through a combination of planetary movements, Aristotelian vapours, combustion theory, electrical hypotheses, volcanism, atmospheric heating, seasonal changes and divine wrath.<sup>196</sup> In summary, it seems clear that in Peru a durable alternative path for disaster astrology had been found, that not only incorporated the rationalising movement of the *astrologia sana* in Europe, but also fixed astrological interpretation at the core of disaster explanation.

---

194 Figueroa, *Opusculo de astrologia en medicina, y de los terminos, y partes de la astronomia necessarias para el uso della*, 333–34.

195 "Este Aspecto por una continua desgraciada observacion, se ha experimentado siempre fatal en este Clima, por que en el acaecen de ordinario semejantes movimientos, que aunque muchas veces son remissos, alguna atemeriza demasiado su violencia." Anon., *Individual, y verdadera relacion de la extrema ruina que padeció la Ciudad de los Reyes Lima, capital del reyno del Perú, con el horrible temblor de tierra acaecido en ella, la noche del 28. de octubre de 1746. y de la total assolacion del presidio, y puerto del Callao, por la violenta irrupcion del mar, que ocasionò en aquella bahia* (Lima: en la Imprenta que estaba en la Calle de los Mercaderes, 1746), A1v.

196 José Hipólito Unanue, *Observaciones sobre el clima de Lima y su influencia en los seres organizados, en especial el hombre*, ed. Carlos Enrique Paz-Soldán (Lima: Lux, 1940), 20–23.

The period between 1652 and 1692 was a turning-point for the astrological prediction of catastrophes. By associating astrology with popular panics and vulgar credulity, critics were able to diminish the authority of astrological interpretations while simultaneously lending legitimacy to natural philosophical approaches. The eclipses of 1652 and 1654 and the comets of 1664-65 and 1680-81 offered golden opportunities for sustained critique. Disaster astrology survived this crucible by a remarkable act of adaptation. The astral prediction and explanation of calamities successfully transformed into a range of different approaches, developed according to the priorities and demands of local contexts. Overall, the heated debates over comets and eclipses helped to increase the sophistication of disaster research in two ways. Firstly, they pressed the case for evidentiary standards and collaborative practices of data-gathering. Secondly, they promoted new syncretic blends of knowledge that allowed researchers to develop ambitious, multi-modal causal frameworks for disasters. Over the following decades these ideas, in combination with the new methods discussed in the previous chapter, would form the core of epistemic arrangements that prioritised the discovery of environmental interconnections.

#### Chapter 4: Expanding the scale of disasters

The debates on comets and eclipses between the 1650s-80s extended across the Atlantic world and encouraged scholars to consider the effects of celestial influences in the calamities of various countries. Over the following two decades, a series of seismic catastrophes greatly extended the sense of the reach of hazardous phenomena. The apparently unusual geographical scale of these events combined, in some cases, with their apparent proliferation and the severity of their impact to inspire the *comparative* study of disastrous phenomena. At the same time, the growing appreciation and theorisation of their reach beyond localities drove an increasingly *global* view of disasters. Those changes involved innovations both in the natural philosophical and theological interpretation of catastrophe that radically revised older understandings of disasters as fundamentally local in extent and origin. Two key developments underpinned these intellectual changes. On the one hand, a growing awareness of and interest in catastrophic occurrences in other parts of the world, communicated by means of correspondence networks and printed news, invited the combined analysis of different events and speculations on the connections between them. On the other, research into historical disasters from antiquity to the recent past allowed scholars both to assess the novelty of contemporary events and to overturn the old teachings on the spatial limitation of disastrous phenomena, and in particular of earthquakes. By the beginning of the eighteenth century, the scholarly analysis of disasters — both natural philosophical and theological — had greatly complicated and undermined the doctrine that catastrophes were typically judgements on the sins of individual communities.

Before the late seventeenth century, most theologians and natural philosophers agreed that disasters were generally limited in scope: they affected a geographically bounded location. Scripture

showed that God employed disasters to punish or admonish specific nations, cities, families or individuals. In the tale of the destruction of Sodom and Gomorrah in Genesis 19, God deliberately restricted the extent of the destruction to the two offending cities and the adjacent plain, allowing Lot to escape to a nearby town. This assumption that judgements would be precisely targeted was an integral part of the providential doctrines that emerged in the first centuries of Christianity and were reinforced and reimagined during the Reformation and Counter Reformation. Whether the Lord inflicted corrections through the operation of natural laws or by the miraculous descent of the *digitus dei*, the resulting calamities could always be interpreted as special lessons for the affected communities. Theologians allowed for disasters on a larger scale only on very rare and special occasions, such as the Deluge in Genesis, or the universal earthquake that according to one patristic tradition had accompanied the death of Christ.<sup>1</sup> Finally, the Bible prophesied that much of the world would experience earthquakes and various other kinds of physical destruction at the end of the world.<sup>2</sup> Global disasters were therefore anticipated during periods of heightened apocalyptic fervour. In the early years of the Protestant Reformation, for example, a vague astrological prophecy of 1499 provided the inspiration for the widespread expectation of a second universal Deluge in 1524.<sup>3</sup> However, apocalyptic reasoning required such occurrences to be exceptional — part of a special train of unique events that served as milestones in sacred time between the Creation and the Last Judgement. Sixteenth-century accounts of disasters did invoke these universal events

---

1 Paulus Orosius, *Historiae adversus paganos*, VII.4. “[...] At that time [of the crucifixion] a very severe earthquake shook the whole world. The rocks upon the mountains were rent, and many sections of the largest cities were overthrown by its unusual violence. [...]” : Paulus Orosius, *Seven Books of History against the Pagans: The Apology of Paulus Orosius*, trans. Irving W. Raymond (New York: Columbia University Press, 1936), 326–27. The text of Matthew 27:51-54 described a shaking of the earth and breaking open of tombs but made no explicit reference to a global seismic event.

2 This is described in most detail in the Book of Revelation, but other scriptural passages also mention the role of disasters in the Apocalypse, including Luke 21:10-11.

3 Ottavia Niccoli, *Profeti e popolo nell'Italia del Rinascimento*, Biblioteca di cultura moderna (Editori Laterza) ; 947 (Roma: Laterza, 1987).



of sacred history by analogy, for instance by likening severe inundations to Noah's Flood, but outside of this metaphorical realm they did not make sustained attempts to analyse contemporary disasters on a planetary scale.<sup>4</sup> In fact, the confessional conflicts of the sixteenth century and the first half of the seventeenth encouraged the narrowing of visions of divine judgement to religious and political enemies, including the sudden deaths of individuals (sometimes specific, named opponents).<sup>5</sup> When disasters struck towns and districts, religious and many lay commentators constructed a picture of providential judgement closely tied to local sins. In its 1649 petition to the Scottish parliament, the city councillors of Aberdeen drew attention to the losses their town had suffered from plague, fire and the sword, but noted "[we] shall rather acknowledge what came that way on us to have been just from God as the punishment of our sins".<sup>6</sup> This view of the Lord's selective application of judgements applied to diverse kinds of calamities, from the small (lightning strikes) to the very large (great earthquakes, conflagrations, storms and plagues). In the eyes of contemporaries, even widespread diseases seemed to affect some provinces, city districts, families and individuals much more than others. "What is the cause of this", asked the Church of England clergyman Nicholas Bownd in 1604, "but that it pleaseth the Lord in wisdom [...] to defend some for a time, and not the rest?"<sup>7</sup> It was generally understood to be a fundamental part of the justice of God that certain persons or communities would be struck by calamity while others would be spared.

---

4 Pace the argument presented in Lydia Barnett, *After the Flood: Imagining the Global Environment in Early Modern Europe* (Baltimore, Maryland: Johns Hopkins University Press, 2019), 28–31.

5 This was the trend embodied by providential judgement collections such as Thomas Beard, *The Theatre of Gods Judgements: Wherein Is Represented the Admirable Justice of God against All Notorious Sinners, Great and Small, Specially against the Most Eminent Persons in the World, Whose Exorbitant Power Had Broke through the Barres of Divine and Humane Law.*, The fourth Edition, With Additions (London: Printed by SI & MH and are to be sold by Richard Whitaker at the signe of the Kings Armes in St Pauls Churchyard, 1648).

6 Records of the Parliament of Scotland, NAS. PA6/9, 12 March 1649.

7 Nicholas Bownd, *Medicines for the Plague That Is, Godly and Fruitfull Sermons Vpon Part of the Twentieth Psalme, Full of Instructions and Comfort: Very Fit Generally for All Times of Affliction, but More Particularly Applied to This Late Visitation of the Plague. Preached at the Same Time at Norton in Suffolke, by Nicholas Bownd, Doctor of Diuinitie. And Now Published for the Further*

Classical natural philosophy lent support to the view that disasters were confined to specific, bounded locations by emphasising the role that the physical circumstances of particular spaces played in causing them. According to most ancient authorities, earthquakes originated in subterranean caverns, and therefore only the ground under which those caverns ran could be affected by them. Both Aristotle and Seneca insisted that earthquakes could not be universal, and that they were always confined to a locality; Seneca specified an outer limit of 200 miles (*ducenta milia*) for their operation.<sup>8</sup> Medieval authorities such as Albertus Magnus reiterated these restrictions until they became axiomatic.<sup>9</sup> Classical meteorological theory tried to identify the zones (especially mountainous or coastal ones) in which earthquakes were most likely to occur.<sup>10</sup> While the subterranean combustion theories that gained increasing popularity among natural philosophers in the seventeenth century changed ideas about the causes of earthquakes, the reliance of these theories on caverns and deposits of flammable minerals did not significantly alter the spatial limitations set in place by ancient meteorology. Local conditions were also central to other hazardous natural phenomena according to ancient meteorological and medical thought. Pliny spoke of exhalations from certain bodies of water as one of the causes of local storms, while Seneca emphasised the role of marshes, rivers and caverns in generating winds.<sup>11</sup> For Hippocrates, diseases were tied to the

---

*Good of All Those That Love and Feare the Lord. Perused, and Allowed.* (London: Printed by Adam Islip [and Felix Kingston] for Cuthbert Burbie, and are to be sold at the Swan in Paules Churchyard, 1604), 67.

8 Aristotle, *Meteorologica*, II.vii.365a and II.viii.368b. “Now, an earthquake covers not the whole earth but only a part of it” (“Nunc vero terrarum non universarum sed ex parte motus est”): Seneca, *Naturales Quaestiones*, VI.1.3. He notes the maximum spatial extent of an earthquake at VI.25.1.

9 Albertus Magnus, *Meteora*, III.ii.15. Albertus both repeated Seneca’s limit of *ducenta milia* and the point that an earthquake cannot shake the whole earth at once, although he also acknowledged that poets had ascribed great changes in landmasses (such as the separation of Sicily from Italy) to the motion of earthquakes.

10 Aristotle, *Meteorologica*, II.viii.366a, 368b; Seneca, *Naturales Quaestiones*, VI.26.4; Pliny, *Historia naturalis*, II.lxxxii.

11 Pliny, *Historia naturalis*, II.xliv. Compare Aristotle, *Meteorologica*, II.viii.368b. Seneca, *Naturales quaestiones*, speaks of winds generated by marshes and rivers (V.8.1-3), emerging from caverns in the earth (V.14.1-3), and being distributed locally by Providence in arrangements that promote health (V.18.1-4).

physical conditions specific to a locality (particularly its air, winds and waters).<sup>12</sup> Early modern medical discussions often made a distinction between endemic diseases (tied to a locality) and epidemic ones, but although medical theorists recognised that epidemic diseases moved between countries, many continued to attribute their activity to local environmental causes — above all corrupted air.<sup>13</sup> The revival of Hippocratic theories in the seventeenth century helped to emphasise local causes by stressing the relationship between diseases and geographically-delimited climatic zones in which particular illnesses and disease regimes predominated, by virtue of these zones' unique atmospheric and environmental conditions.<sup>14</sup> Although in practice both populations and administrations were aware that infected people themselves posed a health risk, among seventeenth-century medical writers only a small minority maintained that individuals contracted disease directly from other individuals, perhaps by means of invisible particles, rather than from their immediate environment: the majority either emphasised the latter type of transmission or found ways to combine both.<sup>15</sup> Moreover, medical writers often followed theologians in stressing the role of epidemics as supernatural punishments of specific sinful communities and activities; indeed, the physical and supernatural explanations tended to reinforce one other.<sup>16</sup>

---

12 Hippocrates, "Airs, Waters, Places," in *Hippocratic Writings*, trans. J. Chadwick and W.N. Mann (London: Penguin, 1987).

13 For instance, *Seconde Centurie des questions traitées ez conférences du Bureau d'adresse* (Paris: Au Bureau d'Adresse, 1636), 398; Carlo M. Cipolla, *Fighting the Plague in Seventeenth-Century Italy*, Merle Curti Lectures ; 1978 (Madison, Wis: University of Wisconsin Press, 1981), 8; Paul Slack, *The Impact of Plague in Tudor and Stuart England* (London ; Boston: Routledge & K. Paul, 1985), 27–28.

14 For instance, the English physician William Harvey considered smallpox a disease "peculiar to the Northern Climes". Gideon Harvey, *A New Discourse of the Smallpox and Malignant Fevers: With an Exact Discovery of the Scorvey : Comprising the Nature, Manifold Differences, Various Causes, Signs, Prognostics, Chronology, and Several Methods of Curing the Said Disease by Remedies Both Galenical and Chymical : Together with Anatomical Discourses on Convulsions, Palsies, Apoplexies, Rheumatisms, and Gouts, with Their Several Methods of Cure and Remedies : Likewise Particular Observations on Most of the Fore-Mentioned Diseases* (London: Printed by H Hodgskin for James Partridge, 1685), 170–73.

15 Slack, *The Impact of Plague in Tudor and Stuart England*, 28; Françoise Hildesheimer, *La terreur et la pitié: l'Ancien Régime à l'épreuve de la peste* (Paris: Publisud, 1990), 39–40.

16 Slack, *The Impact of Plague in Tudor and Stuart England*, 26–30; L. W. B. Brockliss and Colin Jones, *The Medical World of Early Modern France* (Oxford; New York: Clarendon Press, 1997), 66–69.

In the sixteenth century, natural philosophers used these teachings on the spatial limitations of extreme phenomena to reassess the physical nature of the Biblical Deluge, generally concluding that a universal flood would be physically impossible and that it could therefore only have occurred as the result of a miracle.<sup>17</sup> Some sixteenth-century works, such as Tiberio Russiliano's *Apologeticus adversus cucullatos* (1518), followed the argument of Avicenna (ultimately derived from Plato) that such floods recurred periodically, but most confined global disasters of this kind to miraculous events that occurred at specific points in the course of sacred history.<sup>18</sup> For writers like the Bolognese scholar Lucio Maggio (1571), the same considerations applied to the global earthquake that supposedly attended the death of Christ: as classical meteorology had proven, earthquakes could only occur in limited areas as a result of the concurrence of exhalations; any seismic episode on a larger scale must therefore be miraculous.<sup>19</sup> By offering physical reasons for the spatial delimitation of disasters, natural philosophers in the sixteenth and early seventeenth centuries legitimated the view of public calamities as providential dispensations directed at specific communities. The discovery of large-scale disasters in the second half of the seventeenth century was therefore a momentous development. It compelled a rethinking of the operation of providence in catastrophes, and encouraged natural philosophers to speculate on the structure of the earth and the circulation of air. In other words, it pushed disaster investigators to imagine catastrophic events on a global stage. Particularly important to this development was the analysis by seventeenth-century investigators of

---

17 Barnett, *After the Flood*, 24.

18 “Quarta disputa”, Tiberio Russiliano, *Apologeticus adversus cucullatos: testo critico, traduzione e note* (Cosenza: Periferia, 1991), 152–201. Plato, *Timaean*, 21B–23C; *Laws*, 676–789; Cicero, *Republic*, VI.23.

19 “[...] much less would an earthquake be universal, because proceeding from exhalations raised by the heat that is in the earth and from the sun, all of which concur in the same place and nearby places [...]”. “[...] molto meno sara universale il terremoto, perche procedendo da eshalationi elevate dal calore, che è nella terra, & dal sole, le quali tutte concorrono in un medesimo luogo da luoghi vicini [...]”. Lucio Maggio, *Del terremoto: dialogo* (In Bologna: Per Alessandro Benacci, 1571), 39r-v. See also the discussion in Craig Martin, *Renaissance Meteorology: Pomponazzi to Descartes* (Baltimore: Johns Hopkins University Press, 2011), 72–73.

extensive earthquakes that seemed to defy the spatial rules imposed by ancient natural philosophy and by theology. While such earthquakes had of course occurred before, a cluster of large-scale seismic incidents of varying magnitudes in the last two decades of the century provided the context for a serious reassessment of the geography of earthquakes. This inquiry relied upon the sourcing of many contemporary testimonies from different places, a careful attention to news reports from abroad, and the unearthing of historical incidents for comparative analysis.

The reimagining of earthquakes as planetary rather than purely local phenomena coincided with a growing interest in the second half of the seventeenth century in the earth's natural history from the Creation and the Deluge onwards, as well as with the related question of the origins of fossils.<sup>20</sup> Natural philosophical investigations of earthquakes were bolstered by this work at a theoretical level, even though the coalescence of geology as a field of natural study did not by itself determine developments in seismic inquiry. Among the emerging corpus of scholarship on the natural history of the earth, particularly influential for proponents of subterranean combustion theories of earthquakes was Athanasius Kircher's monumental *Mundus subterraneus* (1664-65).<sup>21</sup> Kircher's wide-ranging inquiry into the structure and nature of the "geocosm" speculated that the body of the earth was interlaced by a complex network of channels that circulated fire, water and air. The

---

20 Paolo Rossi, *The Dark Abyss of Time: The History of the Earth & the History of Nations from Hooke to Vico*, trans. Lydia G. Cochrane (Chicago: University of Chicago Press, 1984); Norman Cohn, *Noah's Flood: The Genesis Story in Western Thought* (New Haven: Yale University Press, 1996); Rhoda Rappaport, *When Geologists Were Historians, 1665-1750* (Ithaca, N.Y.: Cornell University Press, 1997); William Poole, *The World Makers: Scientists of the Restoration and the Search for the Origins of the Earth* (Oxford: Peter Lang, 2010); Barnett, *After the Flood*.

21 Athanasius Kircher, *Mundus subterraneus, in XII libros digestus: quo divinum subterrestris mundi opificium, mira ergasteriorum naturæ in eo distributio, verbo pantámorphou Protei regnum, universæ denique naturæ majestas & divitiæ summa rerum varietate exponuntur* (Amstelodami: apud J Janssonium & E Weyerstraten, 1665). An abridged translation appeared in English as Athanasius Kircher, *The Vulcano's, or, Burning and Fire-Vomiting Mountains, Famous in the World, with Their Remarkables: Collected for the Most Part out of Kircher's Subterraneous World, and Exposed to More General View in English: Upon the Relation of the Late Wonderful and Prodigious Eruptions of Ætna, Thereby to Occasion Greater Admirations of the Wonders of Nature (and of the God of Nature) in the Mighty Element of Fire.* (London: Printed by J Darby, for John Allen, and are to be sold by him, and by Benjamin Billingsly, 1669). Kircher preceded this work with a *prodromus* entitled *Iter Extaticum II. qui & Mundi Subterranei Prodromus dicitur* (1657).

“pyrophyllactic” channels (dramatically illustrated in colour plates) transported fire from a great reservoir in the centre of the earth to volcanoes on the surface, and in the course of this journey the fire encountered and reacted with flammable minerals.<sup>22</sup> Kircher anchored these speculations on his own observations of Etna, Stromboli and Vesuvius, on his experience of an earthquake in Calabria in 1638, and on various written reports of volcanic and seismic phenomena, which he regarded as closely connected.<sup>23</sup> After the publication of *Mundus subterraneus*, Kircher’s views on the interior composition of the earth excited debate among naturalists across Europe.<sup>24</sup> The book did not transform existing theories of earthquake causation, but as later scholars increasingly considered the problem of large-scale and intercontinental seismic activity, Kircher’s vision offered a compelling planetary framework upon which to layer new ideas.

Prior to the 1680s, large-scale seismic events attracted local commentary but did not spark any serious revision of the received wisdom on spatial limits. A useful example of this was the earthquake that shook Quebec and part of New England on 5 February 1663, with a vast territorial impact that amazed French colonists. In August Jérôme Lalemant, the superior of the Jesuits in New France, wrote to the General of the order at Rome, Gian Paolo Oliva, that “[t]he whole region

---

22 Kircher, *Athanasii Kircheri ... Mundus subterraneus, in XII libros digestus*, Book 4, section 1.

23 For Kircher’s commentary on the 1638 earthquake and his ascent of Vesuvius, see cap.s 2 and 3, respectively, of the Præfatio to *Mundus subterraneus*. On this work and its contexts, see Conor Reilly, “Father Athanasius Kircher, S.J.: Master of an Hundred Arts,” *Studies: An Irish Quarterly Review* 44, no. 176 (1955): 464–65; Gerhard F. Strasser, “Science and Pseudoscience: Athanasius Kircher’s *Mundus Subterraneus* and His *Scrutinivm ... Pestis*,” in *Knowledge, Science, and Literature in Early Modern Germany*, ed. Gerhild Scholz Williams and Stephan K. Schindler, University of North Carolina Studies in the Germanic Languages and Literatures No. 116 (Chapel Hill: University of North Carolina Press, 1996); Tara E. Nummedal, “Kircher’s Subterranean World and the Dignity of the Geocosm,” in *The Great Art of Knowing: The Baroque Encyclopedia of Athanasius Kircher*, ed. Daniel Stolzenberg (Stanford, Calif.; Fiesole (Firenze): Stanford University libraries, 2001); Sean Cocco, *Watching Vesuvius: A History of Science and Culture in Early Modern Italy* (Chicago: The University of Chicago Press, 2013), chap. 5.

24 See the discussion of Kircher’s influence in ch. 2, and William C. Parcell, “Signs and Symbols in Kircher’s *Mundus Subterraneus*,” in *The Revolution in Geology from the Renaissance to the Enlightenment*, ed. Gary D. Rosenberg (Boulder, CO: Geological Society of America, 2009).

was shaken at one and the same time”, although the colony suffered no great losses.<sup>25</sup> It was, he believed, “[a]n earthquake, extending over a region more than two hundred leagues in length and one hundred in width — making twenty thousand leagues in all”.<sup>26</sup> To the south, New Englanders also perceived a “very great Earthquake”, with smaller shocks on the two following days.<sup>27</sup> Charles Simon, another French Jesuit whose brief stay in Quebec coincided with the earthquake, claimed to have seen trees uprooted for three hundred miles along the length of the St Lawrence river.<sup>28</sup> From the reports the Order had received in Quebec City, he added, “we are led to believe that all America was shaken by it. In fact, we have already ascertained that it extended from the borders of the Iroquois country to Acadia, which is a part of Southern America, — that is, a thousand miles; multiplying this extent, for each region, by five hundred and three miles, as the measure of the [St. Lawrence] river valley”.<sup>29</sup> The version of Simon’s account printed in France assured readers that the impact of the earthquake extended “over all of America”, for at least five hundred leagues.<sup>30</sup> In their attempts to calculate the area of impact and their emphasis on its wide range, these and other contemporary commentators indicated their recognition that the earthquake’s spread was of a highly unusual nature. François Ragueneau, rector at the Jesuit college at Bourges and a strong advocate for

---

25 Reuben Gold Thwaites, ed., “Epistola ad R.P. Joannem Paulum Olivam, Praepositum Generalem Societatis Jesu, Romae. Hieronymus Lalement; Quebeci in nova francia, August 18, 1663,” in *The Jesuit relations and allied documents; travels and explorations of the Jesuit missionaries in North America 1610-1791*, trans. Finlow Alexander et al., vol. 47 (Cleveland, OH: The Burrows Brothers Company, 1899), 267–68.

26 Reuben Gold Thwaites, ed., “Relation de ce qui s’est passé de plus remarquable aux missions des peres de la Compagnie de Jesus en la Nouvelle France, és années 1663. & 1664. Envoyée au R.P. André Castillon, Provincial de la Province de France,” in *The Jesuit relations and allied documents; travels and explorations of the Jesuit missionaries in North America 1610-1791*, trans. Finlow Alexander et al., vol. 48 (Cleveland, OH: The Burrows Brothers Company, 1899), 27.

27 Nathaniel Morton, *New-Englands Memoriall, or, A Brief Relation of the Most Memorable and Remarkable Passages of the Providence of God Manifested to the Planters of New-England in America with Special Reference to the First Colony Thereof, Called New-Plimouth* (Cambridge (Mass.): Printed by S.G. and M.J. for John Usher of Boston, 1669), 161.

28 Charles Simon, “Relatio Terræmotus in Nova Francia, 1663,” in *The Jesuit relations and allied documents; travels and explorations of the Jesuit missionaries in North America 1610-1791*, ed. Reuben Gold Thwaites, trans. Finlow Alexander et al., vol. 48 (Cleveland, OH: The Burrows Brothers Company, 1899), 220–23.

29 Simon, 206–7. By “all America” he seems to have meant all of New France.

30 “par toute l’Amerique”, Charles Simon, *Recit du prodigieux tremble-terre arriué en la Nouvelle-France l’an 1663, : tiré d’une lettre écrite de ce pays par une personne digne de foy, & confirmé par le rapport de tous ceux qui en sont reuenus cette année avec la flotte de Canada* (s.i.: s.n., n.d.), 5.

the Canadian missions, tried to promote Simon's account to the Pope by sending a Latin translation to Oliva in Rome.<sup>31</sup>

Despite the best efforts of Ragueneau, Simon and Lalemant to publicise the extraordinary features of the event, however, the earthquake in Quebec and its tremendous geographical spread remained obscure. There is little evidence of awareness of the episode at the time among natural philosophers, ecclesiastical writers or lay authors outside North America.<sup>32</sup> Meanwhile, New Englanders who felt the earthquake do not seem to have been aware of the extent of the disturbance in Quebec and considered it a small-scale episode directed specifically at them by God. In his commentary on the 1663 events the Plymouth writer Charles Morton reaffirmed the providential doctrine that earthquakes were "great and terrible works of God", which affected specific groups of people in distinct areas. He considered them "usually ominous to some; strokes and visitations of his hand unto places and peoples where they are". Morton repeated the Aristotelian view that earthquakes were naturally caused by exhalations, but traced their "Efficient Cause" to God or angels. However, he thought that since New England had not experienced any major earthquakes, those that did occur there should be regarded as "rather gentle Warnings unto us, to shake us out of our earthly-mindedness, spiritual security, and other sins". In other words, New England

---

31 Simon, "Relation de ce qui s'est passé," 182–83. The letter enclosing the account is dated at Bourges, 12 December, 1663. As a young man, Ragueneau had attempted to travel to New France to become a missionary in 1628 but his ship was captured by the English at the mouth of the Saint Lawrence. He retained a strong interest in the Canadian missions for the rest of his life, and his brother Paul became superior of the Jesuits in New France (1650–53). See the *Dictionary of Canadian Biography*, "Ragueneau, Paul".

32 Vague and almost folkloric references to the earthquake can be found in John Josselyn, *Chronological Observations of America, from the Year of the World to the Year of Christ, 1673* (London: Printed for Giles Widdowes, 1674), 58–59; Increase Mather, *An Essay for the Recording of Illustrious Providences: Wherein an Account Is given of Many Remarkable and Very Memorable Events, Which Have Hapned This Last Age, Especially in New-England* (Boston in New-England: Printed by Samuel Green for Joseph Browning, and are to be sold at his shop, 1684), 323. Nearly four decades after the earthquake an Italian compilation of great "movements of the elements" described it as a hitherto unknown event ("qualis ante non auditus"); the author offered no details about the earthquake beyond the year of its occurrence and its general location. Giovanni Domenico Musanzio, *Fax chronologica ad omnigenam historiam ...* (Romae: s.n., 1701), 311.



earthquakes were small by design thanks to the divine favour that the Lord bestowed upon the colonists, so long as they did not deviate from the path of piety.<sup>33</sup>

The first serious challenges to the preconception that earthquakes were always spatially limited occurred in the 1680s. On 9 October 1680, a powerful earthquake struck the southern Spanish city of Málaga, destroying some five hundred houses, damaging many of the major buildings and killing dozens.<sup>34</sup> Towns across Andalusia reported damage, including Córdoba, Granada, Seville and Jaen, while residents perceived shaking in cities as far north as Madrid and even Valladolid, roughly 700 kilometers away.<sup>35</sup> In contrast to the Quebec episode, the 1680 earthquake became a significant news event in Europe. Stories of the disaster informed some 27 printed accounts in Spain.<sup>36</sup> An Italian translation of one of these also circulated in manuscript form.<sup>37</sup> Major periodicals also carried

---

33 Morton, *New-Englands Memoriall*, 161–63.

34 The most careful account of the damage is in Manuel Fernando de Velasco, *Relacion de La Ruina de Los Edificios y Casas de La Ciudad de Málaga Que Ocasiónó El Terremoto Del 9 de Octubre de Éste Año. Málaga 1680* (s.l.: s.n., 1680). Estimates of the death-toll varied widely, from seventeen to eighty: Velasco; José de Barzia y Zambrana, *Despertador christiano de sermones doctrinales ...: en dos tomos à que estan reducidos los cinco en que se imprimió antes ...: tomo segundo ...*, septima impression (En Madrid: Por Juan García Infanzon, 1687), 443. Compare also the low figure in Anon., *Relacion verdadera de la lastimosa destruicion, que padeciò la ciudad de Malaga, por el espantoso terremoto que sucediò el miercoles 9 de octubre deste presente año de 1680* (S.l.: s.n., 1680), f. 2v.

35 Anon., *Tercera relacion en que se da quenta de las vltimas noticias de las tempestades sucedidas en el pasado mes de setiembre deste presente año de 1680, y assimismo se refiere el espantoso temblor de tierra que sobrevino à la coronada villa de Madrid, corte angusta de nuestro gran monarca Carlos Segundo (que Dios guarde) el miercoles nueve de octubre de dicho año, en punto de las siete de la mañana*. (S.l.: s.n., 1680); Anon., *Relación verdadera en que se refiere lo sucedido el miércoles nueve de Octubre de este presente año de 1680 con el espantoso Temblor de Tierra que ... se padeciò ... en estos Reynos y especialmente en Cordova, Valladolid, Iaen, Antequera y otras partes ...* (S.l.: s.n., 1680); D. Muñoz and A. Udías, “Evaluation of Damage and Source Parameters of the Málaga Earthquake of 9 October 1680,” in *Historical Seismograms and Earthquakes of the World*, ed. William Hung Kan Lee, H. Meyers, and K. Shimazaki (San Diego: Academic Press, 1988), 211.

36 A bibliographical list of printed works on the earthquake may be found in Pedro Ramírez and Manuel Chaves, “El terremoto como noticia: relaciones de sucesos y otros textos del temblor de 1680,” *Estudios Sobre el Mensaje Periodístico* 14 (2008): 591–600. Many of these publications took the earthquake as their sole concern, while others referred to it in the course of discussing other topics.

37 “Relatione veridica della Lagrimevole Distruttione, che patì La Città di Malaga per il Spaventoso Terremoto Succeduto il mercordi 9. ottobre 1680. tradotta dalla lingua spagnola nell'Italiana”, BNE MSS/978 ff. 182v-189r. This was a translation of Anon., *Relacion verdadera de la lastimosa destruicion, que padeciò la ciudad de Malaga, por el espantoso terremoto que sucediò el miercoles 9 de octubre deste presente año de 1680*.

the news abroad: the *Mercure Galant* in France claimed that a quarter of Málaga had been destroyed, while jets of water surged up from newly-opened holes in the earth.<sup>38</sup>

In Spain the 1680 earthquake prompted important theological reasoning on the spatial limits of calamities. A key factor encouraging this speculation was the earthquake's apparent place within a long list of recent divine judgements in Andalusia. In the words of one pamphlet writer, these calamities manifested “now in pestilent contagions, now in the dearth of the fruits of the earth, now in great storms in the Sea”, in which several ships had been lost within sight of Málaga.<sup>39</sup> Only a few weeks before the earthquake, seventeen people had reportedly died in Osuna when a powerful storm raged through the town.<sup>40</sup> In a repetition of the curse that accompanied the Fall, nature itself seemed to have turned against the sinful Spanish. In the hyperbolic rhetoric of one pamphleteer, God had “summoned all the Creatures that benefited Man, in order to make them the instrument of his great ruin, fear and terror”, and finally “the earth, infected by its inhabitants, not being able to suffer them any longer”, had opened in mouths to swallow them all.<sup>41</sup> The sense of an escalating sequence of disasters was very apparent to José de Barzia (or Barcia) y Zambrana, a canon and theology professor in Granada, who had also felt the shaking on 9 October. He had previously preached during the recent epidemic, and now developed his disaster ideas in a sermon on

---

38 *Mercure Galant*, November 1680, pp. 278-83.

39 “breves años la han sobrevenido por sus muchas culpas, ya en pestilentes contagios, ya en la falta de terrestres frutos, ya en sobervias Borrascas en el Mar”. Anon., *Relacion verdadera de la lastimosa destruicion, que padeciò la ciudad de Malaga, por el espantoso terremoto que sucediò el miercoles 9 de octubre deste presente año de 1680*, f. 1r.

40 Anon., *Verdadera Relación, de La Grande Auenida, y Huracan Tremendo, Que El Día Viernes Seis de Septiembre Acaeciò En La Villa de Ossuna, Este Presente Año de 1680 y Cosas Maranillosas Que Suciedieron, Como Vera El Curioso Lector* (Cordova: [s.n.], 1680); Vicente Cabrera, *Segunda relacion y mas lata noticia de todo lo sucedido en el memorable, y lastimoso mes de Setiembre deste presente año de 1680: En que se refieren las grandes, y repetidas Tempestades, Avenidas y Ruinas de Puentes, Edificios, y Heredades de Castilla y Andaluzia; y en particular del recio Huracan que padeciò la Villa de Ossuna, el dia 6 del referido mes.* (En Valencia: Por Vicente Cabrera ... : Vendense en la misma Imprenta, 1680).

41 “aora la tierra infecta por sus Habitadores, no pudiendolos ya sufrir, à unos los arrojaba, à otros matò; y à todos, abriendo bocas, se los queria tragar. Convocò Dios todas las Criaturas que benefician al Hombre, para que fuessen instrumento de su mayor ruina, pavor, y espanto”. Anon., *Relacion verdadera de la lastimosa destruicion, que padeciò la ciudad de Malaga, por el espantoso terremoto que sucediò el miercoles 9 de octubre deste presente año de 1680*, f. 1r.

earthquakes. Instead of having the text of the speech printed as a pamphlet, he included it within an immense compilation of his sermons, entitled *Despertador christiano* (“Christian Awakener”), which offered sample templates for churchmen everywhere to use on specific occasions, and also included an appendix giving the lyrics of the songs to be sung in rogative processions. The frontispiece was preceded by a woodcut of a sleeping person, with a textual motif running around the picture: “Sleeping soul awake. / The eternity for which you wait / Rests upon a moment”, recalling the common message of preachers that death might suddenly arrive at any time and that spiritual preparations therefore needed to be made now.<sup>42</sup> Originally published in 1677, the updated versions from 1681 included Barzia’s preaching on the earthquake within a bundle of sermons on disaster subjects: drought, dearth, famine, epidemics and the invasion of locust swarms. The edition of 1687 contained a total of seventeen sermons on the topic of plague: seven of these to be used as a preventative measure when the fear of plague arose (i.e. after the receipt of news of an outbreak elsewhere), additional sermons for when citizens suspected the plague to be in their city, when the infection in the city was certain, when the plague was raging and when it had begun to diminish, and five thanksgiving sermons for deliverance from the plague — including anniversary sermons to be delivered one, two and three years after its cessation. Several of the plague sermons focused on the invocation of specific intercessors, such as Jesus, “Christ of the Column”, Mary and Saint Peter. Although totally obscure now, the *Despertador christiano* seems to have been an early modern best-seller. After the appearance of the second edition it was reprinted every few years in many different cities until the 1760s. Translations of all or part of the work appeared in English, German and

---

42 “Alma dormida despierta. / De un momento esta pendiente / La eternidad que te espera”. This was a reference to 13 Mark 35-7: “Watch ye therefore (for you know not when the lord of the house cometh, at even, or at midnight, or at the cock crowing, or in the morning): Lest coming on a sudden, he find you sleeping. And what I say to you, I say to all: Watch.” (Vulgate: Douay-Rheims)

Latin.<sup>43</sup> As a practical guide it became indispensable for Catholic clergy, achieving a tremendous circulation around the Atlantic. Mission library records show that the Jesuits of Caracas and even the missionaries of remote New Mexico possessed copies of at least some of the volumes.<sup>44</sup>

For Barzia, the spiritual purpose of the extraordinarily wide-ranging earthquake of 1680 was to give Andalusians an irrefutable signal of the need for penitence and moral reformation. A native of Málaga, Barzia urged his congregation to regard the fate of his hometown as a painful lesson: “Turn your eyes, O Granada! to that City, if I can call what they say remains of it a City”.<sup>45</sup> The Lord had sent the earthquake, he thought, partly as a punishment for the irreverence shown to churches and monasteries, but also because Andalusians had ignored the warnings and judgements of the recent past. In particular, Spanish congregations had not heeded the import of the sermons he and other preachers had supplied after the plagues and other disasters; recapitulating the central message of the *Despertador christiano*, he characterised his countrymen as sleepers needing to be jolted awake.<sup>46</sup> The consequence of this emphasis on a concatenation of events was to turn a conventional theological interpretation of a single episode into a narrative sequence to be viewed from a historical perspective. Barzia extrapolated that line of inquiry by locating the 1680 episode within the context of a long history of seismic disasters. This included an earthquake of 1456 that (according to Cardinal Jacobo de Papia) had levelled Naples, as well as a minor earthquake in England in 1575,

---

43 *Inter alia*: José de Barzia y Zambrana, *A Discourse of the Excellency of the Soul, and the Care Every Christian Ought to Have of It: In a Sermon Preach'd in Spanish* (London: Printed for Matthew Turner ..., 1685); José de Barzia y Zambrana and Marcus Fridl, *Christ-eyfriger Seelen-Wecker...* (Augsburg; Dillingen: Bencard, 1721); José de Barzia y Zambrana, *Christianus animarum excitator...* (Augustae Vindel. ; Dilingae: Bencard, 1740).

44 Eleanor Burnham Adams, *Two Colonial New Mexico Libraries, 1704, 1776* (Santa Fe: University of New Mexico, 1944), 156; Francisco Atanasio Domínguez, *The Missions of New Mexico, 1776; a Description, with Other Contemporary Documents* (Albuquerque: University of New Mexico Press, 1956), 223; José del Rey Fajardo, *Entre el deseo y la esperanza: los jesuitas en la Caracas colonial* (Caracas: Universidad Católica “Andrés Bello”, Instituto de Investigaciones Históricas, 2004), 457.

45 “Buelve (ò Granada!) los ojos à aquella Ciudad, si es que puedo llamarle Ciudad, segun me escriven ha quedado”. Barzia y Zambrana, *Despertador christiano de sermones doctrinales ...*, 443.

46 Barzia y Zambrana, 440–42.

which Barzia had read about in the Jesuit theologian Francisco Ribera's apocalyptic commentaries.<sup>47</sup> He also referred to the ancient earthquakes described by Seneca, Pliny, Orosius, Ammianus Marcellinus and Eusebius. Barzia was aware of the natural explanations for earthquakes offered by classical writers, but through a series of unusual metaphors he turned them into theological motifs. For Barzia, the natural mechanism of earthquakes described by Aristotle and others offered a moral lesson, by way of corporeal analogy. Just as winds became trapped within caverns in the earth, so sins coalesced into a dry, thick vapour ("*vapor grueso*") in the heart of an impenitent. These noxious gases could be voided through confession, in the same way that earthquakes expelled winds.<sup>48</sup> Since earthquakes engendered a fear that inspired penitence, their periodic occurrence served a vital purgative function for the spiritual health of the social body.

However, the insistence of ancient meteorology on the spatial delimitation of earthquakes suggested to Barzia that the explanation for the vastness of the 1680 earthquake lay in a special act of divine providence. Here the sequence of calamities in Andalusia may have been instructive: by allowing the earthquake to exceed the usual natural bounds, God cemented its moral association with the wide territorial spread of the earlier pestilence. Barzia reflected on the opinion of El Abulense (the fifteenth-century bishop Alonso Fernández de Madrigal) that "famines, & pestilences

---

47 A manuscript of these commentaries dates from 1585-87: BNE MSS/17745. Printed editions included Francisco de Ribera, *Francisci Riberae ... Societatis Iesu ... In sacram b. Iohannis Apostoli & Euangelistae Apocalypsin commentarij: cum quinq[ue] indicibus ... ; his adiuncti sunt quinq[ue] libri de Templo & de iis quae ad templum pertinet, ad multorum intelligentiam cum primis vtilis ...* (Salmanticae: excudebat Petrus Lassus, 1591). On the 1456 disaster, see Bruno Figliuolo, "Il Terremoto Napoletano Del 1456: Il Mito," *Quaderni Storici* 20, no. 60 (3) (1985): 771-801; Bruno Figliuolo, "Il Terremoto Napoletano Del 1456: La Cartografia," *Quaderni Storici* 20, no. 60 (3) (1985): 803-10; Bruno Figliuolo, *Il terremoto del 1456, Storia e scienze della terra 1* (Altavilla Silentina: Studi storici meridionali, 1988).

48 Barzia y Zambrana, *Despertador christiano de sermones doctrinales ...*, 445. Here he was developing the analogy in Aristotle's *Meteorologica* (II.viii.366b) between earthquakes and bodily fits or spasms. Aristotle pointed out that exhalations trapped within the earth and the gases that build up in the body both cause tremors. Seneca also considered corporeal analogies, for instance in a comparison of the earth to a sick body in his *Naturales Quaestiones*, VI.14.

can be general in a province in some way or another; but earthquakes never”.<sup>49</sup> Yet while Málaga had clearly borne the brunt of the recent devastation, a number of “trustworthy accounts” (*Relaciones fidedignas*) from various parts, as well as his own experience in Granada, confirmed to Barzia that this earthquake had indeed occurred across the province.<sup>50</sup> As a result, he declared that “[w]hen we see that the earthquake extended to this whole Kingdom, as is clear to us, we must consider it more than natural”.<sup>51</sup> While Barzia could find many examples of God’s anger expressed in great earthquakes, only a few incidents seemed to match the wide dispersal of tremors of the case at hand. These included a great earthquake at the time of the Roman emperor Theodosius II which Barzia believed had miraculously shaken much of the earth for six months, the reputed destruction of twelve cities of Asia Minor during the reign of Tiberius, and the shaking of Dardania in 518 CE.<sup>52</sup> By placing the events of 1680 into the recent history of Andalusian miseries on the one hand and the longer history of remarkable earth movements on the other, Barzia reached the conclusion that a geographically widespread earthquake constituted a clear and urgent warning from God.

This method of addressing an unusually extended disaster through comparative historical research was one that other writers also arrived at around this time. An anonymous Spanish manuscript entitled “Observations of earthquakes that have happened at various times” tried to

---

49 “fames, & pestilentiaē possunt esse generales in tota aliqua provincia; sed terræ motus nunquam”. Quæstio 63 in Alphonsus Tostado Ribera, *Alphonsi Tostati Hispani, Episcopi Abvlensis, Philosophi, Theologi ... Commentaria in Sextam Partem Matthæi: Mendis nunc sanè quàm plurimis diligenter expurgata ...* (Venetiis: Nicolini, 1596). Barzia might equally have consulted the 1615 edition, also printed in Venice. Barzia y Zambrana, *Despertador christiano de sermones doctrinales ...*, 439.

50 Barzia y Zambrana, *Despertador christiano de sermones doctrinales ...*, 443.

51 “Quando el temblor que vimos alcançò à todo este Reyno, como nos consta: màs que natural debemos considerarle”. Barzia y Zambrana, 439.

52 Barzia y Zambrana, 443. For the first of these earthquakes, Barzia inherited from his Byzantine source (Nikephoros Kallistos Xanthopoulos’s fourteenth-century *Historia ecclesiastica*, xiv.46) a conflation of two different events: a series of minor tremors in 438 CE that lasted several months, and a more destructive earthquake in 447 that damaged the walls of Constantinople. On these two episodes and the confusion in the Byzantine historiography see Brian Croke, “Two Early Byzantine Earthquakes and Their Liturgical Commemoration,” *Byzantion* 51, no. 1 (1981): 122–47. The sources for the destruction of the twelve cities of Asia Minor were Pliny, *Historia naturalis*, II.lxxxvi and Seneca, *Naturales quaestiones*, VI.10.13. Barzia’s source for the third event was Marcellinus Comes’ *Chronicon*, 518: Ind. XI.1.

enumerate the most important seismic events of known history up to the early seventeenth century.<sup>53</sup> At the bottom of each entry the author listed the source of his information, most often histories such as Juan de Mariana's *Historia general de España* (1601).<sup>54</sup> Crucially, the manuscript's author was interested not only in the damage caused by each earthquake but its geographical extent: some of these seemed to him to have affected only one city — such as Constantinople in 1556 — or a single region, as when the Azores shook in 1611.<sup>55</sup> On other occasions, he believed that the impact had stretched over a much larger area, as in 1580, when an earthquake extended to Flanders, Holland and England at the same time.<sup>56</sup> During the reign of the emperor Gallienus, “the earth shook in Rome, all Italy and Africa”, while in Nero's time there was a *temblor* “in all Europe and a great part of Africa”.<sup>57</sup> The author therefore drew a distinction between “particular earthquakes” (*temblores particulares*) and “general earthquakes” (*temblores generales*). Localised events, such as the tremors in Seville in 1624, clearly fitted the former category.<sup>58</sup> The latter class included not only several ancient earthquakes but also medieval ones, such as the shaking of the kingdom of Valencia

---

53 “Observaciones de temblores de tierra que han suzedido en varios tpos”, BL Add MS 14002, ff. 450r-452v. The manuscript bears no indications of date or authorship but is bound with several accounts of the comet of 1680. The only entry without any historical source listed is the final one, concerning an earthquake in Seville in 1624. Since this was not an especially well-known event, it seems plausible that the author was either from Seville or had close ties to the city.

54 Juan de Mariana, *Historia general de España: compuesta primero en Latin, despues buelta en Castellano* (En Toledo: Por Pedro Rodriguez, 1601).

55 BL Add MS 14002, f. 450r. His source for the first of these events was Luis Cabrera de Córdoba, *Filipe Segundo, Rey de España* (s.l.: por Luis Sanchez, 1619), 104. For the 1611 earthquake, the source was Mariana, *Historia general de España*, vol. 2, p. 620.

56 BL Add MS 14002, f. 450v. His source was Luis de Bavía and Luis Sánchez, *Tercera parte de la Historia pontifical y catholica. Compuesta y ordenada por el D. Luis de Bavía...* *Contiene esta tercera parte de la historia pontifical, las cosas mas notables sucesidas en el mundo, desde el año de mil y quinientos y setenta y dos, hasta el de mil y quinientos y noventa y uno.* (En Madrid: por Luis Sanchez... y a su costa, 1608), 363.

57 “temblo la tierra en Roma toda Italia y Africa”; “un temblor en toda Europa y y mucha parte del Africa”. BL Add MS 14002, ff. 451r, 450v. His source for these two episodes was Pedro Mexía, *Historia imperial, y cesarea: En que sumariamente se contienen las vidas, y hechos de todos los emperadores, desde Iulio Cesar, hasta Maximiliano Primero* (En Madrid: Por Melchor Sanchez, 1655), 60, 170–71.

58 BL Add MS 14002, f. 452r. The author does not specify a source for this event.

and the eastern Spanish seaboard in 1396.<sup>59</sup> More recently, an earthquake in 1612 had supposedly shaken all of Europe.<sup>60</sup> However, the author took considerable liberties in assessing the spatial extent of some of these earthquakes. His source for the massive earthquake in the reign of Gallienus, the sixteenth-century historian Pedro de Mexía, simply described an earthquake “in many places” (*en muchas partes*) that destroyed the city of Laodicea. The chronicler Hernando Camargo y Salgado, the historical authority for the 1396 event, merely stated that the earthquake affected the city of Valencia and the sea coast, not “the whole kingdom” (“*todo el Rey[n]o*”) as the manuscript presented it. The author was thus unafraid to expand the geographical range of these historical disasters, either to magnify their dramatic qualities or to throw into relief the distinction in scale between particular and general events. The compilation made no attempt to identify a cause of the phenomena, as Barzia had, instead repeating factual descriptions in the manner of a chronicle — although in the process uncritically repeating stories about prodigies, such as the rain of blood that supposedly fell on Rome in 1017.<sup>61</sup> Nevertheless, the manuscript demonstrates that at least some Spanish writers were considering how to conceptualise very large-scale seismic disasters, and circumventing the ancient authorities’ declaration of their theoretical impossibility by searching out (and if necessary, elaborating) reported cases in the historical record.

In England, news of the 1680 earthquake and its geographical spread coincided with natural philosophical debates about the possibility of sudden geological changes. In January 1681 a meeting of the Royal Society in London, at which Robert Hooke and Christopher Wren were present, discussed a paper that pointed out the coincidence of the catastrophe in Málaga with tremors in

---

59 BL Add MS 14002, f. 452r. His source was Hernando Camargo y Salgado, *La iglesia militante: cronologia sacra y epitome historial de todo quanto ha sucedido en ella prospero y adverso* (Con privilegio en Madrid: Por Francisco Martínez Acosta de Pedro Garcia de Sodruz, mercader de libros, 1642), f. 274r.

60 BL Add MS 14002, f. 452r. The author’s citation of the *Iglesia militante* here seems to be a misattribution.

61 BL Add MS 14002, f. 451v. His source was Camargo y Salgado, *La iglesia militante*, ff. 210v-211r.



Morocco.<sup>62</sup> In Hooke's view, earthquakes were an essential part of any account of the major transformations of the earth from the Creation to the present, as well as the key to understanding why fossilised sea shells existed in hinterlands and on mountains.<sup>63</sup> He accordingly presented his ideas on earthquake theory and its relationship to these geological questions in lectures to the Society between 1667 and 1700.<sup>64</sup> In a lecture of 1678 he had drawn on an account of a volcanic eruption and accompanying earthquakes during the previous year on La Palma, in the Canary Islands, to support his conclusions about the ability of earthquakes to transform the landscape.<sup>65</sup> However, that incident did nothing to challenge his subscription to the ancient idea that earthquakes were concentrated in mountainous or coastal zones (since those areas possessed the most caverns).<sup>66</sup> The Málaga/Morocco case, on the other hand, furnished Hooke and other Society fellows with evidence of the ability of earthquakes to move beyond these circumscribed zones and even migrate over sea boundaries.

---

62 Minutes of the Royal Society meeting of January 19, 1680 [O.S.], HF 471. In the *Hooke Folio Online* (<http://www.livesandletters.ac.uk/cell/Hooke/Hooke.html>).

63 Amongst other scholarship, see Albert V. Carozzi, "Robert Hooke, Rudolf Erich Raspe, and the Concept of 'Earthquakes,'" *Isis* 61, no. 1 (1970): 85–91; Giorgio Ranalli, "Robert Hooke and the Huttonian Theory," *The Journal of Geology* 90, no. 3 (1982): 319–25; Rossi, *The Dark Abyss of Time*, chap. 3; William Poole, "The Genesis Narrative in the Circle of Robert Hooke and Francis Lodwick," in *Scripture and Scholarship in Early Modern England*, ed. Ariel Hessayon and Nicholas Keene (Aldershot, England; Burlington, VT: Ashgate, 2006), 41–57.

64 The lectures were printed collectively as Robert Hooke, "A Discourse of Earthquakes," in *The Posthumous Works of Robert Hooke...* (London: printed by Sam Smith and Benj Walford printers to the Royal Society at the Princes Arms in St Paul's Church-Yard, 1705). Additional material is in Robert Hooke, *Lectiones Cutlerianae, or, A Collection of Lectures, Physical, Mechanical, Geographical, & Astronomical: Made before the Royal Society on Several Occasions at Gresham Colledge: To Which Are Added Divers Miscellaneous Discourses* (London: Printed for John Martyn, 1679). This is reproduced in R. T. Gunther, ed., *Early Science in Oxford* (Oxford: Printed for the Oxford historical society at the Clarendon press, 1923), vol. 8. For the chronology and context of the lectures on earthquakes, see Rhoda Rappaport, "Hooke on Earthquakes: Lectures, Strategy and Audience," *The British Journal for the History of Science* 19, no. 2 (1986): 129–46. Further important discussion is in D. R. Oldroyd, "Robert Hooke's Methodology of Science as Exemplified in His 'Discourse of Earthquakes,'" *The British Journal for the History of Science* 6, no. 2 (1972): 109–30; Ellen T. Drake, *Restless Genius: Robert Hooke and His Earthly Thoughts* (New York: Oxford University Press, 1996).

65 Hooke, *Lectiones Cutlerianae*, 48–56.

66 He expressed this view in one of the lectures he delivered between 1667 and 1668, after presenting a lengthy quotation from Seneca's *Quaestiones naturales*: Hooke, "A Discourse of Earthquakes," 311.

A minor earthquake in France in 1682 offered a further example of the potential geographical spread of seismic phenomena. The *Gazette* reported that during the night of 11-12 May, buildings in the town of Tonnerre in Burgundy shook, the earth raised itself up, people lost their footing and the shock caused pregnant women to give birth prematurely.<sup>67</sup> The paper added that tremors had been noted at the same time in Paris, Orléans, Reims, Nancy and several other towns, thus extending across a large swathe of French territory. Within two weeks the *Gazette* added reports of either one or two earthquakes on the same day at Strasbourg, Basle, and Zweibrücken in Germany, while the *Mercur Galant* added Lyon and Geneva to the list.<sup>68</sup> By June, the *Mercur* declared that “[t]he majority of the Letters that we have received for the last month have confirmed that the earthquake was universal”, across France and Switzerland.<sup>69</sup> The June issue of the *Journal des Sçavans* affirmed this wide spread of the tremors in France, Switzerland and western Germany, on the basis of reports from around thirty towns.<sup>70</sup> Thus, from the journalistic press emerged an evolving picture of an earthquake covering an unusually large area. Just as Spanish writers had done, the *Journal* attempted to make sense of the scale of the event through a number of historical comparisons. Besides invoking the classic example of the destruction of the twelve cities of Asia in the reign of Tiberius, the writer also considered an earthquake in Peru in 1586 that had extended for around 300 leagues along the coast and 70 leagues inland.<sup>71</sup> The closest French example of a large-scale earthquake he could think of was that of 1580, which had similarly shaken a substantial part of France, again

---

67 *Gazette* (later the *Gazette de France*), no. 46, 1682.

68 *Gazette*, no.s 47 and 49, 1682; *Mercur Galant*, May 1682, pp. 222-3.

69 "La plûpart des Lettres que l'on a reçeuës depuis un mois nous ont confirmé que le tremblement de terre a esté universel". *Mercur Galant*, June 1682, pp. 170-73.

70 *Journal des Sçavans*, 1682, no. XIV, pp. 159-69.

71 *Journal des Sçavans*, 1682, no XIV, 159, 165. His source on the former event was Tacitus, *Annals*, II.47. He copied the description of the Peruvian earthquake (which originally derived from Acosta's *Historia natural y moral de las Indias*) very closely from Pierre Gassendi and François Bernier, *Abrégé de la philosophie de Gassendi*, ed. Sylvia Murr and Geneviève Stefani, *Corpus des œuvres de philosophie en langue française* (Paris: Fayard, 1992), vol. 5, p. 93.

without doing significant damage.<sup>72</sup> Distilling the observations of Pliny and Ammianus Marcellinus, the *Journal* set out a four-part typology of earthquakes, arranged from least to most destructive, along with concrete examples.<sup>73</sup> However, having provided this list, the writer could not decide to which of the categories the 1682 tremors belonged. The first two types could be dramatic but were limited in scope, whereas the others were broader but far more devastating: the third involved a shaking from coast to coast and widespread urban destruction, and the fourth called for the flattening of mountains and the swallowing up of cities in great chasms.<sup>74</sup> Clearly, the cities and mountains of France remained largely intact and in place. The cause of the earthquake was similarly perplexing: the writer considered both wind and combustion explanations, alongside one recent suggestion that heavy rains and great floods in the Netherlands may have eroded the walls of subterranean caverns and brought about sudden collapses. He also discussed an explanation offered by the Lyonnais doctor Jean-Baptiste Panthot, which pointed to the force of subterranean fires fuelled by bitumen and sulphur; a view that seemed to be corroborated by a report of flames on a mountain near Geneva.<sup>75</sup>

As the *Journal's* analysis indicates, the 1682 earthquake stimulated French natural philosophical discussion about large-scale seismic events but did not afford firm conclusions about their operation or causes. On 13 May the members of the Académie Royale des Sciences also discussed the

---

72 *Journal des Sçavans*, 1682, no XIV, pp. 160, 162, 163-4.

73 Pliny, *Historia naturalis*, II.lxxxiv; Ammianus Marcellinus, *Rerum Gestarum*, XVII.vii.

74 *Journal des Sçavans*, 1682, no XIV, pp. 160, 162, 168-9.

75 *Journal des Sçavans*, 1682, no XIV, pp. 165-67. Panthot was a medical practitioner with alchemical interests. He was also the inventor of a healing stone, and of a divining rod that supposedly pointed out not only waters and buried treasures but also thieves and murderers. Jean-Baptiste Panthot, *Traité de la baguette, ou La recherche des véritables usages auxquels elle convient pour la découverte des voleurs, des meurtriers, sur la terre & sur les eaux, des bornes, des trésors...* 3e édition augmentée (Lyon: T. Amaulri et J. Guerrier, 1693); Jean-Baptiste Panthot, *Dissertation tres instructive, et tres curieuse pour la pratique sur trois operations de la pierre faites en six mois de temps: avec un grand succez, et une parfaite guerison de celui qui les a souffert* (A Lyon: chez Jacque Guerrier ..., 1702).

widespread attestations of the tremors.<sup>76</sup> However, since most locations displayed only minor effects, their attention shifted to the more dramatic aspects of the events allegedly experienced in the small town of Remiremont in Lorraine, which had suffered the most damage.<sup>77</sup> The architect and physician Claude Perrault read to the Académie an eyewitness account that reported mysterious, foul-smelling flames shooting up from the unbroken earth in various places.<sup>78</sup> The members found this information compelling and credible enough to print in the official publication of the Académie, but in the process their initial interest in the earthquake's wide zone of impact disappeared from view.<sup>79</sup> Meanwhile, royal propagandists sought to convert the moral interpretation of the earthquake from a fearful sign of divine anger to a positive augury both for the reign of Louis XIV and the future career of his grandson, *le petit dauphin*, born in August. In December, the *Mercure* declared that “[t]hese sorts of Prodiges are almost always sure portents of the grandeur of Princes, & the felicity of Peoples”.<sup>80</sup> To support this conclusion, the writer pointed out that an earthquake had shaken “all these States” at the coronation of Charlemagne, while another had occurred in the Pyrenées upon the marriage of the current monarch in 1660.<sup>81</sup> While the commentators on the Málaga disaster had drawn upon historical comparisons to throw into relief the dismal moral connotations of the earthquake or to illuminate its wide spread, these French writers used historical examples to downplay the novelty and terror of the tremors. After all, “[e]arthquakes are nothing new”, and the

---

76 Académie des Sciences, Procès Verbaux, vol. 10, 13 May 1682, f. 97v.

77 Damage to the church at Remiremont is recorded in a manuscript: BNF NAF 1283, f. 67r. The damage to the town as a whole was described in a letter printed in the *Mercure Galant*, May 1682, pp. 223-24.

78 “De Remiremont en Lorraine ce Juillet 1682”, Académie des Sciences, Procès Verbaux, vol. 10, 21 April 1683, ff. 134v-135r.

79 *Histoire de l'Académie royale des sciences*, 1682, 1733 reprint, tome I, pp. 341-42.

80 “Ces sortes de Prodiges sont presque toujours des présages assurez de la grandeur des Princes, & de la félicité des Peuples.” *Mercure Galant*, December 1682, 225. Such declarations built on the favourable interpretations of royal propagandists after the 1660 earthquake in the Pyrenees: see Grégory Quenet, *Les tremblements de terre aux XVIIe et XVIIIe siècles : la naissance d'un risque*, Epoques (Seyssel: Champ Vallon ; Paris Diffusion, Presses universitaires de France, 2005), 186–89.

81 *Mercure Galant*, December 1682, p. 225.

comparison of events in France to the much greater convulsions in Spain, let alone the repeated destruction of cities in Italy since Roman times, counselled a calm assessment of the most recent occurrence.<sup>82</sup>

Despite the evidence from Spain and France, most natural philosophers of the 1680s continued to think in terms of localised seismic effects. This was in part a result of the dominance by that point of combustion theories of earthquakes, which held that subterranean fires reacted explosively with naturally-occurring flammable minerals such as sulphur, nitre and bitumen. In Spain, the Jesuit professor of mathematics José de Zaragoza affirmed this view in his *Esphera en comun Celeste y Terraqueo* (1675). In 1682 Thomas Henshaw, an enthusiast for chemical and alchemical matters, signalled the dominance of combustion explanations in a letter to the government official and natural philosopher Robert Southwell, when he stated that there could be "scarse any tollerable Hypothesis of earthquakes but from subterraneous fires".<sup>83</sup> When a minor earthquake shook Oxford in September 1683, Thomas Pigot, a fellow of both the Royal Society and Wadham College at Oxford University, suggested that this shaking was a consequence of the subterranean heat boiling a mixture of nitre, vapours and moisture, like a covered vessel of water on a fire.<sup>84</sup> Proponents of combustion theories had always struggled to account for the origins of the subterranean fires themselves and to explain how they could exist *in perpetuum* within their caverns without exhausting their fuel supply. However, in 1684 the physician and naturalist Martin Lister appeared to solve that problem by demonstrating the ability of pyrites (iron sulphides) both to generate a flammable

---

82 "Les tremblemens de terre ne sont pas nouveaux". *Mercurie Galant*, May 1682, p. 225.

83 Thomas Henshaw to Robert Southwell, December 23 1682, RS MM/20/57, f. 1v.

84 Thomas Pigot, "An Account of the Earthquake That Happened at Oxford and the Parts Adjacent Sept. 17. 1683. by a Fellow of a College in That University, and of the Royal Society," *Philosophical Transactions of the Royal Society of London* 13, no. 151 (1683): 311–21. Pigot also assigned a role to frosty weather conditions in the area, which he thought had "locked up" the potentially explosive mixture in the earth.

sulphurous “breath” and to ignite spontaneously.<sup>85</sup> Robert Plot, professor of chemistry at Oxford, argued that the mixture of pyrites with nitre would produce “the true natural Gunpowder” whose explosions created earthquakes.<sup>86</sup> Such theories relied heavily on the local availability of mineral deposits — Plot based his speculations on coal pits — and therefore could not easily account for the wide extension of earthquakes across large tracts of land (or water).

However, from the middle of the 1680s new ideas began to offer alternative explanations for the physical migration of earthquakes from one area to another. In an essay published in 1685, Robert Boyle felt confident enough to overturn Seneca’s spatial limit of 200 miles for earthquakes, since modern observations “warrant us to allow them a far greater spread”.<sup>87</sup> Boyle’s interest in the geographical reach of earthquakes had deep roots: in 1665 he had remarked on the surprisingly wide extension of minor tremors in Oxfordshire, which he believed had “reach’d a good many miles”, but at that time he declined to examine seriously the “uncertain reports of the Extent and other Circumstances”.<sup>88</sup> Nevertheless, in the *Experimental discourse* his method in establishing the possibility of wide earthquake dispersal was not the analysis of recent events or his personal experience but rather the comparison and reassessment of historical occurrences.<sup>89</sup> His first example was the

---

85 Martin Lister, “Three Papers of Dr. Martin Lyster, the First of the Nature of Earth-Quakes; More Particularly of the Origine of the Matter of Them, from the Pyrites Alone,” *Philosophical Transactions of the Royal Society of London* 14, no. 157 (1684): 512–15. For Lister’s pyrite investigations more generally, see Anna Marie Eleanor Roos, *The Salt of the Earth: Natural Philosophy, Medicine, and Chymistry in England, 1650-1750*, History of Science and Medicine Library ; v. 3 (Leiden ; Boston: Brill, 2007), 65–87; Anna Marie Roos, “All That Glitters: Fool’s Gold in the Early-Modern Era,” *Endeavour* 32, no. 4 (2008): 147–51.

86 Robert Plot, *The Natural History of Stafford-Shire* (Oxford: Printed at the Theater, 1686), 142–43.

87 Robert Boyle, *An Essay of the Great Effects of Even Languid and Unbeeded Motion: Whereunto Is Annexed An Experimental Discourse of Some Little Observed Causes of the Insalubrity and Salubrity of the Air and Its Effects* (London: Printed by M Flesher for Richard Davis, 1685), 50.

88 Robert Boyle, “A Confirmation of the Former Account Touching the Late Earth-Quake Near Oxford, and the Concomitants Thereof,” *Philosophical Transactions of the Royal Society of London* 1, no. 11 (1665): 181.

89 For the important relationship of historical study to the production of theories about the earth at this time, see Rappaport, *When Geologists Were Historians, 1665-1750*. A contrasting account focused on the eighteenth century may be found in M. J. S. Rudwick, *Bursting the Limits of Time: The Reconstruction of Geobiology in the Age of Revolution* (Chicago: University of Chicago Press, 2005), chap. 4.

Peruvian earthquake of 1586, which he understood to have extended for 160 leagues, while others in the country had run for up to 300.<sup>90</sup> He also believed that an even larger earthquake had taken place in 1601, reaching from the French coast to Asia and shaking “a great part of Europe”.<sup>91</sup> In his view, the mechanism of transmission for such large earthquakes was unlikely to be subterranean fires or explosions, since even trains of gunpowder would not have been able to convey the fire quickly enough through underground caverns to create a near-simultaneous shock in widely separated places. He thought it more plausible that the shaking of one tract of land transmitted its motion to neighbouring areas through the air, in the same fashion as a cart passing down a street caused surrounding buildings to shake.<sup>92</sup> Since this hypothesis had nothing to do with combustion or pyrites, it put Boyle on the margins of the earthquake discussion at the Society. It seems most likely that he regarded this notion of aerial transmission as a supplement to combustion theories rather than a major revision of them, since he had previously affirmed the existence of subterranean fire, along with hot exhalations “sulphureous and Bituminous in smell”, and had also emphasised the role of local deposits of minerals in the Oxfordshire tremors.<sup>93</sup>

If the years between 1680 and 1685 generated growing interest in the ability of earthquakes to traverse large spaces, without provoking a sea-change in attitudes, the stakes became much higher in

---

90 The key source of information on the Peruvian events was José de Acosta, *Historia natural y moral de las Indias* (Madrid: R Anglés, impresor, 1894), vol. 1, p. 278.

91 Boyle simply alluded to “good writers” as his source, but may have specifically derived his information from Bartholomäus Keckermann, *Meditatio de insolito et stupendo illo terræ-motu: quo anno praeterito, VIII. Septembris ... tota penè Europa & Asia ... pars non exigua uno propè momento contremuit* (Haidelbergae: Typis Vœgelinianis, 1602); Bartholomaeus Keckermann, *Contemplatio gemina: prior, ex generali physica de loco; altera, ex speciali, de terrae motu; potissimum illo stupendo, qui fuit anno 1601, mense septembri* (Hanoviae: Apud Guilielmum Antonium, 1607). The estimate of this earthquake's reach and power was probably an exaggeration: for its effects in Switzerland see Gabriela Schwarz-Zanetti, Nicolas Deichmann, and Donat Fäh, “The Earthquake in Unterwalden on September 18, 1601: A Historico-Critical Macroseismic Evaluation,” *Eclogae Geologicae Helvetiae* 96, no. 3 (2003): 441–50.

92 Boyle, *An Essay of the Great Effects of Even Languid and Unbeeded Motion*, 51–52.

93 Boyle, “A Confirmation of the Former Account Touching the Late Earth-Quake Near Oxford, and the Concomitants Thereof,” 181; Robert Boyle, *Tracts Written by the Honourable Robert Boyle: About the Cosmicall Suspitions, the Temperature of the Subteraneall Regions, the Temperature of the Submarine Regions, the Bottom of the Sea: To Which Is Praefixt An Introduction to the History of Particular Qualities* (Oxford: Printed by W H for Ric Davis, 1670), 29–30.

1687-88, when major catastrophes raised the possibility of connections between disasters in distant parts of an intercontinental empire. On 20 October 1687, a massive earthquake struck Lima and its port of Callao. Many of the major buildings received extensive damage, including the viceroy's palace, the cathedral and the chambers of the Audiencia. Archbishop Melchor de Liñán y Cisneros, convalescing in Callao, became trapped in his sleeping quarters when the earthquake struck. Confined with his chaplain, the two gave each other absolution in the expectation that they would die. However, the men managed to escape by crawling in their nightclothes along a beam, and were thereupon rescued by surviving members of the archbishop's retinue. Further horrors were in store, however, when a massive tsunami smashed into the port. Ships berthed in the harbour broke their anchors and surged onto the land. Lifted in a chair by his followers, the prostrate archbishop narrowly escaped the torrent when the group reached the wall of the dike. Others were not so fortunate: Liñán believed that around 1,000 people had perished.<sup>94</sup> The damage both to Lima and Callao was vast. Most of the provincial capital's inhabitants sought refuge in the plazas, and the viceroy himself (Melchor de Navarra y Rocafull, Duque de la Palata), set up a pavilion for his family in the Plaza Mayor, from where he directed the relief effort.<sup>95</sup>

This severe earthquake-tsunami also produced substantial damage far beyond the capital, which posed special administrative challenges for the secular and ecclesiastical authorities in Lima.<sup>96</sup> The

---

94 Melchor de Liñán y Cisneros to Carlos II, 3 December 1687, AGI, Lima, 304, ff. 3r-5r.

95 "Copia de Carta del Duque de la Palata, para Su Mag.d su fha en Lima a 8. de Diz.e de 1687", BNE MSS/9375, ff142r-145r. For the secondary scholarship on this disaster, see: Pablo Emilio Pérez-Mallaína Bueno, "Le pouvoir de l'État contre les forces de la Nature: la reconstruction de Lima après le tremblement de terre de 1687," *Villes en Parallèle* 25, no. 1 (1997): 160–77; Pablo Emilio Pérez-Mallaína Bueno, "La Fabricación de Un Mito: El Terremoto de 1687 y La Ruina de Los Cultivos de Trigo En El Perú," *Anuario de Estudios Americanos* 57, no. 1 (2000): 69–88; Judith Mansilla, "Providing Temporal and Spiritual Assistance: Responses to the 1687 Earthquake in Lima," *The Latin Americanist* 57, no. 1 (2013): 107–24; Judith Mansilla, "La población de Lima y la administración colonial frente al impacto del terremoto de 1687," *Summa Humanitatis* 8, no. 1 (2015): 52–73; Domenico Cecere, "Subterranea Conspiración?. Terremoti, Comunicazione e Politica Nella Monarchia Di Carlo II," *Studi Storici* 4 (2019): 832–40.

96 In fact, modern seismological investigation indicates that there may have been two different earthquakes in close succession: the first in central Peru and the second in the south. This was not a view expressed at the time,



first of these was the necessity of piecing together the facts of the disaster and the extent of the damage across Peru. As reports to the archbishop and the viceroy drew ever-widening informational rings around Lima, it became increasingly apparent that the scale of the destruction represented something new and frightening. On the day of the disaster the bishop of Arequipa, in the far south of the viceroyalty, wrote to the archbishop to tell him that his city and bishopric lay in ruins, with “entire provinces laid to waste”, so that only a few small buildings in three of four settlements remained standing.<sup>97</sup> Two days later a report from Ica claimed that the sea had retreated a league from the shore, leaving large numbers of fish writhing on the exposed seabed.<sup>98</sup> When it surged back to land the water crashed into the town with immense force, sweeping away the house of the *alcalde*, who miraculously escaped, and destroying more than 50,000 bottles of wine and aguardiente. All of nature seemed disordered: the birds of Ica were too afraid to land on the trees, instead seeking shelter with humans, while trenches opened in the ground and torrents of dirty water issued forth. In Pisco, the tidal wave brought two great ships onto land, smashing them into the city.<sup>99</sup> The people of Otoca, according to the town’s *corregidor*, feared that the surrounding hills would merge together and bury them alive, while Cañete was completely levelled.<sup>100</sup> The bishop of Cusco, high in the mountains, had felt the earthquake in his city too. Although it did no great damage there, he informed the archbishop that he had organised processions and a special service in the cathedral to implore God’s mercy.<sup>101</sup> The archbishop did not conceal his astonishment at the size of the disaster area: “[o]ne of the circumstances that has made this Earthquake so singular is

---

however. L. Dorbath, C. Cisternas, and C. Dorbath, “Assessment of the Size of Large and Great Historical Earthquakes in Peru,” *Bulletin of the Seismological Society of America* 80, no. 3 (1990): 560.

97 “assolandose provincias enteras”, AGI, Lima, 304, f. 12v.

98 AGI, Lima, 304, ff. 13r-v.

99 AGI, Lima, 304, ff. 13v-14r.

100 AGI, Lima, 304, f. 14r.

101 AGI, Lima, 304, ff. 12r-v.

that its motion was of such a great amplitude that it was noted at a distance of more than 700 leagues, running from the port of Concepción de Chile to the City of Zaña in Peru, close to the coast [over 4,000 km away]: the effect was so intense and violent that it destroyed everything in over 200 [leagues], as I note from the letters and news from different parts, from the City of Arequipa to this of Lima”.<sup>102</sup>

The viceroy similarly marvelled over the extent and severity of the earthquake, even though he assigned a more modest area of effect of 280 leagues (the distance between Arica and Chancay); his chief consolations amidst the destruction lay in the preservation of the silver fleet, which had departed from Callao the previous day, and of the mercury mines near Huancavelica.<sup>103</sup> Meanwhile an anonymous writer took some license in describing all the cities of the coast as “totally devastated” (*totalmente desoladas*), claiming that even in the Chilean ports of Concepción and Valparaiso, where the tremors and tidal waves did not cause great damage, all the inhabitants nevertheless “considered themselves dead at the hands of the dual Hurricanes of the Earth and the Sea”.<sup>104</sup> The Franciscan procurator general in Lima, Domingo Alvarez de Toledo, claimed to have received news that even as far away as Ambato in modern Ecuador many people had died, only a half dozen houses remained standing, and a pasture full of cows had disappeared into a crack in the earth.<sup>105</sup>

According to Alvarez’ (unnamed) source of information, the inhabitants of Quito had mounted

---

102 “Una de las circunstancias que mas han singularizado este Terremoto, es q. siendo de tal extension su movim.to que se reconocio en distancia de mas 700 leguas que corren desde el puerto de la Conzpcion de Chile hasta la Ciudad de Saña del Peru proxima a su costa: fue tan intenso, y violento el efecto en mas de las 200 que todo lo assolò, segun he reconocido por las cartas y noticias que [sence] han participado de diferentes partes desde la Ciudad de Arequipa hasta esta de Lima”. AGI, Lima, 304, f. 11v.

103 “Copia de Carta del Duque de la Palata, para Su Mag.d su fha en Lima a 8. de Diz.e de 1687”. BNE MSS/9375, ff. 143v, 144v.

104 “se consideraron muertos â manos de los dos Uraçanes de Tierra y Mar”. “Relacion del temblor que succedio en Lima lunes 20 de ôctubre de 1687”, BNE MS. 18760, f. 4r.

105 “Copia de una Carta que el P.e Fr. Domingo Alvarez de Toledo Procurador General de Corte, de la orden de Nro. P.e San Francisco escrivio desde Lima al Reverendissimo P.e General en Este Chasque; su fha en 29. de octubre de 1687”, BNE MSS/9375, ff. 139v-140r. The distance from Ambato to Concepción de Chile is roughly 5,400 km, so that if this report were accurate most of the western coastline of South America would have experienced the earthquake.

*“innumerables penitencias”* with great public displays of mortification.<sup>106</sup> Sliding easily into the language of prodigies and portents, Alvarez also averred that in distant Santa Fé trumpets had sounded in the air at the precise moment when the earthquake began at Lima.<sup>107</sup> Allowing for the exaggerated tone of these passages, we can deduce that large numbers of people within and beyond the viceroyalty of Peru were broadly conscious of the unusual extension of the earthquake-tsunami, and that the area of intense emotional and psychological impact far exceeded the zone of the most severe physical damage.

On the level of ideas, this event posed the double problem of how to integrate a huge catastrophe of this kind into the local experience of hazards while also addressing its extraordinary scale. After a previous earthquake in 1678, the archbishop of Lima had already taken the opportunity to declare that the recurrence of seismic episodes in Peru did not in any way diminish their spiritual significance. As he understood it, God had made each part of the world prone to particular hazards, such as lightning bolts, torrential rains, floods, plagues or (in the case of Peru) earthquakes, in order to serve as a reminder of God’s supreme power, and thereby place a restraint (*pone por freno*) on human wickedness.<sup>108</sup> Within that scheme, it was possible to identify two general categories: on the one hand the “punishments, or threats” (*los castigos, o las amenazas*) that the elements repeatedly presented in the ordinary course of nature, and on the other the special class of “*publicas calamidades*”.<sup>109</sup> God sent great catastrophes of this latter kind, in his view, for three reasons: to test the faithful, to reform the wicked or to punish the obstinate; but given the inscrutability of

---

106 BNE MSS/9375, f. 140r.

107 BNE MSS/9375, f. 139v.

108 "El Arcob.po de Lima Virrey del Peru. Da cuenta a V.M. del temblor que padecio aquella ciudad A dia 17 de Junio de 1678 Y diligencias que se hicieron para aplacar la divina Justicia", AGI, Lima, 78, no. 3, f. 1v.

109 AGI, Lima, 78, no. 3, ff. 1v, 4r.

divine providence, it was impossible to determine which of the three operated in any one case.<sup>110</sup> Regardless of the divine motive, the response had to be the standard ritual invocation of mercy in order “to revoke the capital sentence of Nineveh”, through processions, confessions, public expressions of grief and moral reform.<sup>111</sup> The view that the 1687 earthquake in particular was qualitatively distinct from most other incidents, and therefore required an especially urgent spiritual response, seems to have been widely shared by ordinary *limeños*. One anonymous writer expressly declared that no such event had occurred in the 153 years since the founding of the City; he looked with approval on the spiritual response of the authorities, particularly the solemn procession of some 3,000 people led by the viceroy and his family, barefoot and ringing bells, with their foreheads daubed with ash and necks collared with ropes.<sup>112</sup> Individuals also made more personal contributions: Doña Antonia del Castillo, an occasional seamstress and member of an indigenous lay organisation called the *Cofradía de Indios de Nuestra Señora de Copacabana*, donated her jewellery in a panic to the confraternity when she thought her life was in danger. In the court case that she subsequently brought to reclaim the items (having repented of her rashness), she emphasised the general terror that animated *limeños* in those “calamitous days” (*calamitosos dias*), which compelled them to perform extraordinary acts of devotion.<sup>113</sup>

Writers found ways to integrate such spiritual responses into a natural philosophical analysis. By the 1680s Peruvians could draw on theories of subterranean combustion to explain earthquakes, as well as the ancient ideas concerning winds and exhalations. One anonymous writer believed that

---

110 AGI, Lima, 78, no. 3, f. 4r.

111 “revocar la sentencia capital de Ninive”. AGI, Lima, 78, no. 3, ff. 2r-v

112 “Diario de las noticias de Lima en que se haze saver de Una traxedia lastimosa que le sobrevino del Cielo el ano de ochenta y siete en Veinte de octubre en adelante”, BNE MSS/13939, f. 125v.

113 “Autos seguidos por doña Antonia del Castillo, hija de don Pedro del Castillo y de doña Juana Negrillo, para sue se le devuelvan unas joyas que ofreció a la cofradía de indios de Nuestra Señora de Copacabana (iglesia de Nuestra Señora de Copacabana) como limosna, porque no contaba con el permiso de su madre”, Archivo Arzobispal de Lima, *Cofradías* 11:13 (1690). I am grateful to Ximena Gómez and Marcella Hayes for this reference.

the secondary (i.e. natural) cause of the earthquake was the rapid evacuation of winds from the inner parts of the earth, producing a series of furious expulsions akin to volcanic eruptions.<sup>114</sup> In 1678 the archbishop had thought that extraordinary earthquakes were the product of a conspiracy of elements, particularly a certain “unsettled” (*descompuesto*) quality of the air and the violent movement of the earth.<sup>115</sup> In 1687 he developed another theory, a hybrid of the exhalation and combustion explanations, to account for the much more severe destruction at Callao. Thanks to its position as a port, the ground of Callao occupied a kind of liminal position between the “superior solid body” (*cuero superior sólido*) of the mainland and the sea. From the latter, “ignited spirits” (*espiritus inflamados*) arose as an exhalation from the lower regions of the sea bed, rarefying the water and breaking the vulnerable coastal ground.<sup>116</sup> These *espiritus inflamados* recall the “fiery spirit” (*spiritus ignatus*) that Georgius Agricola (*De ortu*, 1546) described as a key agent in the production of volcanic eruptions by setting fire to naturally-occurring bitumen in the ground.<sup>117</sup> There is also evidence that syncretic ideas involving combustion, exhalation and divine providence had a wider purchase in Peru. In 1698 an earthquake in Ecuador stimulated great apprehension among *limeños*, not least because the wide impact of the 1687 earthquake had already generated an expectation that a major seismic event elsewhere in the viceroyalty was likely to permeate the whole kingdom.<sup>118</sup> A pamphlet printed to record the elaborate placatory processions and ceremonies in Lima on this occasion

---

114 BNE MS. 18760, f. 2v.

115 AGI, Lima, 78, no. 3, f. 1v.

116 AGI, Lima, 304, f. 4r.

117 Georg Agricola, *De ortu & causis subterraneorum lib. v.* (Basileae: Hieronymum Frobenium, 1546), 34. Compare also Agricola’s exploration of the role of “hot exhalations” (“exhalationes [...] calidæ”) in generating earthquakes (at p. 33). A number of other sixteenth- and early seventeenth-century writers further elaborated this idea: see Rienk Vermij, “Subterranean Fire. Changing Theories of the Earth during the Renaissance,” *Early Science and Medicine* 3, no. 4 (1998): 335–36. As Vermij points out (at 323–5), much of this theorisation of subterranean heat purported to follow Aristotle, but actually relied on pseudo-Aristotelian works such as the *De proprietatibus elementorum* (a ninth-century Arabic treatise) and Albertus Magnus’ commentary on it.

118 It is worth noting the inversion of the experience of 1687, when the destruction in Lima prompted processions in Quito.

reflected that earthquakes were the physical product of “the ignited vapours that our Climate foment”.<sup>119</sup> The anonymous author noted that the mountains of Peru contained not only valuable minerals but also bitumen, which when set alight produced exhalations in the form of volcanoes, that in turn caused earthquakes.<sup>120</sup> However, he also thought that God directed the earth to operate this way in order to express His justice: “the earth fights against the sinner”, but the burning exhalations and fiery “spirit of saltpetre” (*espíritu de el salitre* — another reference to flammable minerals) could be averted if Lima remained morally reformed and thereby retained both angelic and astral protection.<sup>121</sup>

As they attempted to locate elemental and spiritual causes for large-scale destruction, Peruvian commentators tended to treat earthquakes as a part of a special Andean ecology. The 1687 earthquake had pushed the geological bounds of that ecology out to encompass the whole of the viceroyalty (and possibly beyond), but the Peruvian writers of the 1680s and ‘90s do not seem to have envisaged their ideas as applicable on a global scale. However, the wide diffusion of news about the 1687 disaster transferred speculation on its nature to a trans-Atlantic audience, which encouraged broader interpretations. The transmission of disaster news from Lima to Spain was greatly disrupted by the presence of pirates, who preyed on shipping both as it traversed the Peruvian coast and as it left the staging posts of the Caribbean.<sup>122</sup> As a result, reports of the disaster

---

119 “los encendidos vapores, q[ue] fomenta nuestro Clima”. Anon., *Copia de Carta que contiene una breve relacion de los Desagravios, Processiones de Penitencias, y otros actos de edificacion, con q[ue] à procurado esta Ciudad de Lima desarmar la Divina justicia despues de las noticias del Terremoto de Riobamba, la Tacunga, y Ambato: escriviala a un Cavallero ausente una pluma devota*, BNE R/36200, f. 206r/A2r.

120 BNE R/36200, f. 205v/A1v.

121 “Pelee la tierra contra el pecador”. BNE R/36200, ff. 205v/A1v-206r/A2r.

122 This difficulty is noted in the letter of Manuel de Belmonte to the Conde de Oropesa, Don Manuel Joaquín Álvarez de Toledo y Portugal, July 5, 1688, BNE MSS/9403, f. 102r. The autobiography of one of the pirates active at the time reveals the ability of these corsairs to move between the Caribbean and the Pacific: Jacques Raveneau de Lussan, *Journal du voyage fait à la mer du Sud avec les flibustiers de l’Amérique en 1684 et années suivantes, par le sieur Raveneau de Lussan* (Paris: J. Le Febvre, 1699). The viceroy of Peru regarded them as one of the chief threats to the realm, as he made clear in his outgoing report: “Relacion de Gobierno por el Ex.mo Señor Duque de la Palata. Virrey que fue del

at Lima reached England and New England before Spain. “The news about Lima’s Ruine comes abroad”, the Massachusetts merchant Samuel Sewall recorded in his diary: “Above 60.000 persons perished, and now there is a Pool of Water where it stood, if the news be true”.<sup>123</sup> This exaggerated “news” in some way reflected the damage incurred by the tsunami at Callao, but more significantly played upon deep-rooted ideas about the power of earthquakes to effect profound change in the landscape, turning cities into wilderness.<sup>124</sup> Information about the earthquake reached England in the form of the account that the Franciscan Domingo Alvarez de Toledo had addressed to the head of his order. This came by way of Portobelo in Panama and Jamaica, and must have arrived in England before 25 May, when John Evelyn became aware of “the most prodigious earthquake that was almost ever heard of, subverting the city of Lima and the country in Peru, with a dreadful inundation following it”.<sup>125</sup>

The early information about the immense scale of the disaster clearly shocked contemporaries around the Atlantic world. No doubt contributing to their strong reactions was the idiosyncratic quality of Alvarez’ account. In this case what the Atlantic and European communication networks conveyed was not a careful bureaucratic or natural philosophical testimony but a work of intense Peruvian baroque spirituality. Alvarez’ colourful, emotive narrative exaggerated the structural damage to Lima in rhetorical flourishes: he claimed that the city was a

---

Reyno del Peru. Al Ex.mo Señor Conde de la Monclova su subcesor. Hecha en Lima a 18 de Dic.re de 1689. Trasumptada en Mexico año de 1734”, NL VAULT Ayer MS 1198. French colonial correspondence also showed concern about their activities at this time: see for instance the letter from the naval secretariat to Pierre Paul Tarin de Cussy, 9 July 1687, ANOM, B13, f. 25v.

123 Samuel Sewall, *Diary of Samuel Sewall: 1674-1729*, Collections of the Massachusetts Historical Society; Ser. 5, v. 5-7 (Boston: Massachusetts Historical Society, 1878), vol. 1, pp. 211, 362. Sewall initially heard the news on 4 August.

124 The idea that Peruvian earthquakes were so powerful as to replace towns with lakes dated back to the sixteenth century: Acosta, *Historia natural y moral de las Indias*, III.26. It also built upon the descriptions of the environmental changes produced by earthquakes in Pliny, *Historia naturalis*, II.lxxxii and II.lxxxix and Seneca, *Naturales quaestiones*, III.16.4.

125 John Evelyn, *The Diary and Correspondence of John Evelyn*, ed. William Bray, New edition (London: George Bell and Sons, 1908), vol. 2, p. 275.

melancholy “ruin levelled to the Ground with all its grandness and buildings”.<sup>126</sup> His interpretation of the disaster was also extremely providential in character. In a similar fashion to Barzia’s sermon in 1680, he declared that God had made the earthquake so immense and horrible “only in order for the image of death to awaken us from our [spiritual] sleep”.<sup>127</sup> He also gave unquestioning endorsement to stories of the prophetic visions of nuns after the catastrophe. A Mother Angela claimed that God had revealed to her that He would destroy the city entirely, unless *limeños* emended four of their worst sins immediately.<sup>128</sup> Doña Marcelina of the order of Our Mother of Santa Clara said that she had seen a singing apparition of a fellow nun who had died in the earthquake; this ghost informed her that God had wanted to destroy the entire kingdom outright, “handing it over to Barbarous Nations”, but that Mary had successfully interceded on Peruvians’ behalf.<sup>129</sup> Alvarez described in some detail the imagined drama of intercession in the celestial court. However, alongside these stories of prodigies he also drew attention to the wide geographical spread of the shaking and the damage it had caused from Lima to the province of Quito.<sup>130</sup>

The Council of State in Madrid first learned of the destruction from Pedro Ronquillo, the Spanish ambassador in London, who relayed Alvarez’ account on June 7.<sup>131</sup> Since it had arrived in Madrid by such a circuitous route and no other news had yet reached the government, the Constable

---

126 “triste su ruyna arrassada por los Suelos con toda su grandeza, y edificios”, “Copia de una Carta que el P.e Fr. Domingo Alvarez de Toledo Procurador General de Corte, de la orden de Nro. P.e San Francisco escrivio desde Lima al Reverendissimo P.e General en Este Chasque; su fha en 29. de octubre de 1687”, BNE MSS/9375, f. 138r.

127 “solo fué para despertarnos del sueño imagen de la muerte”, BNE MSS/9375, f. 138r.

128 These consisted of the injustices committed by the potentates against the poor; profane dress and excessive ornamentation in dress and buildings; greed for lands and honours; and luxury.

129 “entregandolo a Barbaras Naciones” — probably either a reference to indigenous peoples or English pirates. BNE MSS/9375, f. 139v.

130 BNE MSS/9375, ff. 139v-140r.

131 “Remito à V.M. la lastimosa relacion de la total ruyna de Lima [...] estas cartas las trujo un Navichuelo de Bristol [...]”. Don Pedro Ronquillo, 7 June 1688, AGS EST, 3963. This letter reveals that the Spanish court first received news about the disaster earlier than scholars have previously thought, and by means of a different channel. Contrast the account in Cecere, “‘Subterranea Conspiración’. Terremoti, Comunicazione e Politica Nella Monarchia Di Carlo II,” 837–38.



of Castile believed it to be false or exaggerated when the Council discussed it.<sup>132</sup> His scepticism was also aroused by the alleged preternatural occurrences in the testimony. Indeed, in many ways Alvarez' account resembled the fantastical stories about Peruvian and Chilean disasters that had circulated in the 1650s.<sup>133</sup> However, other Council members concurred with Ronquillo's opinion that more official reports had probably been sent, but were either lost at sea or intercepted by pirates.<sup>134</sup> The Council accepted the standard providential reasoning that the disaster must have been "a punishment that our Lord has desired to send to those people for their disorders, lack of Justice, and bad government".<sup>135</sup> However, it also delicately pointed out that the catastrophe bore a moral message for the imperial government in Spain as well: "this event can serve us also as a warning, in case there should be something to be emended here, without waiting for God to take upon himself the satisfaction". The council softened what could have been taken as an implicit criticism of Carlos II's reign by suggesting that this was the sort of "pious and Christian consideration, which all sovereigns must make on such occasions".<sup>136</sup> It then turned its attention to urgent practical matters. With their fortifications damaged and their armaments depleted, *limeños* would be "exposed to the ultimate fatality" if a foreign power or the pirates should invade. After all, they considered, "a ruined Country can be repaired, but a Country that is lost cannot".<sup>137</sup> Shortly after the Council session a second account arrived in Madrid to verify the news, transmitted from the Netherlands by the Spanish royal agent Manuel de Belmonte. This more detailed report

---

132 AGS, Estado, 3963, ff. 5v-6r.

133 See the discussion in ch. 2.

134 AGS, Estado, 3963, ff. 3v-4r.

135 "[...] un castigo que nro sr. há querido émbiar á aquellos pueblos por sus desordenes, y falta de Justicia, y mal gobierno [...]". AGS, Estado, 3963, f. 2r.

136 "[...] este suceso nos puede servir también de advertencia, por sí ubiése alguno que enmendar por acá, sin esperar que Dios tome por sí la satisfaccion; esto es por lo que mira ala consideracion pia y xstiána, que todos los soberanos deven haçer en semejantes sucesos". AGS, Estado, 3963, f. 2r.

137 "[...] éxpuesto a ultima fatalidad [...] Pays arruinado puede tener remedio, pero Pays perdido no lo tiene", AGS, Estado, 3963.

concluded by mentioning the vast geographical scale of the earthquake and tsunami, which it said had affected the whole region from Arequipa to Chancay, over a thousand kilometers away.<sup>138</sup>

Accounts from Lima also made their way to France, both through Spain and the Caribbean. These included a French epitomisation of Alvarez de Toledo's narrative, forwarded by Pierre-Paul Tarin de Cussy, the governor of Saint Domingue and Tortuga.<sup>139</sup> However, de Cussy refused to repeat the lurid stories of visions and revelations in Alvarez' account, suggesting that "these kinds of things resemble rather paganism than Christianity".<sup>140</sup> In July the *Mercure Galant*, which also repeated parts of Alvarez' account, noted that many in France doubted the extraordinary news, which was still arriving by way of England and Jamaica rather than Spain or Panama.<sup>141</sup> By July 5 the French consul in Cádiz, Pierre de Catalan, had also heard of the disaster in Peru, and communicated this news to Jean-Baptiste Colbert de Seignelay, Secretary of State for the Navy. Catalan admitted that no ship from Spanish America had yet arrived in Cádiz, but the captain of an English vessel in the harbour told him that he had received news at Jamaica of "three earthquakes at Lima of such fury that they had destroyed most of the houses and killed a large number of people". Catalan immediately calculated the implications of the reported disaster for trans-Atlantic trade: "if that [news] is true, as I fear it is, there can be no doubt that there will be many losses to suffer, both for the inhabitants of Lima and for general Commerce".<sup>142</sup> By July 19 he had something concrete to

---

138 Manuel de Belmonte to the Conde de Oropesa, Don Manuel Joaquín Álvarez de Toledo y Portugal, July 5, 1688, BNE MSS/9403, ff. 102r-104r. Belmonte explained that this account had travelled from Lima by way of Guayaquil, Cartagena and Jamaica.

139 "Extrait d'une Lettre q'un Pere de Lordre de St Francois nommé alvaro de Toledo escrit au Reverend Pere Commissaire gen.al de Lima le 20e. 8bre. 1687 au sujet d'un prodigie [sic] Tremblement de terre", ANF MAR/B/7/212, ff. 3r-5r.

140 "[...] ces sortes de choses ressentans plus tost le paganisme que le Christianisme [...]". ANF MAR/B/7/212, f. 4v.

141 *Mercure Galant*, July 1688, 87-9.

142 "[...] trois tremblements de terre a lima sy furieu<x> quilz avoient abismé la plus part des maison<s> et fait perir grand nombre de monde"; "sy cellà est vray comm<ent> l'on Craint Il ne faut pas doupter quil y a<ura> bien des

transmit to Versailles to confirm the information from England: a copy of a short letter from the viceroy of Peru to the governor of Guayaquil (dated 28 October), brought by a ship from Cartagena to Sanlúcar de Barrameda.<sup>143</sup> Responding to Colbert de Seignelay's request for more information on the *desordre* at Lima, in December he relayed a further message from the viceroy to Guayaquil, which emphasised both the severity of the damage to buildings in the provincial capital and the vast spread of the coastal destruction from Chancay to Pisco.<sup>144</sup> Catalan also learned from the same vessel that 3,000 people had died in Chile of disease, so that the picture he relayed to France was of a Pacific coast in chaos.<sup>145</sup> In letters from Portobelo he later discovered that Lima, too, had suffered an epidemic after the earthquake, but "they do not report the length of time that it lasted, nor the ravages it has made, only that everybody is greatly reformed since that time".<sup>146</sup>

Just as Europeans struggled to make sense of the scale of the catastrophe in Peru, a second major earthquake on June 5 of 1688 in southern Italy added another layer of complexity to their analyses, since the nearly simultaneous circulation of news about these two disasters challenged contemporaries to find ways to connect or reconcile them.<sup>147</sup> The kingdom of Naples, a Spanish

---

perles a souffrir tant pour les habi<tants> de Lima que pour le Commerce general [...]". Pierre de Catalan to Jean-Baptiste Colbert de Seignelay, July 5, 1688, ANF AE/B/I/213, f. 133v.

143 "Copia de Carta del ex.mo Sr. Virrey de 28 de Octt.re 1687 [...] escrita al Gene.l D. fern.do Ponçe de leon Gover.or de Guayaquil", ANF AE/B/I/213, f. 139r.

144 Appended to this was a note in French about the looting that had taken place after the earthquake, and the viceroy's crackdown on. "Copia de Carta del Ex.mo S.or Virrey de lima de 28 de Octt.re 1687 escrita al General Dn. fernando Ponce de leon", ANF MAR/B/7/212, ff7r-8r. This must have been the enclosure referred to in the letter, Pierre de Catalan to Jean-Baptiste Colbert de Seignelay, December 6, 1688, ANF AE/B/I/213, ff188r-190v.

145 Other accounts suggested a death toll in Chile in excess of 15,000: Anon., *Relacion del exemplar castigo que embió Dios á la Ciudad de Lima Cabeça del Perú, y à su Costa de Barlovento con los espantosos Temblores del dia 20 de Octubre del Año de 1687* (Con licencia en Lima, y por su original en México: por la viuda de Francisco Rodriguez Lupercio, 1688), A3v.

146 "[...] elles n'avisent point le tems qu'il y a duré, n'y du ravage qu'il y a fa<it> seulement que tout le monde y est fort reformé depuis ce tems la". Pierre de Catalan to Jean-Baptiste Colbert de Seignelay, April [misdated?], 1688, ANF AE/B/I/213, f. 215v.

147 The June issue of the English periodical *Modern History* reported the news of the catastrophe at Naples alongside an English translation of Alvarez' Peruvian account, excusing the delay on the basis that the latter's authenticity had been consistently denied by writers in Madrid. *Modern History or A Monthly Account of All Considerable Occurrences*, June 1688, no. 9. In July, the *Mercure Galant* similarly juxtaposed the continuing uncertainty about events in Lima with definite information about the destruction in Italy: *Mercure Galant*, July 1688, p. 89.

imperial possession since 1503, was no stranger to seismic activity. However, the earthquake of 1688 was a particularly powerful one, incurring a death toll of perhaps ten thousand people across the kingdom and the neighbouring papal enclave of Benevento, and destroying many buildings in Naples itself.<sup>148</sup> As with the catastrophe at Lima, providential interpretations dominated the explanations of this disaster. Importantly, the ground had already been prepared for these kinds of narratives in February, when the Congregation of Bishops in Rome sent out a declaration, to be transmitted through each diocese, that warned of “the imminent punishment, that may be justly feared from Lord God, [who has been] vexed by continuous faults”, and whose wrath could only be placated through the repentance of the populace.<sup>149</sup> In France, the *Mercure Galant* initially considered that the physical origin of the earthquake was the same subterranean fire that Vesuvius occasionally ejected: since there had been no eruptions for some time, this fire must have become trapped in the earth, and as the pressure grew the ground above it shook.<sup>150</sup> However, by August the *Mercure* speculated that the earthquake might not have arisen from natural causes at all, and was rather one of the “great scourges of the anger of God”, brought about by the “general corruption” in southern Italy, “where they lived worse than in Sodom”.<sup>151</sup> One particularly egregious case concerned a Spanish Carmelite monk in Naples who had allegedly sold consecrated Hosts, so that they could be

---

148 BNE MSS/8379, ff. 170r-174r. On this earthquake see Mario Baratta, *I Terremoti d'Italia: Saggio Di Storia, Geografia e Bibliografia Sismica Italiana* (Torino: Fratelli Bocca, 1901), 154–63; Riccardo Lattuada, “La ricostruzione a Napoli dopo il terremoto del 1688: architetti, committenti e cultura del ripristino,” in *Contributi per la storia dei terremoti nel bacino del Mediterraneo: secc. V-XVIII*, ed. Aldo Marturano, Storia e scienze della terra 5 (Salerno: Laveglia, 2002); Monica Azzolini, “Coping with Catastrophe. St Filippo Neri as Patron Saint of Earthquakes,” *Quaderni Storici* 52, no. 3 (2017): 727–50; Cecere, “Subterranea Conspiración? Terremoti, Comunicazione e Politica Nella Monarchia Di Carlo II,” 821–32.

149 “[...] l'imminente castigo, che giustamente si può temere dal Sigr. Iddio, irritato dalle continue colpe [...]”. “Lettera circolate à tutti i Vescovi d'Italia, che si manda dalla Congreg.ne de Vescovi”, 21 February, 1688, BNE MSS/978 ff. 223r-v.

150 *Mercure de France*, July 1688, pp. 97-98.

151 “de grands fleaux de la colere de Dieu”; “la corruption generale qui estoit dans ce Pays, où l'on vivoit plus mal qu'à Sodome”. *Mercure Galant*, August 1688, 171, 178-9. The writer qualified these searing remarks with the phrase “if what they write to us about it is true” (“si ce que l'on nous écrit est veritable”).

used in spells that would allow the enchanter to win lotteries and games of chance.<sup>152</sup> Refuting the opinion of those who thought this earthquake was totally unprecedented in scale, the *Mercure's* writer pointed out that such massive earthquakes had indeed happened in the past — but rather than looking to Lima or Málaga, he turned (as Barzia had done) to Byzantine history, and the destruction of several cities in Syria in 750 CE.<sup>153</sup>

However, in the context of the news from Peru an emphasis on the divine punishment of local transgressions no longer seemed sufficient to many contemporaries. When the news of the 1688 disaster arrived in Spain its character transformed from a chastisement of merely local sins to a question of the spiritual integrity of the empire as a whole.<sup>154</sup> The Council of State had advised the king on July 7 that the disaster at Lima should occasion some kind of moral reform in Spain.<sup>155</sup>

After considering the disaster news from Naples, Carlos II resolved upon a general spiritual response, ordering towns all over the country to conduct special rogative services and processions in order to implore divine mercy.<sup>156</sup> The Count of Bornos penned verses on 28 July to commemorate the earliest ceremonies in Madrid, in which he pointed out that although the shaking had occurred at Naples, “[o]ver here we are trembling”, because “we are all of one earth” and the anger of God

---

152 *Mercure Galant*, August 1688, 179-80.

153 *Mercure Galant*, August 1688, 178. His source for this was Nikephoros Kallistos Xanthopoulos' *Historia ecclesiastica*. A new abridged French translation had appeared only four years earlier: Nikephoros Kallistos Xanthopoulos, *Abregé de l'histoire byzantine de S. Nicephore, Patriarche de Constantinople*, trans. Pierre Moret (A Paris: Chez Jean & R.J.B. de la Caille, 1684). A belated review of this edition noted the earthquake of 750 as one of the book's key points of interest: *Journal des Sçavans*, 1695, no. III, 33-4.

154 The viceroy in Naples sent an account of the disaster to the Spanish court on 11 June: AGS, Estado, Nápoles, 3319, f. 85. For discussion of this see Cecere, “Subterranea Conspiración?. Terremoti, Comunicazione e Politica Nella Monarchia Di Carlo II,” 824. Note that the viceroy dispatched his letter just a few days after Ronquillo forwarded his copy of Álvarez' account of the Lima earthquake to the court.

155 AGS, Estado, 3963, f. 2r.

156 A copy of this order is in AHN, Estado, 3169, no. 28. The order referred to the earthquake in Naples but omitted that of Lima. This was because, as one preacher put it, “the news was not yet certain” (“no eran aun ciertas las noticias”). Vicente Noguera, *Sermon de rogativas por los terremotos sucedidos en las ciudades de Napoles, y Lima: celebradas de orden del Rey ... la ... Diputacion, y Reyno de Valencia, en 13 de setiembre 1688* (Valencia: en la Imprenta de Iaime de Bordazar, en la Plaça de las Barcas, 1688), 3. However, by the time the rogative ceremonies took place more information had arrived to authenticate the news of the disaster, so that some towns made reference to both catastrophes in their proceedings.

threatens all alike.<sup>157</sup> In Toledo, the chaplain Mathias Fernández de Consuegra drew clear links between the catastrophes in Italy and Peru in verses printed to accompany the rogative procession in his city. God had become so furious with the sins of the empire's subjects, he maintained, that Lima's destruction was only a dress rehearsal for the main judgement. Once He had reprimanded Peru, "careless" Naples became the next target for the divine bullet.<sup>158</sup> Consuegra conjured up an empire that was completely connected in its experience of disaster, as if it shared a single intercontinental nervous system: "the blow that struck Lima / Was heard in Toledo, and that astonishing occurrence / Naples duplicates, in shocks / That everyone by now feels".<sup>159</sup> His message was clear: the residents of Toledo should be alarmed by disasters not just in their own province but elsewhere in the empire, and actively root out their own sins in order to avoid the same destruction.

To understand the relationship between these disasters at distant points of the globe, Spanish writers again turned to the comparative study of historical and scriptural earthquakes. The rogative sermon of Vicente Noguera, canon of the cathedral of Valencia, drew on some of the same examples that Barzia and others had used earlier in the decade, including the destruction of the twelve cities in Asia Minor during the reign of Tiberius.<sup>160</sup> He now linked this event explicitly to the

---

157 "[...] Por âca êsttamos temblando [...] todos somos de una tierra [...]". "Romance en la rogattiba sobre el tterremotto [sic] de Napoles êstte año de 1688", AHNz BORNOS,C.242,D.5, f. 1v.

158 "Napoles [...] descuidada" Matias Fernández de Consuegra, *Relacion suscinta de la solemne, quanto deuota procesion de rogatiua, que por el estrago de Lima, y Napoles ha celebrado la piedad de los fieles imperiales de la my catbolica, y nobilissima ciudad de Toledo, à solicitud de su devotissima esclavitud (ò Hermandad) de Nuestra Señora de la Esperanza de San Lucas ... y devota procesion saliò al real monasterio de Santa Fè religion del grande apostol patron de las Españas Santiago, el dia cinco de agosto de 1688* (n.p.: n.p., 1688), f. 2v.

159 "Oyòsse de Lima el golpe / En Toledo, y lo assombroso / Napoles duplica, en pasmos / Sintiendo ya el Temblor todos".

160 Noguera, *Sermon de Rogativas Por Los Terremotos Sucedidos En Las Ciudades de Napoles, y Lima*, 13. Besides Pliny, his sources were Tacitus, *Annals*, II.47 and the brief note in Suetonius, *Life of Tiberius*, XLVIII. Different aspects of Noguera's sermon are considered in Armando Alberola-Romá, "Terremotos, memoria y miedo en la Valencia de la Edad Moderna," *Estudis. Revista d'Història Moderna* 38 (2012): 58; Cecere, "'Subterranea Conspiración'. Terremoti, Comunicazione e Politica Nella Monarchia Di Carlo II," 811–12.

earthquake that shook “the whole globe of the earth” (*todo el globo de la tierra*) upon the death of Christ. Noguera’s authority for this was the text *De mirabilibus sacrae scripturae* (*Of the miracles of the sacred Scripture*), widely credited to the Church Father Saint Augustine, although it was actually the work of a seventh-century Irish monk.<sup>161</sup> Alongside ancient and Biblical episodes Noguera added the example of the earthquake that had devastated Santiago de Chile in 1647.<sup>162</sup> Thus, whereas Barzia had thought only in terms of Europe and the Mediterranean, Noguera’s perspective was trans-Atlantic and indeed, at least on a superficial level, global. Noguera spoke in terms of “the vast body of the earth” (*el cuerpo vasto de la tierra*) because in his view the same terrestrial nature linked Spain with America and Italy.<sup>163</sup> He likened God’s causation of two earthquakes in distant parts of the earth to a man grasping hold of a bird by both its wings.<sup>164</sup> In an idiosyncratic, Catholicised reading of Aristotle’s *Meteorologica*, Noguera told his audience that the earth was not to blame for earthquakes because it too suffered: instead it was the inspirited air within the earth that caused the commotion, and it was human sin that agitated it. He continued by adapting a metaphor of Thomas Aquinas: sinners were the clothes-moths on the world’s tunic, and to get rid of them God had to

---

161 Noguera, *Sermon de Rogativas Por Los Terremotos Sucedidos En Las Ciudades de Napoles, y Lima*, 13. Pseudo-Augustine, *De mirabilibus sacrae scripturae*,

II.3. The relevant passage in the 1473-4 manuscript of Nicolaes Ketelaer and Gerard de Leempt (Universiteitsbibliotheek Utrecht, F fol 302 (Rariora) dl 3) reads: “[...] et in terre motu d.nice passionis undecim [urbes] in tracia subverse sunt [...]”. For the authorship of the treatise see Mario Esposito, “On the Pseudo-Augustinian Treatise, ‘De Mirabilibus Sanctae Scripturae’: Written in Ireland in the Year 655,” *Proceedings of the Royal Irish Academy* C35, no. 2 (1919): 189–207. There are discrepancies with Pliny’s (and Noguera’s) account: Pseudo-Augustine numbered the destroyed cities as 11 not 12, and gave their location as the province of Thrace rather than Asia. The author also referred to an earthquake overturning 100 cities in Libya, however he did not describe the earthquake at the Passion as global in scope. Cornelius Lapidè’s Biblical commentary on Matthew 27, also cited by Noguera, referred to Pliny’s and Suetonius’ account of a great earthquake in Asia, but similarly made no claim for a global event. Noguera’s information on this point instead came from Orosius, *Historiae adversus paganos*, VII.4.

162 Noguera, *Sermon de Rogativas Por Los Terremotos Sucedidos En Las Ciudades de Napoles, y Lima*, 12. His source for this was Gaspar de Villarroel, *Gobierno Ecclesiastico pacifico, y union de los dos cuchillos, pontificio y regio* (Madrid: D. Garcia Morràs, 1656), II.XX.ii.

163 Noguera, *Sermon de Rogativas Por Los Terremotos Sucedidos En Las Ciudades de Napoles, y Lima*, 9.

164 Noguera, 9.

shake the earth vigorously. “When there aren’t any clothes-moths in the world”, he concluded, “there aren’t any earthquakes in the ground”.<sup>165</sup> It was no wonder, then, that Lima and Naples had both suffered earthquakes, since not only the rags of the poor in those places but even the robes of the king were being consumed by the insects of wickedness. Noguera pointed out that the concern the two disasters had generated in Valencia was in part prompted by “the fear of not knowing whether the Divine Justice is yet satisfied with the current damage, or if it still has its bow nocked to shoot new furies against us”.<sup>166</sup> This prevailing sense of menace indicates a growing public perception that catastrophes were not self-enclosed events but rather open processes that threatened communities in different parts of the earth.

This reconceptualisation of providential judgements from local chastisements to trans-continental processes was a highly significant shift in the theological interpretation of disaster. The sins of local communities retained a key role, but they now needed to be set in the context of the suffering of distant populations and the morality of whole imperial polities. They also involved imagining hazards not only as part of local ecologies but as possible functions of a global environment, imagined as a machine operated by divine levers. Noguera talked about “the machine of the universe” (*la maquina del universo*), which in earthquakes worked to dissolve man’s final refuge (the earth) against the other three elements.<sup>167</sup> Bornos’ line “we are all of one earth” indicated that the earthquakes of 1687-88 were reminders of the global unity of mankind. Like Noguera, he invoked the earthquake at the death of Christ, which according to Christian doctrine had signalled the redemption of humanity.<sup>168</sup> Others outside Spain were also prepared to see some great spiritual

---

165 “No aya polilla en el mundo, y no avrà terremotos en la tierra”. Noguera, 9.

166 “[...] el temor de no saber, si la Iusticia Divina se dà por satisfecha con los estragos presentes, ò si tiene aun flechado el arco, para disparar nuevas iras contra nosotros”. Noguera, 3.

167 Noguera, 5.

168 AHNz BORNOS,C.242,D.5, f. 1r.



message in these earthquakes. In September of 1688, Evelyn associated the disaster at Lima not only with the earthquake in Italy, but also with others in Smyrna and Greece. Reflecting on the concurrence of these events within a short span of time, he considered them “forerunners of greater calamities”, adding: “God Almighty preserve His Church and all who put themselves under the shadow of His wings, till these things be over-past!”<sup>169</sup>

To match this geographical expansion in providential interpretations, other commentators began to postulate physical connections between the various disaster events. In July of 1688, Hooke presented a lecture to the Royal Society in which he reflected on the “Contemporariness of Earthquakes at great distances upon the Earth”.<sup>170</sup> Here he speculated not only on a possible relationship between the earthquakes in Peru and Italy, but also a recent epidemic in England and apparent changes in the climate. Refusing to enter into an analysis of celestial conjunctions (he would “leave those to the Astrologians”), he identified as the key factor linking all these phenomena the air.<sup>171</sup> Volcanic eruptions, he knew, could shoot forth air and matter to a tremendous distance, and he evidently considered earthquakes equally capable of expelling air at great force. This fitted neatly into Hooke’s nascent theories of global air circulation. Subterranean vapours had long been thought to carry “noxious effluvia” that caused diseases,<sup>172</sup> but Hooke was the first person to hypothesise that corrupt air could be blown across the globe to cause an epidemic in another continent. He also thought that earthquakes and eruptions could alter the climate, or that the same cause that produced them also worked upon the atmosphere. It could be no coincidence, in his view, that the Málaga earthquake a few years prior had coincided with terrible droughts, followed by

---

169 Evelyn, *The Diary and Correspondence of John Evelyn*, vol. 2, p. 280.

170 Hooke, “A Discourse of Earthquakes,” 428–33.

171 He did however make special note of comets, implying that he would speak of their significance at another time.

172 e.g. Albertus Magnus, *Meteora*, III.ii.12.

catastrophic storms and floods.<sup>173</sup> Finally, he was eager to extend the analysis further both spatially and temporally, to consider the coincidence of extreme climatic events with earthquakes in China and the East Indies. All these phenomena seemed to him to share “more than an accidental Concurrency of Effects”. However, it seems his ideas on the subject were too ambitious to develop properly within a single lecture, so he deferred any definite conclusions and never again resumed his speculations on the matter. Nevertheless, Hooke’s innovative lecture constituted a key step towards the creation of physical disaster ideas on a global scale, as well as an important precursor to later climatic theories of disaster.

Questions about the physical and moral scope of disasters received a new impetus in 1692, when news circulated of a massive earthquake in Jamaica. The island’s mercantile centre, Port Royal, had by this stage become one of the largest and wealthiest settlements in the British Americas. Its many residents lived crowded together within a narrow spit of land extending into the harbour. When the earthquake struck in June 1692 the spit quickly became inundated, the sandy ground liquefied and buildings tumbled down or slid into the sea with their occupants inside. Contemporaries variously estimated the death toll at between 1,500 and 5,000.<sup>174</sup> After the earthquake, a deadly epidemic surged through the colony’s beleaguered population, perhaps brought about by the fetid living

---

173 He apparently accepted as factual some of the claims in the pamphlet literature, including the account of fish spontaneously leaping onto fishing boats in the moments before the earthquake at Málaga. For this story see Anon., *Relacion verdadera de la lastimosa destruicion, que padeciò la ciudad de Malaga, por el espantoso terremoto que sucediò el miercoles 9 de octubre deste presente año de 1680*, f. 1v.

174 Bodleian Library MS Ballard 39, doc. 45, f. 85r; Narcissus Luttrell, *A Brief Historical Relation of State Affairs, from September 1678 to April 1714*, vol. 2 (Oxford: Oxford University Press, 1857), 534; Captain Crocket, *A True and Perfect Relation of That Most Sad and Terrible Earthquake, at Port-Royal in Jamaica, Which Happened on Tuesday the 7th. of June, 1692...* (London: Printed by R Smith, and are to be sold by G Croom and William Miller, 1692); Anon., *The Truest and Largest Account of the Late Earthquake in Jamaica, June the 7th, 1692* (London: Printed for Tho. Parkhurst, 1693), 4. Charles Hatton to Christopher, Lord Hatton, August 10 1692. In Edward Maunde Thompson, ed., *Correspondence of the Family of Hatton, Being Chiefly Letters Addressed to Christopher, First Viscount Hatton, 1601-1704*, vol. 2, Camden Society. Publications, n.s., XXII-XXIII (Westminster: Printed for the Camden society, 1878), 183.

conditions and crowds of putrefying bodies, or the unprecedented numbers of mosquitoes.<sup>175</sup> By December, Captain Lawrence Hammond received word in Boston that some 4,000 people had died of disease on the island.<sup>176</sup>

Many early interpretations of the catastrophe tended to revert to the motif of a localised judgement on wickedness, and there was much for contemporaries to find fault with, given the male colonists' notorious penchant for drinking, gambling and prostitutes, as well as their growing wealth and the presence among them of political dissidents and heterodox sects.<sup>177</sup> The English physician Hans Sloane, who had treated members of the population for various ailments during his sojourn on the island, lamented the Jamaican habit of heavy drinking and criticised the people as “more

---

175 The Council of Jamaica to the Earl of Nottingham, 20 September 1692; Samuel Bernard to the Earl of Nottingham, 20 September 1692, J W Fortescue, *Calendar of State Papers Colonial, America and West Indies*, vol. 13 (Printed for His Majesty's Stationery Office: London, 1901), 710–11.

176 Lawrence Hammond, *Diary Kept by Capt. Lawrence Hammond: Of Charlestown, Mass. 1677-1694*, ed. Samuel A. Green (Cambridge [Mass.]: J Wilson and Son, 1892), 23. This was on top of the 2,000 that he believed had perished in the earthquake. For modern accounts of the disaster, see Michael Pawson, *Port Royal, Jamaica* (Oxford: Clarendon Press, 1975), chap. 9; Matthew Mulcahy, “The Port Royal Earthquake and the World of Wonders in Seventeenth-Century Jamaica,” *Early American Studies: An Interdisciplinary Journal* 6, no. 2 (2008): 391–421; Ben Hughes, *Apocalypse 1692: Empire, Slavery, and the Great Port Royal Earthquake* (Yardley, Pennsylvania: Westholme Publishing, LLC, 2017), chap. 7. For the earthquake's place within the longer social, commercial, demographic and urban history of the island, see Orlando Patterson, *The Sociology of Slavery: An Analysis of the Origins, Development and Structure of Negro Slave Society in Jamaica*, Studies in Society (London: MacGibbon & Kee, 1967), 18–21; Carl Bridenbaugh and Roberta Bridenbaugh, *No Peace beyond the Line: the English in the Caribbean, 1624-1690*, Bridenbaugh, Carl. *Beginnings of the American People 2* (New York: Oxford University Press, 1972), 189–91; Richard S. Dunn, *Sugar and Slaves: The Rise of the Planter Class in the English West Indies, 1624-1713* (Chapel Hill: Published for the Omohundro Institute of Early American History and Culture by the University of North Carolina Press, 2000), 187; Nuala Zahedieh, “‘The Wickedest City in the World’: Port Royal, Commercial Hub of the Seventeenth-Century Caribbean,” in *Working Slavery, Pricing Freedom: Perspectives from the Caribbean, Africa and the African Diaspora*, ed. Verene Shepherd (Kingston : Oxford: Ian Randle Pub.; James Currey Pub, 2002), 3–4; James Robertson, “Rewriting the English Conquest of Jamaica in the Late Seventeenth Century,” *The English Historical Review* 117, no. 473 (2002): 815, 818, 839.

Louis P. Nelson, *Architecture and Empire in Jamaica* (New Haven ; London: Yale University Press, 2016), chap. 3.

177 On the religious, political and social features of the colony and their relationship to allegations of divine judgement, see David Manning, “Reformation and the Wickedness of Port Royal, Jamaica,” in *Puritans and Catholics in the Trans-Atlantic World, 1600-1850*, ed. Crawford Gribben and Scott Spurlock, Christianities in the Trans-Atlantic World, 1500-1800 (New York: Palgrave Macmillan, 2016), 131–63. Religious interpretations are further discussed in Larry Gragg, “The Port Royal Earthquake,” *History Today* 50, no. 9 (2000): 28–34; Susan Scott Parrish, *American Curiosity: Cultures of Natural History in the Colonial British Atlantic World* (Chapel Hill: University of North Carolina Press, 2006), 99–100. For a contrary view emphasising physical explanations of the disaster, see Mulcahy, “The Port Royal Earthquake and the World of Wonders in Seventeenth-Century Jamaica.”

debauch'd than in England".<sup>178</sup> One travel account colourfully described the island as "The Receptacle of Vagabonds, the Sanctuary of Bankrupts, and a Close-stool for the Purges of our Prisons"; "As Sickly as an Hospital, as Dangerous as the Plague, as Hot as Hell, and as Wicked as the Devil".<sup>179</sup> Given this reputation it proved easy to characterise the earthquake as a judgement on Port Royal in particular, as the epicentre of the island's sinning: according to one news-sheet, "this Place has been one of the Ludest in the Christian World, a Sink of all Filthiness, and a meer Sodom".<sup>180</sup> The analogy of the destruction of Sodom and Gomorrah, that archetypal episode of divinely directed disaster, informed several of the accounts sent from Jamaica. Emmanuel Heath, the minister of Port Royal, described the devastated city as a "wretched sinfull place", adding that "God in some short time will utterly destroy" it.<sup>181</sup> When Heath's letters were worked up later into a pamphlet, their language became even more lurid: the islanders were "a most Ungodly Debauched People"; "I hope by this terrible Judgment, God will make them reform their lives, for there was not a more ungodly People on the Face of the Earth".<sup>182</sup> Many of the islanders clearly found such representations of their moral state offensive: when the Quaker planter Joseph Norris tried to preach to the colonists (for the third time), with an exhortation of repentance for their grievous sins,

---

178 Hans Sloane, *A Voyage to the Islands Madera, Barbados, Nieves, S. Christophers and Jamaica...* (London: printed by B M for the author, 1707), vol. 1, p. xxxi.

179 Edward Ward, *A Trip to Jamaica: With a True Character of the People and Island.*, The fourth edition. (London: sn, 1699), 14.

180 Crocket, *A True and Perfect Relation.*

181 "From on board the Granada in the Harbour of Port Royal", 19 June 1692, Bodleian MS Ballard 39, doc. 45, f. 86r.

182 Emmanuel Heath, *A Full Account of the Late Dreadful Earthquake at Port Royal in Jamaica: Written in Two Letters from the Minister of That Place: From a Board the Granada in Port Royal Harbour, June 22, 1692.* (London: Printed for Jacob Tonson, and sold by R Baldwin, 1692), 1–2.

a Major Harrison “frothyly said how now so, has not our Sermon been long enough already, that thou must come and make it longer, threatning [sic] me with a Prison if I would not begone”.<sup>183</sup>

This message of the divine punishment of a latter-day Sodom spread around the Caribbean and beyond. From Boston, Cotton Mather wrote to his uncle John Cotton Junior (a pastor in Plymouth colony) on 5 August with the news that “Port-Royal, the *Tyrinus* of the whole English America, but a very Sodom for Wickedness, was immediately swallow'd up”.<sup>184</sup> In France (then at war with England), the *Mercuré Galant* reprinted a Jamaican merchant’s letter that had been intercepted by French warships, in which the writer represented the earthquake as “a punishment of Heaven, which the enormous crimes that we commit here daily have drawn down upon us”.<sup>185</sup> The sense of culpability was enhanced still further when printers altered and adapted the letter into a sensational pamphlet, which spoke of a blow from “[t]he high and mighty God of Hosts, justly irritated with us for our enormous crimes and debauched life, of which we are guilty”.<sup>186</sup> A hugely exaggerated manuscript account also found its way to the Duke of Osuna in Spain, which suggested that the destruction was a divine punishment on the colonists for having burned an effigy of the pope on 12 May. According to this account, a terrible storm arose in June that flooded the island, while the earth shook and the sea shot forth flames. The anonymous author declared that 7,000 people had perished immediately, since those who had tried to escape the flood burned to death in the fires, and

---

183 Joseph Norris to Isaac Norris, undated (probably early September), 1692, HSP 0454, vol. 1, pp. 32-3. It should be noted that none of the Quaker accounts of the disaster suggested that their own religious community had sinned; it was instead the “people of the world” that they lived alongside who had aroused God’s anger.

184 Cotton Mather to John Cotton Junior, 5 August 1692, in Cotton Mather, *Diary of Cotton Mather, 1681-1724*, Collections of the Massachusetts Historical Society; Ser. 7, v. 7-8 (Boston: The Society, 1911), vol. 1, p. 143; John Cotton, Jr, *The Correspondence of John Cotton Junior*, ed. Sheila McIntyre and Len Travers, Publications of the Colonial Society of Massachusetts, Vol. LXIX (Boston: The Colonial Society of Massachusetts, 2009), 420.

185 “un chastiment du Ciel, que nous ont attiré les crimes énormes qui s’y commettent journellement”. *Mercuré Galant*, October 1692, p. 130.

186 “Le Haut & Puissant Dieu des Armées, justement irrité contre nous pour les crimes énormes & la vie débordée dont nous sommes coupables [...]”. Anon., *Les Malheurs des Anglois dans la Jamaïque. A Bord du Vaisseau l’Industrie, devant la Baye des Ruines de Port Royal dans la Jamaïque, le 30. Juin & 10. Juillet 1692* (s.l.: s.n., 1692), 1.

the island was now totally uninhabitable.<sup>187</sup> However, some commentators managed to combine a condemnation of Jamaica's sins with consideration of issues elsewhere. Mather viewed the disaster "as an Accident speaking to all our English America", since the increasing prosperity of New England threatened to send it down the same path of immorality as Jamaica — after all, Boston itself had experienced several serious fires within the last two years alone.<sup>188</sup> Meanwhile, the Jamaican merchant and his French publishers signalled an awareness of other major earthquakes of the recent past in Málaga, Naples, Ragusa and Smyrna, if only to throw into relief the scale of the devastation at Port Royal.<sup>189</sup> Thus, even though many contemporaries were initially disposed to regard the disaster as an affair limited to the punishment of one wicked city, at least some had begun to acquire the habit of placing such dreadful judgements within a wider comparative perspective.

Over the next twelve months the episode of Port Royal's destruction definitively metamorphosed from the punishment of a single wicked city to a transatlantic hazard, thanks to its apparent place within a series of calamitous events. The slow circulation of news across the Atlantic meant that the public discussion of the Jamaican catastrophe in London took place in August and early September.<sup>190</sup> Shortly afterwards, on 8 September, a minor earthquake affected southern England and part of France, the Low Countries and Germany. King William III, on campaign against the French in Flanders, saw bricks falling from the house in which he was dining.<sup>191</sup> In the Spanish camp, the captain of an infantry *tercio* informed the Duque del Infantado of "a Great

---

187 AHNz, Osuna, CT. 198, D. 100. There are no indications of the date or authorship of this manuscript (which is now in poor condition), or of the letter in which it was originally enclosed.

188 Mather, *Diary of Cotton Mather, 1681-1724*, vol. 1, p. 143. There were fires on 3 August 1690, 16 September 1690 and 5 July 1692, reported in *Publick Occurrences both Forreign and Domestick*, no. 1, 25 Sept 1690; Hammond, *Diary*, 14, 21.

189 *Mercure Galant*, October 1692, 140; Anon., *Les Malheurs des Anglois dans la Jamaïque. A Bord du Vaisseau l'Industrie, devant la Baye des Ruines de Port Royal dans la Jamaïque, le 30. Juin & 10. Juillet 1692*, 3.

190 For details on the circulation of the news about the earthquake in Jamaica and the tremors in England, see Louis Gerdelan, "The Royal Society, Port Royal and the Great Trans-Atlantic Earthquake of 1692," *Studi Storici* 4 (2019): 849–51.

191 Luttrell, *A Brief Historical Relation of State Affairs, from September 1678 to April 1714*, 1857, 2:565.

shaking of the earth that gave much horror and fear to the People”, killing a number of locals in their houses and causing the church bells to ring out.<sup>192</sup> The English physician and surgeon Sir Edmund King sent the politician Viscount Hatton a description of the general fear and excitement immediately after the shake in London: "a great many gentlemen came running into the coffee house, pale and frightened, out of their houses, and the women and children in great numbers came running out of their houses too into the street in great amazement". He also noted that although he had personally experienced only a moment of alarm and confusion, in the ensuing gossip the event had taken on a considerably more fearful aspect: "it's the wholl talke now all the towne over; much more frightfull than wh[a]t we felt".<sup>193</sup> Evidently the talk was of a grim and foreboding character, for King added: "I pray God we may have no 2d part of it. But all pray God to keep off the judgments we have deserv'd. This is a serious thing". For Britons who had only recently been discussing a catastrophic earthquake in the Caribbean, it seemed highly plausible that this “2d part” could involve devastation on a similar scale, so that the mild tremors of September should be viewed as the “forerunner of a much Greater Earthquake, from which we are no more secured and absolutely preserved by the Advantage of our Countreys Scituation, and because such things have not been so usually among us as among others”.<sup>194</sup>

A moral connection gradually emerged in the minds of many contemporaries between the seismic events in Jamaica and Europe. Before 8 September, some Londoners evidently felt the events in Jamaica to be distant enough to be treated with levity: puppeteers even entertained

---

192 “un Gran temblor de tierra que puso mucho òrro y miedo ã las Jentes”. Juan de Velasco to Juan de Dios Silva Mendoza Haro, Duque del Infantado, 18 September (NS) 1692, AHNz, Osuna, CT. 99, D. 2.

193 Sir Edmund King to Lord Hatton, 8 Sept 1692, in Thompson, *Correspondence of the Family of Hatton, Being Chiefly Letters Addressed to Christopher, First Viscount Hatton, 1601-1704*, 2:184.

194 Richard Stafford, *The Absolute Truth, and Utmost Certainty of the Word of God: And That All Things Which Are Contained in the Scriptures, Yea to Every Tittle and Iota Thereof, Will Be Fulfilled: Demonstrated in a Discourse on Rom IX. 6* (London: Printed, and are to be sold by Ralph Simpson, 1699), 24.

audiences at the Southwark fair with a farcical representation of the destruction of Port Royal and the distress of its notoriously debauched inhabitants.<sup>195</sup> Subsequently, however, Britons began to suspect that the disaster might actually have been a divine message directed specifically at the sins of England. Reconsidering the “tremendous stroak” at Port Royal in the light of the events of September, the Presbyterian minister Robert Fleming pointed out that the destruction in Jamaica was “directed to a place where the whole *Country was purely English* in its Interest and Inhabitants, and thus a part of the same Nation, though at a distance”. In his eyes the inescapable conclusion from this observation was that the devastation of Port Royal “hath a proper Aspect in a *monitory way on this Island* [i.e. Britain], and [is] set up as a *publick Beacon and Monument of Judgment*”.<sup>196</sup> It was against the backdrop of such sobering reassessments of the disaster in the Caribbean that the Lord Mayor of London sent officers on 13 September to shut down the “idle and vicious” puppet show.<sup>197</sup> A few writers sought to reassure the English public, emphasising the great difference in intensity between the events in Jamaica and England: one described the European tremors by comparison as mere “shivering Fits”.<sup>198</sup> However, these were lonely voices amidst a clamour of stern warnings.<sup>199</sup> In Fleming’s view, the Almighty had timed the earthquakes with precision. The later earthquake in England “was given in so near a Conjunction with the former [in Jamaica], and with such Evidence as the Lord speaks to Moses, [Exodus 4:8] *If they will not hearken to the Voice of the first Sign, they may yet hearken to the Voice of the second*; yea, when the first had the less Influence, that it was so remote in its

---

195 Evelyn, *The Diary and Correspondence of John Evelyn*, 321–22.

196 Original emphasis. Robert Fleming, *A Discourse of Earthquakes; as They Are Supernatural and Premonitory Signs to a Nation; with a Respect to What Hath Occurred in This Year 1692...* (London: Printed for Thomas Parkhurst ... and Jonathan Robinson, 1693), 15–16.

197 Luttrell, *A Brief Historical Relation of State Affairs, from September 1678 to April 1714*, 1857, 2:565. The censorious description was John Evelyn’s. He claimed that the closure of the play came at the orders of the queen herself. Evelyn, *The Diary and Correspondence of John Evelyn*, 321–22.

198 *The Present State of Europe, or, the Historical and Political Monthly Mercury*, September 1692, Issue 8.

199 See for instance L. D., *A Check to Debauchery, and Other Crying Sins of These Times: With Several Useful Rules for the Attaining the Contrary Virtue: To Which Are Annexed Some Directions and Heads for Meditation and Prayer, Taken out of Holy Scripture...* (London: Printed for Richard Butt: and are to be sold by Randal Taylor, 1692), 78–79.



Distance, this comes and speaks in that manner as Jeremiah [23:23], *I am a God near at hand, and not a far off only*".<sup>200</sup> Large-scale disaster was not an alien concept for Londoners: the ongoing reconstruction of St Paul's (which would not be complete for almost two decades) served as a visible reminder of the vulnerability of the capital to the devastations of the elements. To the list of national judgements crowned by the Great Plague of 1665-66 and the Great Fire of 1666, commentators could now add an earthquake linked to far-off Jamaica.<sup>201</sup> The Presbyterian preacher Thomas Doolittle labelled the succession of calamities "the Great Dying", "the Great Burning" and "the Great Trembling".<sup>202</sup>

Just as with the earthquakes of the 1680s, those of 1692 stimulated exercises in the collection and comparison of information about these frightening phenomena. One Spanish gazette compared the wide geographical scale of the September tremors "in all of Holland" to other "general" earthquakes in the Low Countries in 1580 and 1640.<sup>203</sup> Meanwhile, in his personal notebook the Yarmouth customs master William Jackson compared the September event with the "prodigious moving of the Earth" in Hereford in 1572, when the hill of Much Marcle appeared to shift to a new location, leaving a pit behind it.<sup>204</sup> A broadsheet licensed on 20 September entitled *A true and faithfull account of all earthquakes* extended the comparison to a longer series of events in England since the

---

200 Fleming, *A Discourse of Earthquakes*, 17.

201 As one clerical commentator put it in 1693: "I might speak of the dreadful Pestilence and Fire in *London*, in the Year 1665, and 1666; and the Wars at the same time [...] For all which, I doubt, *England* hath not been rightly humbled to this day. And when God comes to us again in way of Judgment, we have reason to expect he will visit for these, as well as our latter Provocations". John Dunton, *England's Alarum, Being an Account of God's Most Considerable Dispensations of Mercy and Judgement toward These Kingdoms for Fourteen Years Last Past: And Also of the Several Sorts of Sins and Sinners Therein ... with an Earnest Call to Speedy Humiliation, Supplication, and Reformation ...* (London: Printed for Thomas Parkhurst, 1693), 1–2.

202 Thomas Doolittle, *Earthquakes Explained and Practically Improved: Occasioned by the Late Earthquake on Sept. 8, 1692 in London, Many Other Parts in England, and beyond Sea* (London: Printed for John Salusbury, 1693), A2v.

203 *Noticias ordinarias del norte, Italia, España, y otras partes*, 14 October 1692.

204 CUL MS Oo.VI.115, ff. 150r-v. Contemporary reactions to the 1572 incident are discussed in Alexandra Walsham, *The Reformation of the Landscape: Religion, Identity, and Memory in Early Modern Britain and Ireland* (Oxford; New York: Oxford University Press, 2011), 340.

twelfth century.<sup>205</sup> The anonymous author was convinced that these were “Strange and Wonderful Dispensations of the Divine Providence”, which served as “pressing Messengers” to urge moral reform and spiritual awakening.<sup>206</sup> However, he worried that the public had largely ignored these warnings, and that God’s next act would be to destroy the country entirely. Thus, “to endeavour the averting, I have collected out of our own Chronicles, and here present to the Thinking Readers view, such Instances of his Wrath as we felt but t’other day, that so we may presently take up; considering that God's Patience and Forbearance may now well be thought to draw towards an end”.<sup>207</sup> This collection included an earthquake of 1276, which allegedly coincided with a thunder storm and a comet in the shape of a dragon.<sup>208</sup> Less remote were the mysterious migration of Much Marcle in 1572 (although the author erred in both his description and the date of the event) and the tremors of 1580 that alarmed much of England.<sup>209</sup> The broadsheet was not a scholarly work and contained no analysis of the events it reported, but it did communicate to a general reading public that there was some wider pattern that could be discerned through compiling or comparing incidents. The interpretation the author advanced was in itself a simple reaffirmation of doctrine; his motive in collecting and presenting past events was not to uncover any mysteries of the workings of nature but to convince his readers that the tremors of 1692 should not be dismissed as a trifle or an anomaly,

---

205 Anon., *A True and Faithful Account of All the Earthquakes and the Dreadful Effects Thereof, That Have Happened in England since the Norman Conquest, to This Day: Wherein God's Judgments Are Plainly Described, with Animadversions Thereon* (London: Printed for Richard Baldwin, 1692). A larger and more detailed earthquake compilation appeared two years later: R. B. [Nathaniel Crouch], *The General History of Earthquakes: Being an Account of the Most Remarkable and Tremendous Earthquakes That Have Happened in Divers Parts of the World, from the Creation to This Time...* (London: Printed for Nath Crouch, 1694).

206 Anon., *A True and Faithful Account of All the Earthquakes and the Dreadful Effects Thereof, That Have Happened in England since the Norman Conquest, to This Day*, 1.

207 Anon., 1.

208 Anon., 2.

209 Anon., 2. The broadsheet claimed that the Hereford event occurred in February 1561 instead of 1572. The 1580 tremors had affected not only England but also the Low Countries and France. This was the same event that French writers recalled in 1682. For further detail on the English response to the 1580 earthquake see Alexandra Walsham, *Providence in Early Modern England* (Oxford; New York: Oxford University Press, 1999), 130–35.

but rather situated within a long providential history. Jokes and frivolous puppet-shows needed to be replaced with watchful attention to monitory events and serious-minded introspection.

The moral imperative to come to terms with the earthquakes of 1692 reinvigorated discussion of the mechanics of earthquakes and distance. First of all, the September tremors had shaken a very wide, transnational area at one and the same moment, as testimonies from England, France, Germany and the Low Countries confirmed.<sup>210</sup> Even more significantly, however, the possibility of a connection between the events in Jamaica and England invited consideration of the transcontinental correspondence of disaster. One way to theorise events on this vast scale was to follow the example of some of the Spanish writers in 1688 in regarding the earthquakes as special supernatural acts that suspended ordinary physical laws. In Fleming's view, the September tremors by themselves could only be explained as an act of God's extraordinary providence:

whence should such a Correspondence in *this great Sign* have a Rise, that almost in the same Hour it made the Earth to tremble at *London*, and in the *Sea-Coasts* there, in so astonishing a manner, and then also given the same *Signal* and Warning through the *whole Low-Countries, with other adjacent parts of Germany*, when so great an Extent of Sea lyes betwixt the same; since it is not possible that in the ordinary course of Nature, the *Influence of any subterraneous Fires or Vapours*, should have so immediate a *Conjunction with Places so vastly remote*, and separate from other by so great an Extent of the Sea.<sup>211</sup>

Fleming acknowledged that God normally worked through the "inferior Causes" of nature, but because of the concurrence of seismic events across vast distances "in this present case, if with a serious and prepared Mind, Men do consider these *two late Earthquakes* under their proper

---

210 A more detailed discussion of these communications is in Louis Gerdelan, "The Royal Society, Port Royal and the Great Trans-Atlantic Earthquake of 1692," *Studi Storici* 4 (2019): 861–62.

211 Fleming, *A Discourse of Earthquakes*, 17–18.

Circumstances, then it is not possible but they must see them to be such Events, as cannot possibly be ascribed to another Cause, than an immediate Divine Power”.<sup>212</sup> He believed that natural philosophical theories of earthquakes were so conjectural and so disputed that they could not be relied upon to explain simple local tremors at the best of times, whereas this complex series of intercontinental events clearly pointed to an intelligent design.<sup>213</sup> To support his insistence on a providential reading of events, he drew upon the “undeniable Evidence” of “the most judicious Records of History”, which (he claimed) demonstrated that earthquakes were signs of remarkable events.<sup>214</sup> Here the key example was the earthquake that Josephus described as preceding the destruction of Jerusalem, as prophesied in Matthew 24:7.<sup>215</sup> However, unlike some of the Spanish commentators of the 1680s, Fleming did not believe that history furnished any counterparts to the universal earthquake that he thought had occurred in 1692. He considered a number of English earthquakes: those of 1571 and 1580, as well as another earth movement in Dorset in 1582, but unlike recent events those past occurrences “were restricted only to particular Bounds”, so that “I humbly judge if the most exact Search were made into *History both Modern and Ancient*, under such Circumstances, no Instance so strange and unaccountable, as to any natural Causes herein will be found”.<sup>216</sup> This left only a theological interpretation, but Fleming’s explanation pushed at the boundaries of traditional disaster doctrine. On the one hand, he accepted that the destruction of Port Royal was a divine punishment of wickedness, and especially of the colonists’ alleged habit of consulting astrologers.<sup>217</sup> On the other hand, he also thought the Jamaican earthquake was connected to the seismic event in September, and that both formed components of a complex chain

---

212 Fleming, 25.

213 Fleming, 5, 24.

214 Fleming, 8.

215 Fleming, 8. Josephus, *Judean War*, IV.4.5.

216 Fleming, 18–19.

217 Fleming, 16–17.

of signs that included the comet of 1680 and unusual summer rains.<sup>218</sup> Viewed in this context, the earthquakes served simultaneously as supernatural messages to *both* Jamaica and England, *and* functioned as indications of the impending Apocalypse.<sup>219</sup> Thus, while Fleming did not abandon the idea of disaster as a localised judgement of God, he nevertheless tried to juggle that explanation with a much broader conception of the workings of providence within a trans-Atlantic perspective.

Fleming's tract and the *True and faithfull account* articulated a widely-shared belief that the September earthquake, when set beside the devastation in June, constituted an urgent and perhaps final warning to England. Indeed, some believed that the divine Judge had spared London on this latest occasion only through an astounding act of mercy, "[f]or it might have brought the same calamity upon this great city, as the other d<id> last June upon Port Royall in Jamaica".<sup>220</sup> Preachers and many laymen insisted that this deliverance would only be temporary, if the ungrateful population of England did not hasten to commit itself to "work a generall repentance & a reformation", and clear its burgeoning debt of sin with the Lord, "before it bee to Late".<sup>221</sup> The travails of the empire also became a subject of political contention, since it was possible to regard them as a sign of divine disapproval for the "Glorious Revolution" of 1688 that had removed James II from the throne. The Jacobite propagandist William Anderton, soon after executed as the author of seditious writings, connected "the never to be forgotten Earthquake in Jamaica" to "those late Monitory Shakings which ran though all this land", as well as to an epidemic in the East Indies in which many Englishmen had perished.<sup>222</sup> Reminding his readers that "we never heard of an

---

218 Fleming, 19–23.

219 Fleming, 8, 45.

220 Thomas Smith to Edward Bernard, 13 September 1692, Bodleian Library MS Smith 57 f. 297v.

221 Ibid.

222 William Anderton, *Remarks upon the Present Confederacy, and Late Revolution in England, &c* (London: s.n., 1693), 46. A pamphlet protesting his execution appeared later in the year: Samuel Grascome, *An Appeal of Murther from Certain Unjust Judges, Lately Sitting at the Old Baily: To the Righteous Judge of Heaven and Earth; and to All Sensible English-Men, Containing*

Earthquake in this Island but did certainly forerun some very remarkable Calamity”, he urged them to restore James II to the throne, in order to avert “those dismal Plagues which otherwise e’re long will fall upon their Heads”.<sup>223</sup> For Williamites, who read God’s disapproval as directed instead at the moral degeneration of the English in general, the alarms of 1692 joined with other calamities to inspire a movement for the reformation of manners.<sup>224</sup>

If the moral connections between the earthquakes of 1692 were bitterly disputed, the question of some kind of underlying physical cause also aroused great debate. Thomas Tenison, the Bishop of London (and later Archbishop of Canterbury) raised the problem with John Evelyn: “in this earthquake it must have been something of mighty force to make it so general, and of wonderful celerity to cause it in so many very distant places about the same hour”.<sup>225</sup> Tenison believed that a lightning strike had ignited “nitro-sulphurous matter” under the ground in Jamaica, but was prepared to accept some other trigger. Whatever the original cause was, he was sure that the motive force had been conveyed in subterranean passages beneath the Atlantic to Europe — the same

---

*a Relation of the Tryal, Behaviour, and Death of Mr. William Anderton, Executed June 16. 1693. at Tyburn, for Pretended High Treason* (London: s.n., 1693). For the attribution of authorship for the two works, see the *English Short Title Catalogue*, R448 and R216496 .

223 Anderton, *Remarks upon the Present Confederacy, and Late Revolution in England, &c.*, 47. Another pamphlet in the guise of a debate between a Jacobite and a Williamite expressed similar sentiments. The Williamite argued (paradoxically) both that earthquakes had natural causes and that Jamaicans were as wicked as the inhabitants of Sodom and Gomorrah, so that the earthquake was an emblem of divine justice. The Jacobite retorted that such judgements do not necessarily fall upon the greatest sinners, that the regicide and the ousting of James II were greater sins than any Jamaicans had perpetrated, and finally that the September earthquake was a clear warning sign to England. Anon., *A Country Dialogue between William and James, on the Monthly Fast-Day: With Reflections on the Earthquake Which Lately Happened at Jamaica, and Here Sept. 8. 1692* (S.l.: sn, 1692), 6–7.

224 Thomas Beverley, *Evangelical Repentance unto Salvation Not to Be Repented of: Upon 2 Cor. 7, 10 ; and as Most Seasonable, Short Considerations on That Great Context Hebr. 12, 26, “Yet Once More I Shake Not Only Earth, &c.”: Upon the Solemn Occasion of the Late Dreadful Earthquake in Jamaica and the Later Monitory Motion of the Earth in London...* (London: Printed by R Smith for W Miller, 1693); Josiah Woodward, *An Account of the Rise and Progress of the Religious Societies in the City of London &c.: And of the Endeavours for Reformation of Manners Which Have Been Made Therein*, Second edition enlarged. (London: Printed by J D for the author and sold by Ra Simpson, 1698), xiii. See also the discussion in Craig Rose, “Providence, Protestant Union and Godly Reformation in the 1690s: The Alexander Prize Essay, Proxime Accessit,” *Transactions of the Royal Historical Society* 3 (1993): 154–56.

225 Thomas Tenison to John Evelyn, 3 October 1692. In Evelyn, *The Diary and Correspondence of John Evelyn*, vol. 3, pp. 324–5.

passages that Athanasius Kircher had illustrated so dramatically in his *Mundus Subterraneus* (1664-5).<sup>226</sup> Evelyn broadly agreed, but asserted that it was the nitre that provided the explosive force: just as in gunpowder explosions, the sulphur was less important and only served to kindle the fire. A gunpowder experiment that he had witnessed at Gresham College had convinced him of the astonishing power of nitre: he was certain that the "inconceivable swiftness of its motion" had allowed this volatile mineral to shake "so distant places in the same moment almost of time". However, the chain of explosions that he envisioned required not only the presence of vast subterranean channels, extending "perhaps for thousands of miles, even under the sea itself", but also that each should contain a whole train of the necessary fuel. He believed that tunnels of this kind linked Vesuvius and Etna to the volcanoes of Iceland, China and Peru.<sup>227</sup>

Evelyn may have been influenced in his reasoning by Hooke's boundless faith in the power of earthquakes; at any rate he shared the latter's view that subterranean convulsions had raised the earth's mountain ranges.<sup>228</sup> In 1690 Hooke told the Royal Society that subterranean tunnels had carried the effects of an earthquake that year in the Leeward Islands for many miles under the ocean, jostling ships and creating strange tides.<sup>229</sup> He must have reached similar conclusions about the Jamaica earthquake in 1692, since he had been told on September 18 that an earthquake had destroyed the Spanish settlement at Havana at the same time as the disaster occurred at Port Royal.<sup>230</sup> John Ray similarly spoke of "Submarine passages", which he used to explain the occurrence

---

226 Kircher, *Athanasii Kircheri ... Mundus subterraneus, in XII libros digestus*, 176–77; 181–82.

227 John Evelyn to Thomas Tenison, 15 October 1692. In Evelyn, *The Diary and Correspondence of John Evelyn*, vol. 3, pp. 325–8.

228 Evelyn to Tenison, 15 October 1692. In Evelyn, vol. 3, p. 326.

229 Hooke, "A Discourse of Earthquakes," 418.

230 Robert Hooke, *Diary 1688-1693*. In Gunther, *Early Science in Oxford*, vol. 10, p. 216.

of the September earthquake both in England and on the Continent.<sup>231</sup> Nevertheless, the employment of tunnels to connect the 1692 earthquakes left some important questions unresolved, such as why the explosion should have followed the Jamaica-England route rather than some other, why it had taken several months for the fire to cross beneath the Atlantic, and how it had nonetheless managed to pass around Europe with "wonderful celerity". These kinds of problems arose in part because of the nature of the inquiry: many of the commentators on the earthquakes sought to explain a connection that they had already assumed to exist.

If Hooke, Evelyn and Tenison credited a combustion explanation, John Flamsteed, the Astronomer Royal based at Greenwich Observatory, advanced a theory that was aerial and meteorological in nature.<sup>232</sup> He accepted that subterranean combustion had been involved in the earthquake at Jamaica, but rejected the suggestion of Evelyn, Ray and others that vast underground channels had provided the means for its transmission to and around Europe, since he did not believe the earth to be so riddled with caverns or so well-stocked with flammable minerals. Instead, he located the mechanism of transfer in the air. The adherents of combustion ideas had often likened the ignition of flammable materials beneath the earth to thunder claps, while many savants attributed thunderstorms to a similar chemical reaction of nitre and sulphur in the atmosphere.<sup>233</sup> In

---

231 John Ray, *Three Physico-Theological Discourses, Concerning I. The Primitive Chaos, and Creation of the World. II. The General Deluge, Its Causes and Effects. III. The Dissolution of the World and Future Conflagration...*, 2nd edition (London: Printed for S Smith, 1693), 215–16.

232 The first iteration of this theory, in a letter dated 27 September 1692, is visible in a manuscript located at Cambridge University Library RGO 1/42 ff. 73v-75r. Flamsteed adapted the theory in subsequent letters of 27 March 1693 and 10 April 1693; this later version of the theory was sent to Newton, via James Crompton, in April 1693 and to Charles Chamberlaine on 1 May 1693. These letters have been reproduced in *The Correspondence of John Flamsteed, the First Astronomer Royal*, 471-495. See also Frances Willmoth, "John Flamsteed's Letter Concerning the Natural Causes of Earthquakes," *Annals of Science* 44 (1987): 23–70; Frances Willmoth, "Rumblings in the Air: Understanding Earthquakes in the 1690s," *Endeavour* 31, no. 1 (2007): 24–29; J.E. Kennedy and W.A.S. Sarjeant, "Earthquakes in the Air - the Seismological Theory of John Flamsteed (1693)," *Journal of the Royal Astronomical Society of Canada* 76, no. 4 (1982): 213–23.

233 For an explanation of thunder and lightning as an explosive reaction of nitrous and sulphurous particles, see John Mayow, *Medico-Physical Works: Being a Translation of Tractatus Quinque Medico-Physici*, trans. Leonard Dobbin and



addition to reading the printed accounts of the disaster, Flamsteed had apparently been given information about the events of the Jamaican catastrophe by his neighbour, a sea captain, who had been on the island at the time.<sup>234</sup> These sources confirmed his suspicion that the weather during earthquakes was "allways a starke calme", which he took as a clear indication that the air must be somehow involved in the phenomena.<sup>235</sup> In his view, the atmosphere was naturally full of nitrous particles, which could be kindled when subterranean fire burst out of the earth. This caused sudden expansions or explosions, which in turn generated an area of low pressure in the atmosphere. Air from neighbouring regions of higher pressure immediately poured into this area, and the flow of air generated the shaking perceived in an earthquake. Once the initial ignition had taken place at Port Royal on June 7, the air had been rendered explosive, but evidently remained more or less cohesive (Flamsteed was vague on the precise details). From Jamaica this dangerous gas had drifted in a cloud northeast across the Atlantic, retaining its integrity thanks to the saline, moist quality of the ocean air. Eventually it reached England, where it encountered an atmosphere rich in nitre and sulphur, and subsequently exploded. As evidence for this he pointed to the observation that the upper storeys of buildings and the tops of trees had been most affected by the earthquake of September 8. In addition, many people had reported feeling light-headed, which he took to be the result of an expansion in the air. Furthermore, he believed that his theory alone could explain the earthquakes experienced by sailors at sea — though this seemed to contradict his insistence on the stabilising effect of saline particles on the nitro-sulphurous gas. Earthquakes had travelled over the sea in the past, he thought: he dimly recalled that another earthquake "Some few years ago" had

---

Alexander Crum Brown, *Alembic Club Reprints* No. 17 (Edinburgh: The Alembic club, 1907), 147-53. See also Henry Guerlac, "The Poets' Nitre," *Isis* 45, no. 3 (1954): 243–255.

234 John Flamsteed to Andrew Glen, 10 April 1693, In *The Correspondence of John Flamsteed, the First Astronomer Royal*, 483.

235 CUL RGO 1/42 f. 73v. He acknowledged his debt to Aristotle and Pliny for this idea in the letter to Glen of 10 April (at 483).

travelled from Lima to Madeira ("I have forgot the Circumstances but you may remember the gazatts gave an account of it").<sup>236</sup>

Flamsteed's explanation of earthquake transmission was both ingenious and highly problematic. When he presented a version of it to a meeting of the Royal Society on 3 May 1693, Hooke found it ridiculous, recording in his diary "A nonsensicall hypot : of Flamsted about Ear[th]quakes in the air".<sup>237</sup> Hooke's criticism most likely concerned the aerial explosions rather than the transmission mechanism of the floating gas cloud, since he himself had helped to pioneer theories of global air circulation.<sup>238</sup> In any case, Flamsteed appears to have jettisoned the wandering gas cloud in the later versions of his theory. By March 1693 he had replaced its causative role in the September 8 tremors with Lister's sulphurous "breath of the pyrites", which he now believed had kindled the nitre in England's air.<sup>239</sup> He nevertheless thought that in this alternate fashion earthquakes could "shake many and large countreys" — citing Bartholomew Keckerman's probably exaggerated account of the 1601 earthquake as evidence.<sup>240</sup> After the meeting at the Royal Society, Flamsteed evidently abandoned his earthquake ideas entirely, either because he had been discouraged by the hostile reception afforded by the Fellows, or because he wanted to avoid becoming embroiled in current controversies over theories of the earth.<sup>241</sup> However, the gas cloud idea in the earliest iteration of his theory was the only one of the available explanations to account for the discrepancy of three months between the earthquakes in Jamaica and England. At the time

---

236 CUL RGO 1/42 f. 74v.

237 Hooke, *Diary 1688-1693*. In Gunther, ed., *Early Science in Oxford*, 10:236.

238 Hooke, *Posthumous Works*, 364.

239 Flamsteed to Glen, 10 April 1693, In *The Correspondence of John Flamsteed, the First Astronomer Royal*, 489.

240 *Ibid.*, 484.

241 Willmoth, "John Flamsteed's Letter Concerning the Natural Causes of Earthquakes," 31-2, 46. His theory was posthumously published in 1750, as part of the debates over another set of tremors in London: John Flamsteed, *A Letter Concerning Earthquakes, Written in the Year 1693, by the Late Celebrated Astronomer, John Flamsteed, Math. Reg. F. R. S. to a Gentleman Then Residing at Turin in Savoy, on Occasion of the Destruction of Catania, and Many Other Cities, Towns and Villages, in Sicily, in the Year 1692* (London: printed for A Millar, opposite Catharine-Street in the Strand, 1750).

he had thought it quite reasonable that a gas cloud would take that long to cross the Atlantic, especially once contrary winds were taken into account.<sup>242</sup>

While anxious minds contemplated the significance of the apparent juncture of divine warnings, news of even greater carnage from earthquakes elsewhere seemed to suggest that a sequence of dreadful destruction was at hand that extended beyond the interests of Britain and possibly touched on the fate of humanity as a whole. In November the English politician Narcissus Luttrell noted that “[m]erchants have letters of a more dreadful earthquake in China than that at Jamaica, and done more hurt”.<sup>243</sup> Closer to home, on 9 January 1693 an earthquake in the southeast of Sicily killed perhaps 1,000 people; two days later a much larger shock rocked not only Sicily but also Malta and Calabria, incurring a huge death toll of between 55,000 and 66,000.<sup>244</sup> More than half of the inhabitants of Ragusa (51%) and Catania (63%) perished in the disaster.<sup>245</sup> Luttrell had learned of an earthquake in Sicily by 14 February, but the scale of the destruction only became apparent to him in early March, when he read that “the earthquake has wasted a 3d part of Sicily islands [sic] for 5 or 600 miles in circumference”.<sup>246</sup> An anonymous report penned on 20 January also reached France, which suffered its own grievous catastrophe in 1693-94, in the form of a famine that claimed over one million lives (roughly 6% of the population).<sup>247</sup> By late February word had reached Luttrell of

---

242 CUL RGO 1/42 f. 75r.

243 Luttrell, *A Brief Historical Relation of State Affairs, from September 1678 to April 1714*, 1857, 2:605.

244 Baratta, *I Terremoti d'Italia*, 165–73; Stefano Condorelli, “Le Tremblement de Terre de Sicile de 1693 et l'Europe: Diffusion Des Nouvelles et Retentissement,” *Dimensioni e Problemi Della Ricerca Storica*, no. 2 (2013): 139; Emanuela Guidoboni and Jean-Paul Poirier, *Storia culturale del terremoto: Dal mondo antico a oggi* (Soveria Mannelli (It.): Rubbettino Editore, 2019), 194–203.

245 Guidoboni and Poirier, *Storia culturale del terremoto: Dal mondo antico a oggi*, 195.

246 Narcissus Luttrell, *A Brief Historical Relation of State Affairs, from September 1678 to April 1714* (Oxford: Oxford University Press, 1857), vol. 3, pp. 35, 49, 50. The London printer Richard Baldwin issued a pamphlet account of the earthquake sometime later in the year: Anon, *An Account of the Late Terrible Earthquake in Sicily: With Most of Its Particulars* (London: Printed for Richard Baldwin, 1693).

247 “Relation du tremblement de terre arrivé nouvellement en Sicile & Calabre. De Messine ce 20 Janvier 1693”, BNF Français 15466, ff. 117r-v. C. O Grada and J. M. Chevet, “Famine and Market in Ancien Regime France,” *The Journal of Economic History* 62, no. 3 (2002): 708–12.

another major earthquake, this time in Cuba, which had allegedly destroyed 1,500 houses in Havana.<sup>248</sup>

This growing awareness of distant disasters raised important interpretive challenges, since the framework of divine judgements on sinful communities left open the question of whether and how such catastrophes should signify morally to remote audiences. In Boston, the destruction of Port Royal seemed to invite several different moral reactions at once, even from the same individuals. Cotton Mather spoke of a spiritual and emotional “Heartquake” on hearing the news of the disaster: he simultaneously excoriated the sins of justly-punished Jamaica while lamenting the deaths of New Englanders on the island and entreating his fellow Bostonians to regard the catastrophe as an urgent call to moral reformation.<sup>249</sup> The situation became even more complex for New England Protestants when considering the disasters in Catholic Italy and Spanish America. Placing the Jamaica earthquake alongside those in Peru, Naples and Sicily, Sewall seemed to take comfort in the fact that the three latter territories “are all Spanish”. Nevertheless, he also deduced an eschatological significance from the temporal proximity (“but the distance of seven Moneths [sic]”) between the disasters at Port Royal and in Sicily.<sup>250</sup> In London, the bookseller John Dunton found the matter less ambiguous: distant disasters were of pressing importance to Englishmen, “tho’ we are not so nearly concerned”, whatever the creed or political allegiance of the victims.<sup>251</sup> The earthquakes in

---

248 Luttrell, *A Brief Historical Relation of State Affairs, from September 1678 to April 1714*, 1857, vol. 3, p. 40.

249 Cotton Mather to John Cotton Junior, 5 August 1692, Mather, *Diary of Cotton Mather, 1681-1724*, vol. 1, p. 143; Cotton, Jr, *The Correspondence of John Cotton Junior*, 420; Cotton Mather, *The Wonders of the Invisible World Being an Account of the Tryals of Several Witches Lately Executed [Sic] in New-England, and of Several Remarkable Curiosities Therein Occurring*, 3rd edition (London: Printed first at Bostun [sic] in New-England, and reprinted at London for John Dunton, 1693), 15; Cotton Mather, *Magnalia Christi Americana: Or, The Ecclesiastical History of New-England, from Its First Planting in the Year 1620. unto the Year of Our Lord, 1698*. In *Seven Books* (London: T Parkhurst, 1702), 35–36.

250 Samuel Sewall, *Phaenomena Quaedam Apocalyptica Ad Aspectum Novi Orbis Configurata. Or, Some Few Lines towards a Description of the New Heaven as It Makes to Those Who Stand upon the New Earth* (Boston: Printed by Bartholomew Green, and John Allen, and are to be sold by Richard Wilkins, 1697), 42.

251 Dunton, *England’s Alarum*, 4–5. For the attribution of the work, signed J.D., to Dunton, see the *National Union Catalog, pre-1956 imprints*, vol. 152, 220.

Naples, Venice and Smyrna and the ongoing epidemic in the West Indies, “tho' remote, yet should be look'd upon as loud Calls to us, whose Sins cry up to Heaven for Vengeance as well as theirs”.<sup>252</sup>

Dunton's orientation was not cosmopolitan, however: his collection of judgements and mercies focused on Britain and on Britons abroad, and aimed to determine the main classes of sin (eight in number) that called forth divine chastisements. His point in drawing attention to distant catastrophes was that international events had great domestic importance. Protestants needed to monitor constantly disasters around the globe, lest in failing to learn the appropriate moral lessons, God should bring them “home to our own Doors” — as the tremors of September 1692 indicated all too clearly.<sup>253</sup>

The concurrence of so many disasters within such a short space of time seriously alarmed some contemporaries and encouraged speculation about an escalating global crisis. John Edwards, a retired Church of England clergyman and an admirer of John Locke's *Essay concerning human understanding* (1689), entreated his readers to “observe and consider the *Number and Frequency* of this kind of Events of late”, noting in particular the tremors in England in 1692 and the destruction in Italy in 1693.<sup>254</sup> He was convinced that “there have been more Terrible Shakings of the Earth in the space of these last ten Years, than there were in above two (I may say 3 or 4) hundred Years before”.<sup>255</sup> Edwards was well-acquainted with physical theories of earthquakes, both ancient and modern. He accepted the truth not only of the combustion of subterranean sulphur in causing earthquakes, but also of the naturalist John Woodward's theory involving abyssal waters and the

---

252 Dunton, 4–5.

253 Dunton, 5.

254 John Edwards, *A Demonstration of the Existence and Providence of God, from the Contemplation of the Visible Structure of the Greater and the Lesser World: In Two Parts, the First Shewing the Excellent Contrivance of the Heavens, Earth, Sea, &c., the Second the Wonderful Formation of the Body of Man* (London: Printed by J D for Jonathan Robinson and John Wyatt, 1696), 153, 156. For Edwards' attitude to Locke's *Essay*, see David Laurence, “Jonathan Edwards, John Locke, and the Canon of Experience,” *Early American Literature* 15, no. 2 (1980): 107–23.

255 Edwards, *A Demonstration of the Existence and Providence of God*, 156.

ancient wind explanation.<sup>256</sup> Edwards thought that each of these causes could be operative in different events, and perhaps even simultaneously. Nevertheless, he believed that none of these explanations could account for the vast geographical scale of some historical and contemporary earthquakes. The examples he assembled to support this view included the same ones that Boyle had mentioned in 1685: José de Acosta's account of great earthquakes in Peru and the 1601 shaking of Europe and Asia.<sup>257</sup> To these he added the "Universal Shock almost all the World over" in the time of the Emperor Valentinian.<sup>258</sup> He believed that when the more recent events of 1692-93 were considered in the light of these historical cases, "it is hardly to be solved by any of the fore-mentioned [natural] Causes, how there can be a trembling of the Earth at the same moment in Places that are so *vastly distant* from one another".<sup>259</sup> The only possible explanation, in his view, could be an "*Extraordinary Cause*" supplied by divine providence, "and that Man must strain his Philosophy who undertakes to give a Satisfactory Account of it from Common Principles and the Natural Efficacy of Things".<sup>260</sup>

For many contemporaries, the combination of the unusually large span of recent earthquakes and their apparent proliferation strongly recalled the eschatological prophecies in Luke 21:11 and Matthew 24:7 that there would be great earthquakes "in divers places" prior to Christ's second

---

256 Woodward argued that the heat from subterranean fire induced water from a great abyss within the earth to rise, and where this water could not find an exit through the earth's surface it became agitated and shook the ground above it. John Woodward, *An Essay toward a Natural History of the Earth: And Terrestrial Bodies, Especially Minerals: As Also of the Sea, Rivers, and Springs: With an Account of the Universal Deluge: And of the Effects That It Had upon the Earth* (London: Printed for Ric Wilkin, 1695), 139–40.

257 Edwards, *A Demonstration of the Existence and Providence of God*, 152–53.

258 Edwards, 152. This was the earthquake of CE 365 described in Ammianus Marcellinus, *Rerum Gestarum*, XXVI.10.15-19.

259 Emphasis in the original. Edwards, 150–54. Woodward himself had no such qualms, and was even confident that his theory could explain "an universal *Concussion of the whole Globe*", which would simply require a great deal more "Commotion" in the abyss: Woodward, *An Essay toward a Natural History of the Earth*, 140–41.

260 Edwards, *A Demonstration of the Existence and Providence of God*, 153.

coming.<sup>261</sup> The Jacobite pamphleteer Richard Stafford thought the earthquakes in Jamaica and Sicily had been heralded by the comet of 1680-81 as one of the “fearful sights and great signs [...] from heaven” foretold in Luke 21:11.<sup>262</sup> Viewed in this context, “that gentle Universal shaking of the Earth” on 8 September was actually a sign of the approaching end times.<sup>263</sup> A physical understanding could fit alongside this kind of apocalyptic reading of events. Edwards speculated that if the sulphurous exhalations involved in either the earthquake of September 1692 or some more distant one had become blocked up in the earth’s caverns, they could yet discharge in England with explosive fury, sweeping “rebellious Sinners” into oblivion like a latter-day Deluge.<sup>264</sup> Mather linked the subterranean combustion theory of earthquakes with the activity of Satan, “clap’t up, as a Prisoner in or near the Bowels of the earth”, whose agitations grew increasingly frenetic as the end of the world approached.<sup>265</sup> He believed that the Devil had caused great earthquakes before, as with the destruction of the twelve cities of Asia in the reign of Tiberius, but the fact that such incidents were increasing suggested that the final conflagration was at hand.<sup>266</sup>

This impression of the increasing proliferation of catastrophes was in large part the product of the rapidly expanding trans-Atlantic awareness of earthquakes and other disasters. This became a self-perpetuating cycle, since the more disaster investigators looked for connections between catastrophic events and even minor tremors, the more examples they sought and found in contemporary news that reinforced their sense of the proliferation of such events. Meanwhile, as news writers and printers began to appreciate the growing appetite for information about remote disasters that these investigations helped to engender, they in turn supplied more frequent and

---

261 Edwards, 155.

262 Stafford, *The Absolute Truth, and Utmost Certainty of the Word of God*, 24.

263 Stafford, 24–25.

264 Edwards, *A Demonstration of the Existence and Providence of God*, 157–59.

265 Mather, *The Wonders of the Invisible World*, 14–15.

266 Mather, 15.

detailed reporting on them.<sup>267</sup> Natural philosophers participated eagerly in expanding the repertoire of recent earthquakes and the information about them, both by combing the printed news and drawing on their private correspondence networks. After the Jamaica earthquake of 1692, the English physician Hans Sloane — who had briefly lived on the island between 1687-89 — compiled a set of eight accounts for the Royal Society (printed in the *Philosophical Transactions* in 1694). These included Alvarez de Toledo’s narrative of the catastrophe at Lima in 1687, Sloane’s personal observations of a minor earthquake in Jamaica in February 1688, and five accounts of the disaster at Port Royal in 1692.<sup>268</sup> One of the motives for discovering and disseminating additional reports was to test and confirm hypotheses about physical causation. One of Sloane’s informants, for instance, claimed that “Sulphureous, Combustible Matter” had been thrown up from the earth after the earthquake at Port Royal, and gave a detailed description of the sounds the earth had made, which seemed to provide concrete evidence of the subterranean combustion theory.<sup>269</sup> Not to be outdone, in 1701 the *Journal des Sçavans* printed the report of a priest in Martinique that similarly analysed earthquakes on the island in 1698 and 1700 as cases of subterranean combustion.<sup>270</sup> Even as the circulation of fresh accounts further enriched the repertoire for disaster commentators, archaeological and historical work helped to confirm the cluster of ancient disasters that had become a canonical part of earthquake lore. In 1693, excavations revealed an ancient monument commemorating the reconstruction under Tiberius of the twelve cities of Asia, thus confirming the

---

267 For instance, in the June 1688 issue of *Modern History or A Monthly Account of All Considerable Occurrences*, the editor included a special 19-page section devoted not only to accounts of the earthquakes in Peru in 1687 and Naples in 1688, but also to other recent seismic events, floods, storms, frosts and volcanic activity on the Italian peninsula.

268 Hans Sloane, “A Letter from Hans Sloane, M.D. and S.R.S. with Several Accounts of the Earthquakes in Peru October the 20th 1687. And at Jamaica, February 19th. 1687/8 and June the 7th. 1692,” *Philosophical Transactions of the Royal Society* 18, no. 209 (1694): 78–100. For Sloane’s Jamaican sojourn and collecting activities, see James Delbourgo, *Collecting the World: Hans Sloane and the Origins of the British Museum* (Cambridge, Massachusetts: The Belknap Press of Harvard University Press, 2017), ch.s 2-3.

269 Sloane, “A Letter from Hans Sloane, M.D. and S.R.S. with Several Accounts of the Earthquakes in Peru October the 20th 1687. And at Jamaica, February 19th. 1687/8 and June the 7th. 1692,” 98–99.

270 *Journal des Sçavans*, 1701, no. XV, pp. 165-70.



authenticity of Pliny and Tacitus' accounts of this great earthquake.<sup>271</sup> Despite the continual influx of new evidentiary material, the basic intellectual armature developed around the earthquakes of the 1680s-90s remained relatively stable over the following decades. After minor seismic events in Massachusetts and Connecticut in June 1705, Increase Mather preached a sermon in Boston on Luke 21:11 that recapitulated much of the reasoning of earlier Protestant writers. Mather's ancient examples included such familiar events as the destruction of Antioch and of the twelve cities of Asia, as well as the annihilation of Sodom and the shaking of the world at the death of Christ.<sup>272</sup> On the other hand, the list of modern earthquakes "in divers places" included not just the disasters in Lima, Jamaica and Sicily, but also earthquakes in the Dutch East Indies, in the Moluccas in 1695 and Sumatra in 1699.<sup>273</sup> Like his son Cotton, the elder Mather accepted both natural and divine causes for earthquakes, though stressing that all such events were "awfull works of God".<sup>274</sup> And like Cotton, he was sure that this recent proliferation of earthquakes indicated that the end was nigh. Alongside these eschatological views, an increasing eagerness to consider distant events and the growth of international news media bridged the distance between Boston and Batavia, allowing Mather to integrate the small-scale provincial affairs of New England into the much larger context of global disasters.

The ideas of the extension, transmission and interconnection of elemental forces that emerged in the earthquake commentaries of the 1680s and '90s soon transferred to other kinds of disasters as well. The new availability of such reasoning, alongside more traditional ideas, is visible in the discussion of another calamity: the "Great Storm" that battered the coastline of southern England

---

271 *Journal des Sçavans*, 1694, no. XL, pp. 478-79.

272 Increase Mather, *A Discourse Concerning Earthquakes: Occasioned by the Earthquakes Which Were in New-England, in the Province of Massachusetts-Bay, June 16. and in Conecticot-Colony, June 22. 1705...* (Boston: Printed by Timothy Green, for Benjamin Eliot, at his shop under the west end of the Exchange, 1706), 18, 21–22.

273 Mather, 24–25.

274 Mather, 8.

on 26-27 November 1703, which killed perhaps 8,000 people, mostly at sea.<sup>275</sup> Despite the obviously large scale of the disaster, the immediate religious reactions echoed old themes about a divine punishment of local sins. Queen Anne declared a day of humiliation on January 19 with a national fast, for the purpose of imploring God “to Pardon the Crying Sins of this Nation, which have Drawn down this Sad and heavy Judgment on Us and Our People” and to avert further chastisements.<sup>276</sup> A multitude of fast-day sermons assured audiences that the “Tempestuous Hurricane” was a divine judgement on national sins which would require a correspondingly significant national gesture of repentance and reformation.<sup>277</sup> However, other writers had their minds on wider contexts. As part of his large study of the storm printed in 1704, the journalist Daniel Defoe compared the recent tempest with “the Hurricanes of Barbadoes, the North-Wests of New-England and Virginia, the terrible Gusts of the Levant” and “the frequent Tempests of the North Cape”.<sup>278</sup> Along with many of the clerical commentators, Defoe thought that the Great Storm of 1703 was an example of direct providence that could not be fully explained by human reason.<sup>279</sup> Nevertheless, he also used the storm as an opportunity to develop innovative ideas about the environmental conditions that enhanced the risk of severe weather and the mechanisms that allowed it to travel around the globe. He was able to construct those ideas on the basis of large quantities of data, since he had compiled an immense collection of firsthand observations of the storm, solicited by means of newspaper advertisements. This collection he supplemented with the

---

275 Jan Golinski, *British Weather and the Climate of Enlightenment* (Chicago: The University of Chicago Press, 2007), 44.

276 *By the Queen, a Proclamation, for a General Fast.* (London: printed by Charles Bill, and the executrix of Thomas Newcomb, deces'd; printers to the Queens most excellent Majesty, 1703).

277 For instance, Thomas Freke, *A Sermon Preach'd on Wednesday, January XIX, 1703/4.: Being the Fast-Day, Appointed by Authority, for the Humbling Our Selves before Almighty God, in a Deep Sense of His Heavy Displeasure, Shew'd Forth in the Late Dreadful Tempest. As Also, For the Imploring of a Blessing on Her Majesty and Allies, Engag'd in the Present War.* By Thomas Freke. (London: printed for John Lawrence, at the Angel in the Poultry, 1704), 9.

278 Daniel Defoe, *The Storm; or, A Collection of the Most Remarkable Casualties and Disasters Which Happen'd in the Late Dreadful Tempest, Both by Sea and Land* (London: Printed for G Sawbridge, and sold by J Nutt, 1704), 46.

279 Defoe, chap. 1.

many accounts published by the Royal Society in its *Philosophical Transactions*, meteorological works such as Ralph Bohun's *Discourse concerning the origine and properties of wind* (1671) and histories such as William Camden's *Britannia* (1586).

For Defoe, it was not only the unprecedented force of the winds and the carnage they caused that identified the Great Storm as a preternatural occurrence, but its “prodigious Extent”.<sup>280</sup> Just as pious commentators had done with the earthquakes of the 1680s and ‘90s, Defoe insisted that no natural event could have simultaneously affected places across such a vast distance. English storms, he thought, were characteristically limited to a single region, while tempests in the channel regularly left the coasts undisturbed. Indeed, all the previous storms that had taken place in the world since the Deluge, including the most ferocious Caribbean hurricanes, had “spent their Force in a shorter space” than that of 1703. To substantiate this point Defoe listed historical examples of storms that had caused local devastation but left England unaffected. Among these he reproduced in their entirety Sir William Temple's description of two disastrous storms in the Netherlands in 1674-5 and an account of the “great Wind” of 1661 drawn from the sectarian judgement compilation *Mirabilis Annus*, whose anonymous writer (a fellow Dissenter) he considered to be an “unquestion'd Author”.<sup>281</sup> In each of those historical cases the winds had wreaked havoc within a circumscribed zone, “But this terrible Night shook all *Europe*; how much farther it extended, he only knows who *has his way in the Whirlwind*”.<sup>282</sup> Just as earthquake commentators a decade earlier had linked seismic events in the Americas to those in Europe, Defoe connected the disaster in England with a powerful storm on the coast of Florida and Virginia a few days prior.<sup>283</sup> He hypothesised that “the

---

280 Defoe, 46.

281 Defoe, 47–59.

282 Defoe, 59. The Biblical citation is to Nahum 1:3.

283 The phrasing in this section implies that he considered himself in line with a current of natural philosophical opinion on this point.

Confluence of Vapours rais'd by the Sun from the vast and unknown Lakes and Inland Seas of Water” that writers had reported to exist in the latter region had provided the raw material for an epochal storm. Divine providence, working within natural laws, had thereupon mustered the “Troops of Combustion” into an “Army of Terror” which the Lord marched at double-speed across the Atlantic in the direction of Europe. Ordinary storms, Defoe thought, dissipated before they could extend beyond a certain region, since the wind spent itself as the vapour that animated it dilated across space. However in this case the aerial army received reinforcements along the course of its march across the ocean and even agitated the stable air it encountered, thereby pressing it into service with the storm-front. Moreover, like a cavalry troop the tempest had picked up speed gradually, accelerating into a charge only as it approached Britain. Even once there he thought that the fury of the storm had increased over several days.<sup>284</sup>

These remarkable facts were, he insisted, a clear sign that a divine hand had carefully arranged matters, so that “the proportion of Matter being suited to Distance of Place, the Motion shou'd arrive at its full Force just at the Place where its Execution was to begin”.<sup>285</sup> Reports indicated that from England the storm had “carried a true Line clear over the Continent of *Europe*”, traversing France, Germany, the Baltic, Sweden, Finland and part of Russia until it reached the “vast Mountains of Ice and the huge Drifts of Snow” in the Arctic, “in which Abyss of Moisture and Cold it is very probable the Force of it was check'd”. Defoe thought it likely that from there the winds had continued to North America, thus completing a full circuit. His dramatic portrait of this trans-Atlantic journey marked an early vision of the movement of storm systems based on current natural philosophical reasoning about the air and the weather, as well as a large number of local reports. If

---

284 Defoe, *The Storm*, 59–61.

285 Defoe, 61.

none of these reports testified to the alleged progress of the storm across the Atlantic, that was because “[t]hose unhappy Wretches who had the misfortune to meet it in its first Approach, can tell us little, having been hurried by its irresistible Force directly into Eternity”. He was aware of seventeen ships that had purportedly disappeared in the Atlantic around this time, and the lack of information about them was merely “the common way of Discourse of Ships founder’d in the Ocean: and indeed all we can say of them is, the fearful *Exit* they have made among the Mountains of Waters, can only be duly reflected on by those who have seen those Wonders in the Deep”.<sup>286</sup>

Defoe’s work on the Great Storm encapsulated the trend in disaster research towards the comparative study of both contemporary and historical events. That methodological reorientation, combined with the increasing proliferation of news, allowed for the reimagination of disasters on much larger scales. In reflecting on the interconnections and movement of destructive forces between the Málaga earthquake of 1680 and the Great Storm of 1703, writers shifted the focus of disaster ideas from the local to the global, producing new reflections on geological and atmospheric processes. In addition to complicating theological doctrines of divine punishment, this work provoked changes in basic natural philosophical assumptions about the character and causes of earthquakes, storms and epidemics. Moreover, it provided the basis for the new concentration on environmental systems and interconnections that came to dominate disaster research over the first half of the eighteenth century.

---

286 Defoe, 62. The Biblical reference is to Psalms 107:24 (KJV).

## Chapter 5: Charting hazardous climates

The discussions of the earthquakes of the late seventeenth century extended the natural philosophical and theological analysis of disasters from communities and delimited zones to trans-Atlantic and even global scales. This shift provided the foundations for a reimagining of the relationship between the hazards of local environments and the global dynamics of the earth, sea and atmosphere. Over the first half of the eighteenth century, several major trends emerged in disaster investigation. A vast expansion in the collaborative collection of quantitative data and historical testimonies promised to provide a comprehensive index of disaster occurrence. This took place partly through the increasing scale of correspondence networks, and partly through the physical travel of investigators from Europe to the Americas. Researchers imagined large-scale climatic and geographical systems, which both spanned the globe and identified regional characteristics within it. The accumulation of data and the reimagining of space encouraged the perception of hazards as parts of interconnected environmental matrices. Investigators attempted to trace the putative physical relationships between different very kinds of disruptive forces: earthquakes, storms and epidemic diseases, and in doing so re-envisioned the relationship between humans and a volatile natural system.

The new awareness of and interest in distant disasters called for a new conceptual apparatus with which to make sense of the great disruptions of the environment, which could supplement both providential doctrines and physical explanations focused on small geographical zones. Over the first half of the eighteenth century several alternative models emerged, based on natural philosophical, medical and astrological ideas. Chemical reasoning, which had already come to dominate physical explanations for earthquakes in the second half of the seventeenth century, offered one possible

avenue. A key proponent of this approach was the French apothecary Nicolas Lémery, a member of the Académie des Sciences in Paris from 1699. In a brief but influential memoir published in the Académie's periodical in 1700, Lémery outlined a comprehensive combustion theory that he thought could explain earthquakes, volcanic eruptions, thunder storms and even hurricanes.<sup>1</sup> This was essentially an ambitious extension of the more common subterranean combustion explanations of earthquakes, since the important processes all originated under the ground. In Lémery's view, the fermentation of iron and sulphur underground produced a hot, sulphurous wind that raged around the caverns and channels beneath the earth, shaking and lifting the earth's surface in its furious passage. If the wind could find no egress, it caused a great earthquake that lasted until the movement dissipated; or in certain conditions (due to different quantities of flammable material, the availability of air and the presence of openings in the earth) it produced a subterranean fire that emanated in the form of a volcanic eruption that could submerge nearby villages in flames and ash.<sup>2</sup> If the wind successfully exited the ground it instead produced a destructive hurricane; in such cases, Lémery advised people to throw themselves upon the ground, so as to avoid suffocating in the sulphurous fumes.<sup>3</sup> For the chemist, hurricanes offered a vital link between subterranean and atmospheric events, since they served as a vehicle for transporting flammable matter from the earth to the sky. Once in the clouds, Lémery thought, this sulphurous wind mingled with nitre and possibly saltpetre (whose presence in the atmosphere he did not try to explain). As these materials became compressed they began to move increasingly violently and finally ignited, cracking apart clouds and launching downwards in the form of lightning bolts.<sup>4</sup> By re-envisioning earthquakes,

---

1 Nicolas Lémery, "Explication physique et chimique des feux souterrains, des tremblements de terre, des ouragans, des éclairs et du tonnerre," *Mémoires de mathématique et de physique de l'Académie royale des sciences*, 1700.

2 Lémery, 104–5.

3 Lémery, 104–5.

4 Lémery, 106–7.

eruptions and storms as interconnected parts of a single set of chemical reactions, Lémery simultaneously offered a universal theory for extreme elemental phenomena and elevated chemistry above meteorology. He reinforced this move by claiming to offer empirical evidence: not only from the sensory evidence of the smell of sulphur that people commonly reported after lightning storms, hurricanes and earthquakes, but also through his own experiments.<sup>5</sup> In one of these he fermented iron filings and sulphur in a large pot and buried it under the ground; after eight or nine hours he noticed that the earth had become hot, cracked and swollen up, while within the pot itself the sulphur had vanished, leaving only a residue of black iron powder.<sup>6</sup> Lémery took this as confirmation of his hypotheses: the chemical reaction in the pot exhibited in miniature what occurred inside the earth during an earthquake. This seems to have been the first experimental earthquake simulation, and for at least five decades it remained a crucial piece of evidence for combustion explanations of seismic activity.<sup>7</sup>

While chemical theories such as Lémery's offered a persuasive account of the physical processes that took place within elemental forces, they were highly general in character, and therefore could not by themselves provide a satisfactory explanation for specific disaster events, let alone predict future occurrences. Furthermore, they did not address the geographical questions that had become a major source of interest for natural philosophers from the 1680s. Meteorological investigation, which *did* appreciate geographical differences, still seemed to many to hold the secrets to understanding the causation of storms, epidemics, droughts, floods and other kinds of disastrous

---

5 Lémery, 101–2.

6 Lémery, 103–4.

7 See Quest. 31 in Isaac Newton, *Opticks: Or, A Treatise of the Reflections, Refractions, Inflections and Colours of Light*, 3rd ed. (London: printed for William and John Innys at the West End of St Paul's, 1721), 354–55; Anon, *A Dissertation upon Earthquakes, Their Causes and Consequences; Comprehending an Explanation of the Nature and Composition of Subterraneous Vapours, Their Amazing Force, and the Manner in Which They Operate...* (London: printed for James Roberts at the Oxford-Arms, in Warwick-Lane, and for the Booksellers in London and Westminster, 1750), 20–21.



phenomena. Even phenomena that began underground, such as earthquakes and volcanic eruptions, seemed to have some relationship to the atmosphere, whether because rainfall, aridity or air temperature affected seismic activity, or because that activity released chemical exhalations that disturbed the weather (as Lémery thought) and generated the miasmas that created diseases. Moreover, by identifying the patterns by which such events took place, meteorological investigations promised the holy grail of disaster knowledge: accurate forecasting.

These grand ambitions relied on the collection, compilation and interpretation of vast quantities of data. One part of this programme involved the consistent recording of meteorological conditions in “weather diaries” — a collecting technique with a long history that experienced an enormous increase in popularity in the eighteenth century.<sup>8</sup> Weather diarists made regular (often daily) notes on winds, rainfall and other atmospheric phenomena, sometimes employing detailed typologies and shorthand symbols to denote gradations of wind strength, and in many cases using instruments such as thermometers and barometers to provide quantitative data. Where ordinary journals and correspondence tended to present a vague, impressionistic account of meteorological conditions, weather diarists offered meticulous measurements in an attempt to provide an exact record. However, it does not necessarily follow that this attention to detail represented a general shift in interest from extraordinary weather incidents to ordinary, everyday occurrences.<sup>9</sup> In fact, extreme weather events remained central to this kind of investigation. Weather diaries and the natural philosophical writing that drew upon them attempted to locate the patterns that underlay such

---

8 See, inter alia, Theodore S. Feldman, “Late Enlightenment Meteorology,” in *The Quantifying Spirit in the Eighteenth Century*, ed. Tore Frängsmyr, H. L. Heilborn, and Robin E. Rider (Berkeley: University of California Press, 1990), 143–78; Vladimir Janković, *Reading the Skies: A Cultural History of English Weather, 1650-1820* (Manchester: Manchester University Press, 2000); Jan Golinski, *British Weather and the Climate of Enlightenment* (Chicago: The University of Chicago Press, 2007), chap. 3; Joyce Macadam, “English Weather: The Seventeenth-Century Diary of Ralph Josselin,” *Journal of Interdisciplinary History* 43, no. 2 (2012): 221–46.

9 Contrast the argument in Golinski, *British Weather and the Climate of Enlightenment*, xii, 3–4.

occurrences, placing storms within expansive meteorological systems that could be both measured at a granular level and statistically aggregated.

The correspondence between James Jurin at the Royal Society and John Horsley, one of his informants, shows how storms fitted into the wider practice of meteorological data collection. Under the auspices of the Royal Society, Jurin issued a call in 1723 for individuals in Europe and North America to send regular weather observations, which could be collated in London, in order to fulfill the programme of creating a natural history of the air of the kind that Hooke and Boyle had envisioned in the previous century.<sup>10</sup> Jurin praised Horsley on his exact method of measuring rainfall, and asked him to make daily observations of his instruments.<sup>11</sup> But he was especially interested in the latter's notes on storms, and it was this part of the correspondence that Jurin passed on to the Royal Society.<sup>12</sup> In February 1723 he requested that Horsley send him "particular Observations on Storms after the manner of those contain'd in your last". Later letters indicate that Horsley found it difficult to maintain these communications regularly, since in January 1726 Jurin felt it necessary to make the subtle remark that "I find too many Gentlemen discouraged by their not being able to keep a constant regular Journal, who therefore will make no Observations at all, whereas an interrupted Journal would many times be of the same use to me as it were perfect, especially if any Observations happen to be made on Stormy days".<sup>13</sup> Jurin's overall ambition, as he articulated it to Horsley, was to build up a robust account of "the Progress, & probably the Origine of Winds,

---

10 A Jacobo Jurin, "Invitatio Ad Observationes Meteorologicas Communi Consilio Instituendas," *Philosophical Transactions of the Royal Society of London* 32, no. 379 (1723): 422–27.; James Jurin to Johann Theodore Jablonski, 26 December 1726. WL MS. 6146, no. 94; Robert Hooke, "Method for Making a History of the Weather", in Thomas Sprat, *The History of the Royal-Society of London, for the Improving of Natural Knowledge* (London: Printed by TR for J Martyn, and J Allestry, 1667). Robert Boyle, *The General History of the Air* (London: Printed for Awnsham and John Churchill, 1692). The best general discussion of Jurin's project is in Andrea Alice Rusnock, *Vital Accounts: Quantifying Health and Population in Eighteenth-Century England and France* (Cambridge, UK: Cambridge University Press, 2008), chap. 5. Jurin never produced his projected natural history of the air.

11 James Jurin to John Horsley, 26 February 1723 N.S.; Jurin to Horsley, 4 May 1723. WL MS. 6146, no.s 86-7.

12 Jurin to Horsley, 26 February 1723.

13 Jurin to Horsley, January 29 1726 N.S. WL MS. 6146, no. 92. My emphasis.

upon which the changes of Weather seem in great measure to depend”.<sup>14</sup> The only way to achieve such knowledge, in his view, was to construct a regular correspondence from weather diarists like Horsley, “seated at proper distances, over a great Extent of Country”. However, bedeviling this grand design was a total lack of consistency between the reports of amateur observers, of very different backgrounds, using diverse methods and uncalibrated instruments of varied manufacture. It was with this in mind that Jurin asked Horsley to “every where set down the Letters & Numbers themselves” instead of employing shorthand, to tell him the make and type of his instruments, and to describe the layout of the room where he conducted his observations.<sup>15</sup> Ultimately, it proved impossible for eighteenth-century meteorologists to find a way to surmount the immense difficulty of standardisation, let alone to reduce the weather to a set of consistent rules or laws.<sup>16</sup> However, although that grand design proved elusive, the techniques of collaborative data collection honed over the first half of the eighteenth century allowed storms and other disastrous phenomena to be brought within a single, overarching, quantifiable system.

Many naturalists on both sides of the Atlantic understood the overarching system that presided over elemental forces in climatic terms. With deep roots in medicine and meteorology that stretched back to the teachings of Hippocrates and ancient natural philosophy, the idea of climate was already in use in the sixteenth and seventeenth centuries to articulate the physical differences between colonial territories and European metropolises, the presumed differences between races, and the physical effects on Europeans moving to the New Worlds.<sup>17</sup> During the first half of the eighteenth

---

14 Jurin to Horsley, 26 February 1723 N.S.

15 Jurin to Horsley, 4 May (June?) 1723.

16 Lorraine Daston, “Unruly Weather: Natural Law Confronts Natural Variability,” in *Natural Law and Laws of Nature in Early Modern Europe: Jurisprudence, Theology, Moral and Natural Philosophy*, ed. Lorraine Daston and Michael Stolte (Farnham, England ; Burlington, VT: Ashgate, 2008), 233–48.

17 Joyce E. Chaplin, *Subject Matter: Technology, the Body, and Science on the Anglo- American Frontier, 1500-1676* (Cambridge, Mass.: Harvard University Press, 2001), ch.s 4-5; Lucian Boia, *The Weather in the Imagination* (London:

century, climate increasingly came to serve as the key explanatory framework for disasters. Its usefulness derived in part from its modularity: it could be adapted to cover a variety of scales (local, regional and global) and it could draw together almost every known aspect of the physical environment. Climates could be either constants or variables: they accounted for long-term trends or general propensities (for instance, in storms or endemic diseases) and short-term swings (as with droughts and epidemics). Since the rules governing climates and their physical effects were fungible, this left room for both astral influences and a supervening providence to alter environmental conditions and create disasters without suspending natural laws. Increasingly, commentators re-imagined God's judgements as phasic and regional or global, rather than as sporadic, individual chastisements of a specific city. Viewed in this way, divine providence set in train sequences of catastrophic events whose connections could be deduced by the astute investigator, using methods of collation and comparison.

The emphasis on interconnected climatic systems opened the door to vast new studies of epidemic disease. Such inquiries built upon two other developments in the 1720s: widespread attention to the outbreak of plague at Marseille in 1720-22 and the debates over smallpox inoculation in Britain and North America. The former epidemic, which killed perhaps 40-50,000 people in Marseille (out of a pre-plague population of about 90,000), proved to be the last major outbreak of this disease in Western Europe.<sup>18</sup> Although alarm rapidly mounted in neighbouring countries, the French authorities' harsh enforcement of a tight *cordon sanitaire* around the city and the neighbouring region largely prevented its spread beyond a relatively small area of southeastern

---

Reaktion, 2005), chap. 2. For this aspect of climate in the eighteenth century, see Suman Seth, *Difference and Disease: Medicine, Race, and the Eighteenth-Century British Empire* (Cambridge, UK; New York: Cambridge University Press, 2018).

18 Charles Carrière, Ferréol Rebuffat, and Marcel Courdurié, *Marseille, ville morte. La peste de 1720* (Marseille: M Garçon, 1968), 302. | Biraben, 1975 | p. 255 | zu:1312628:QBHW4K8VL. W. B. Brockliss and Colin Jones, *The Medical World of Early Modern France* (Oxford; New York: Clarendon Press, 1997), 349.

France.<sup>19</sup> Nevertheless, the epidemic had commercial and diplomatic ramifications far beyond this region.<sup>20</sup> It also inspired a vast outpouring of printed literature on plague and generated fresh debates among medical writers about the etiology, nature and treatment of the disease. These debates in turn prompted a reassessment of historical outbreaks. In England, many works offered comparisons to the Great Plague of 1665-66. Among these were Daniel Defoe's extensively researched fictional "journal" of England's Great Plague of 1665-6, published in 1722, which attempted to extract from the horrors of this past episode implicit practical lessons for the present.<sup>21</sup> Other English works made the analogies explicit, such as the anonymous pamphlet *The late dreadful plague at Marseilles compared with that terrible plague in London, in the year 1665*, which offered not only advice but also the recipe for a supposedly infallible cure, in case "this Dreadful Marseillian Calamity should unhappily reach this Kingdom".<sup>22</sup>

Medical writers likewise turned to comparative observations, recognising that studying a single disease episode by itself could not supply an adequate quantity of information to form general conclusions. In 1722 the French academician and royal librarian Jean-Paul Bignon complained to John Woodward that the cessation of the plague outbreak had frustrated research, commenting bluntly that "those who like to penetrate the mysteries of Nature would be tempted to wish that it had lasted longer".<sup>23</sup> One solution to this problem of the ephemerality of epidemics was to expand the historical investigation of diseases, which eighteenth-century researchers undertook to do on a

---

19 Jean Noël Biraben, *Les hommes et la peste en France et dans les pays européens et méditerranéens* (Paris: Mouton, 1975), 230–305; Brockliss and Jones, *The Medical World of Early Modern France*, 350–52.

20 Cindy Ermus, "The Spanish Plague That Never Was: Crisis and Exploitation in Cádiz during the Peste of Provence," *Eighteenth-Century Studies* 49, no. 2 (2016): 167–93.

21 Daniel Defoe, *A Journal of the Plague Year: Being Observations or Memorials of the Most Remarkable Occurrences, as Well Publick as Private, Which Happened in London during the Last Great Visitation in 1665*, ed. Louis A. Landa, Revised edition (London, New York: Oxford University Press, 2010).

22 Anon., *The Late Dreadful Plague at Marseilles Compared with That Terrible Plague in London, in the Year 1665...* (London: printed by H Parker, 1721), 3.

23 "[...] ceux qui aiment à penetrer les mysteres de la Nature, seroient tenter de souhaiter qu'elle durât plus longtems [...]". Jean-Paul Bignon to John Woodward, 28 April 1722, UL MS Add. 7647/59r.

massive scale. François de Chicoyneau, a prominent physician of Montpellier who had treated plague victims in Marseille and penned several essays based upon his experiences,<sup>24</sup> published in 1744 a study of “the principal Plagues that have ravaged the world”. Proceeding from the observation that the plague was “a disease almost as old as the world”, he set out a history of its outbreaks from the epidemic in Athens during the Peloponnesian War (as described by Thucydides) onwards.<sup>25</sup> His account supplied detailed descriptions of symptoms in every case for which such information was available, and where there were no “exact writers” (*d’écrivains exacts*) he reasoned by analogy to other plague incidents.<sup>26</sup> Unconcerned by the lack of historicism in this approach, Chicoyneau prioritised the accumulation of information from his source material, which he culled, sometimes without citation, from past medical writers (from Galen to Gabriele Falloppio) as well as from histories. However, this process raised problems of epistemology as well as historical accuracy. On the one hand, however much they disagreed with each others’ descriptions, contemporary medical writers generally assumed that diseases existed in essential forms that could be captured within a single overarching epidemiological classification. Chicoyneau himself had helped to refine the symptomology of plague, and he expressed confidence that “plague almost always displays the same features” — an assumption that allowed him to project modern diagnoses back in time to fill

---

24 François Chicoyneau and François Verny, *Relation de la maladie contagieuse qui a affligé Marseille, envoyée par Messieurs Chicoyneau & Verny, Médecins de Montpellier, qui ont servi pendant cette Contagion à Marseille. Avec une methode pour la traiter* (A Nîmes, 1721); François Chicoyneau, *Observations et reflexions propres à confirmer ce qui est avancé par Mrs Chicoyneau, Verny & Soulier: dans la Relation du 10. decembre 1720 touchant la nature, les événemens & le traitement de la peste de Marseille* (Aix: Joseph David, 1721); François Chicoyneau, *Traité des causes, des accidens, et de la cure de la peste: avec un recueil d’observations et un détail circonstancié des précautions qu’on a prises pour subvenir aux besoins des peuples affligés de cette maladie, ou pour la prévenir dans les lieux qui en sont menacés* (A Paris: Chez Pierre-jean Mariette, Imprimeur-Libraire, rue Saint Jacques, aux Colonnes d’Hercule, 1744).

25 “une maladie presque’aussi ancienne que le monde”. François Chicoyneau, “Notice sur les principales Pestes qui ont ravagé le monde,” in *Pièces historiques sur la peste de Marseille et d’une partie de la Provence, en 1720, 1721 et 1722*, ed. Louis François Jauffret (A Marseille: chez les principaux libraires, 1820), vol. 1, p. 1.

26 Chicoyneau, vol. 1, p. 5.

in the lacunae of the historical record.<sup>27</sup> On the other hand, his survey attempted to show that the disease also evolved in its external aspects (*accidens*). Chicoyneau claimed that in the fifteenth century the external symptoms of plague changed so much that they almost seemed to indicate a “new disease” (*nouvelle maladie*): the spots and buboes of prior outbreaks, for instance, were no longer evident.<sup>28</sup> Chicoyneau’s collection and analysis of historical sources thus offered the implicit suggestion that diseases could not be captured within a static nosology; instead, medical research needed to pay attention to the specific descriptions in the historical testimonies and derive general trends from them. The book also insisted on placing the disaster in Marseille in a global and pan-historical context. As dreadful as that episode had been, it paled before the sixth-century Justinianic plague that “desolated the entire world; from the Empire of the East it extended its ravages across Persia, Italy and France; islands, caverns, the summits of mountains, all inhabited places were infected by it”.<sup>29</sup> The awareness of the world history of a single disease transformed it from a sporadic visitation to an environmental dynamic, which he understood to act (in tandem with warfare) as a recurrent check on the growth of human populations.<sup>30</sup> Moreover, Chicoyneau’s compilation also showed that this dynamic changed over time: after the catastrophe at Marseille the plague had disappeared from Western Europe, and “[t]he causes that produced it and that ended it are alike unknown”.<sup>31</sup>

While Chicoyneau demonstrated the utility of collecting qualitative records of epidemics, the debates over the efficacy and safety of smallpox inoculation tended to revolve around the

---

27 “la peste porte presque toujours les même caractères”. Chicoyneau, vol. 1, pp. 1, 5.

28 Chicoyneau, vol. 1, p. 12.

29 “[...] désola le monde entier; de l’empire d’Orient elle étendit ses ravages sur la Perse, sur l’Italie et sur la France; les isles, les cavernes, les sommets des montagnes, tous les lieux habités en furent infectés [...]” Chicoyneau, vol. 1, pp. 5–6. Chicoyneau’s dating of this pandemic to the fifth century is an error; he later (pp. 8-9) assigns it to the fifteenth year of Justinian’s reign.

30 Chicoyneau, vol. 1, p. 1.

31 “Les causes qui l’ont produite, et qui l’ont terminée, ont été également inconnues”. Chicoyneau, vol. 1, p. 31.

collaborative gathering of statistics. Advocates of inoculation such as Jurin and the Scottish doctor John Arbuthnot refined the quantitative approaches to calculating mortality that had been pioneered by Graunt and Petty, in order to show that people who used this prophylactic technology were much less likely to die from the disease than those who did not.<sup>32</sup> Trans-Atlantic collaboration became a crucial aspect of this quantitative research. In Boston, Cotton Mather put Jurin in touch with the surgeon Zabdiel Boylston and Isaac Greenwood, the first Hollisian professor of natural philosophy at Harvard College; Boylston became the first person in Boston to provide inoculations.<sup>33</sup> In return, inoculation advocates in Massachusetts drew their own assessments from a comparison of mortality statistics in London and Boston. This practice persisted long after the initial round of debates in the 1720s and by the middle of the century had become an important part of how some Bostonians perceived the disease environment of their city. In the early 1750s, the prominent preacher Thomas Prince and the deacon John Tudor exchanged mortality data drawn from their own activities, the Royal Society's accounts and English newspapers. During the "Small pox year" of 1752, Tudor was involved in centralised data collection in his capacity as one of the overseers of the poor in Boston. In July these minor officials, along with the Selectmen, visited each family in their wards, and "to[o]k an exact Account of the Number of persons that have had the small pox, either in the Natural way, or by Inoculation, Since it first broke oute in January last".<sup>34</sup> The findings clearly showed the utility of inoculation: only 31 inoculated people had died in this epidemic compared to 514 among the non-inoculated population. Within Tudor's ward in Boston's

---

32 John Arbuthnot, *Mr. Maitland's Account of Inoculating the Smallpox: Vindicated, from Dr. Wagstaffe's Misrepresentations of That Practice, with Some Remarks on Mr. Massey's Sermon* (London: printed and sold by J Peele, at Lock's Head in Paternoster-Row, 1722); Rusnock, *Vital Accounts*, chap. 2. For the influence of Arbuthnot's methodology on Jurin, see James Jurin, *The Correspondence of James Jurin (1684-1750): Physician and Secretary to the Royal Society*, ed. Andrea Alice Rusnock (Amsterdam; Atlanta, GA: Rodopi, 1996), 23.

33 Jurin, *The Correspondence of James Jurin (1684-1750)*, 20.

34 John Tudor diary, MHS Ms. N-1683, p. 19.



North End none of the 125 inoculated people perished.<sup>35</sup> Tudor kept notes on these numbers and forwarded them to Prince, so that the latter could make his own estimates of the total mortality.<sup>36</sup> Prince in turn compared these figures with the numbers printed in a local newspaper, the sextons' lists of burials and "the common Guess of the most intelligent" among his acquaintances, including physicians.<sup>37</sup>

The sustained commitment of Boston's inoculation advocates demonstrated how religious zeal could function alongside data collection in assessing the causes and progress of epidemics. Indeed, in Massachusetts the early involvement of such a prominent preacher as Mather helped to ensure that the medical debate over the efficacy of inoculation became fused with a heated theological debate about its moral acceptability. Mather suffered "vile Abuse" from conservative opponents of inoculation in the 1720s, who complained amongst other things about the heathen origins of variolation practices.<sup>38</sup> In November 1721 one of his enemies threw a bomb into his house that failed to explode, with a piece of paper attached to it that read: "Cotton Mather, You Dog, Dam you: I'll inoculate you with this, with a Pox to you".<sup>39</sup> The employment of theological arguments by participants on both sides of the debate meant that evolving medical theories of disease and quantitative methods of data collection attained a significance far beyond the context of the inoculation campaign, and acquired connections with broader attitudes about the role of providence in disasters. By the 1750s, Prince detected in the mortality statistics a clear sign that "the Supreme Lord of nature" had "prospere Inoculation".<sup>40</sup> This did not diminish Prince's belief that epidemics,

---

35 MHS Ms. N-1683, p. 20.

36 John Tudor to Thomas Prince, 27 July 1752, MHS Misc. Bd. 1752 July 27.

37 MHS Misc. Bd. 1752 July 27, p. 19 (pagination is my own).

38 Cotton Mather, *Diary of Cotton Mather, 1681-1724*, Collections of the Massachusetts Historical Society ; Ser. 7, v. 7-8 (Boston: The Society, 1911), 634.

39 Mather, 657-58.

40 MHS Misc. Bd. 1752 July 27, p. 15.

and disasters generally, were divine judgements. After a minor earthquake in New England in 1727 he delivered a sermon (which was also printed that year) entitled *Earthquakes the works of God and tokens of his just displeasure*. This was reissued in 1755 after another set of tremors generated alarm in Boston.<sup>41</sup> Prince also collected numerous similar sermons for his extensive personal library, such as Benjamin Colman's *The judgments of providence in the hand of Christ: His voice to us in the terrible earthquake* (1727).<sup>42</sup> Nevertheless, his response to the smallpox epidemics demonstrated his conviction that the understanding of disaster benefited from the collection and analysis of statistics. Indeed, he considered it "our Liberty or Duty to make a carefull Enquiry into the Operations of created causes", which functioned within "the universal scheme of Government".<sup>43</sup> Thus, the debates over smallpox helped to foster a pious motivation for quantitative disaster investigation that fitted within a providential conception of nature as a whole.

Together, the trends of transnational collaboration and of quantitative medical and environmental data collection encouraged the study of epidemics as environmental and climatic phenomena. By combining mortality statistics with meticulous weather records, numerous investigations attempted to realise the promise of the quantitative methodologies established by Graunt and Petty: the identification of the natural laws governing epidemics. In 1724 the Plymouth doctor John Huxham responded to Jurin's call for the submission of weather diaries by beginning

---

41 Thomas Prince, *Earthquakes the Works of God and Tokens of His Just Displeasure...* (Boston in New-England: Printed for D Henschman, over against the Brick Meeting House in Cornhill, 1727); Thomas Prince, *Earthquakes the Works of God, and Tokens of His Just Displeasure...* (Boston: printed and sold by D Fowle in Ann-Street, and by Z Fowle in Middle-Street, 1755); Thomas Prince, *An Improvement of the Doctrine of Earthquakes, Being the Works of God, and Tokens of His Just Displeasure...* (Boston, New-England: printed and sold by D Fowle in Ann-Street, and by Z Fowle in Middle-Street, 1755). See also Thomas Paine, *The Doctrine of Earthquakes: Two Sermons Preached at a Particular Fast in Weymouth, Nov. 3. 1727. The Friday after the Earthquake...* (Boston: Printed for D Henschman, over-against the Brick Meeting-House in Cornhill, 1728).

42 BPL H.17.128; H.18.106.

43 MHS Misc. Bd. 1752 July 27, p. 10. Original emphasis.

his own observations, which he communicated to the Royal Society.<sup>44</sup> Huxham shared Jurin's belief that weather data would be valuable for physicians, and accordingly juxtaposed his meteorological data with a record of illnesses and symptoms among his patients, noting also their responses to his medical treatments. He gave an indication of the conclusions such methods could yield in an analysis, published by the Royal Society, of an outbreak of smallpox in Plymouth between August 1724 and June 1725.<sup>45</sup> In this essay he briefly expressed the opinion that the sickness spread not because of interpersonal infection but climatic factors: "the extraordinary Driness of the Season" in a normally rainy part of the country, together with the prevalence of northerly and easterly winds, both predisposed the inhabitants to contract the disease and worsened its symptoms.<sup>46</sup> He greatly expanded these ideas in his *Observations on the air and epidemic disease* (published in Latin in 1739, with an English translation in 1759), based on his journals from 1728 to 1737, with a second volume taking the coverage up to 1748.<sup>47</sup> In the preface, Huxham approvingly cited Hippocrates' emphasis on aerial observations to the understanding of disease, "for the depraved Constitutions of the Atmosphere are the Causes of almost all epidemic Distempers".<sup>48</sup> As the Plymouth data showed, the number of smallpox and measles cases changed vastly from one year to the next; Huxham ascribed those alterations to meteorological changes, "so that the very Air seems to foment, or

---

44 John Huxham to James Jurin, 22 July 1725; Huxham to Jurin, 1726; Jurin to Huxam, 24 March 1726 (N.S.), in Jurin, *The Correspondence of James Jurin (1684-1750)*, 308–11, 321, 332–33.

45 John Huxham, "A Short Account of the Anomalous Epidemic Small-Pox, Beginning at Plymouth in August 1724, and Continuing to the Month of June 1725," *Philosophical Transactions of the Royal Society of London* 33, no. 390 (1724): 379–94.

46 Huxham, 383–84.

47 John Huxham, *Observations on the Air and Epidemic Diseases: From the Year MDCCXXXVIII. to MDCCXXXVII. Inclusive; Made by Doctor Huxham, at Plymouth: Together with a Short Dissertation on the Devonshire Colic. Translated from the Latin Original, and Now Published with the Doctor's Approbation* (London: printed for J Hinton, at the King's-Arms in Newgates Street, and Henry Whitfeld, in Plymouth, 1759); John Huxham, *Observations on the Air, and Epidemic Diseases,; From the Beginning of the Year 1738, to the End of the Year 1748 : Vol. II.* (London: printed for J Hinton, at the King's-Arms in Pater-Noster Row, and Henry Whitfeld, at Plymouth, 1767).

48 Huxham, *Observations on the Air and Epidemic Diseases*, i–ii.

suppress the Contagion, like as a Spark of Fire, thrown on proper Materials, bursts out into a vast Conflagration, whereas falling into Water, or the like, it is presently extinguished”.<sup>49</sup>

In a similar fashion to Huxham, George Cleghorn, a Scottish surgeon stationed with the British troops on the island of Minorca from 1736, kept journals that juxtaposed medical and meteorological information. His observations for 1744-49 appeared in print in 1751, with four subsequent editions (the last in 1815).<sup>50</sup> Cleghorn’s records offered quantitative measurements of the weather (through thermometer and barometer readings), along with tables of rainy days and heat, as well as summaries of prevalent illnesses in each month which revealed seasonal patterns. Cleghorn insisted that climatic differences between geographically distant locations produced marked changes in the disease environment that affected both the prevalence of illnesses and the efficacy of treatments. As a result, the diagnoses and treatments derived from medical practice in temperate countries needed to be supplemented with additional observations from warmer ones.<sup>51</sup> Minorca, for instance, was prone to diseases (especially tertian fevers) that Hippocrates, Galen and other classical writers had noted, but with which British practitioners were unfamiliar.<sup>52</sup> On the other hand, Cleghorn thought that climates could be grouped together by latitude, so that his own observations on Minorca should be applicable to to “many other Parts of the Globe”, including countries “to which our Fleets frequently repair”.<sup>53</sup> In his view, the advancement of medical meteorology and the prosecution of imperial geo-strategic interests marched hand in hand. If all the physicians located in the scattered British colonies and territorial possessions would publish similar

---

49 Huxham, ii.

50 George Cleghorn, *Observations on the Epidemical Diseases in Minorca. From the Year 1744 to 1749. To Which Is Prefixed, A Short Account of the Climate, Productions, Inhabitants, and Endemial Distempers of That Island.* By George Cleghorn, Surgeon to Brigadier General Offarrell’s Regiment (London: printed for D Wilson, at Plato’s Head, in the Strand, 1751).

51 Cleghorn, iii–iv.

52 Cleghorn, viii–ix.

53 Cleghorn, iv, x.

journals, medical practitioners could dramatically improve the efficacy of their treatments and thus safeguard British colonists, merchants and naval personnel.<sup>54</sup>

Whether in the analysis of a single location like Plymouth or a climatic latitude, medical meteorology promised to map the geography and atmosphere of the earth through a multitude of personal observations. Arbuthnot's *An essay concerning the effects of air on human bodies* (1733) set out the kinds of general propositions that could arise from combining a universal theory of the environmental interactions between the air and disease with the awareness of the variations of local climates.<sup>55</sup> Like Huxham and Cleghorn, Arbuthnot endorsed "the keeping a Journal of the Weather and reigning Diseases", which if maintained systematically had the potential to "reduce the Physiology of the Air to a Science".<sup>56</sup> This science would be observational, not doctrinal: Arbuthnot's perception of the disease geography of the earth as a set of distinct but interlinked climates left little space for the interpretation of plagues as direct judgements of the Almighty on specific local sins. While acknowledging God's power over nature, he pointed out that "[t]he Inhabitants of those Countries which have never been afflicted with the Plague, are not less Sinners than others", with the corollary that investigators should pay more attention to meteorological phenomena than the "miraculous Operation of Divine Vengeance".<sup>57</sup> Nevertheless, an awareness of global patterns in epidemics did not preclude providential analysis entirely. Elsewhere he indicated that quantitative studies could reveal the providential patterns that ordered the world, tracing the

---

54 Cleghorn, v.

55 John Arbuthnot, *An Essay Concerning the Effects of Air on Human Bodies* (London: printed for J Tonson in the Strand, 1733).

56 Arbuthnot, ix–ix.

57 Arbuthnot, 191.

“innumerable Footsteps of Divine Providence to be found in the Works of Nature”.<sup>58</sup> Thus the natural order and divine government, although not the same thing, converged and overlapped.

The project of mapping the earth’s myriad geographies through journals was not the only global epidemiological vision available in the eighteenth century, as is visible in the debate over yellow fever in the Caribbean. In 1739-40 the Barbadian physician Henry Warren controversially denied any causative role to the local climate in the production of yellow fever in the West Indies. Warren accepted the necessity of a Hippocratic monitoring of weather conditions for medical research, and acknowledged that woods, marshes and mountains generated stagnant air that produced disease. However, he insisted that “the present Malignity does not owe its Birth to any different Temperatures or our *Atmosphere*, nor to any Vapours or Exhalations from the Surface or Bowels of our little Spot of Earth”, pointing out that Barbados was a largely deforested island with frequent winds that scattered any unhealthy vapours.<sup>59</sup> Warren’s own record of weather conditions showed that recent outbreaks of yellow fever did not correlate to any recognisable meteorological patterns; indeed, the alterations of the weather at these times corresponded closely to those in healthy seasons.<sup>60</sup> Instead, he was convinced that the disease was a “foreign Intruder”, a pestilential fever (like the plague and smallpox) transmitted by sailors — an inference he supported with reference to the exceptionally high infection and mortality rates among seafarers.<sup>61</sup> He thought that yellow fever originated in the Far East: the French appellation, *Maladie de Siam*, indicated that it was endemic to

---

58 John Arbuthnot, “An Argument for Divine Providence, Taken from the Constant Regularity Observ’d in the Births of Both Sexes. By Dr. John Arbuthnott, Physitian in Ordinary to Her Majesty, and Fellow of the College of Physitians and the Royal Society,” *Philosophical Transactions of the Royal Society of London* 27, no. 328 (1710): 186–90.

59 Henry Warren, *A Treatise Concerning the Malignant Fever in Barbados, and the Neighbouring Islands: With an Account of the Seasons There, from the Year 1734 to 1738. In a Letter to Dr. Mead. By Henry Warren, M. D* (London: printed for Fletcher Gyles against Grays-Inn in Holborn, 1740), 68, 72.

60 Warren, 8.

61 Warren, 9, 3–4, 73–74.

southeast Asia.<sup>62</sup> Warren traced a line of transmission from the Levant to Martinique via a French ship, and from there to Barbados.<sup>63</sup> He thought that previous outbreaks could be linked to similar trans-Atlantic voyages, even dating back to the early settlement of the Spaniards, who had probably brought it with them. In all cases these outbreaks were temporary intrusions, “unwelcome Guests” introduced from abroad, rather than the periodic re-emergence of a disease indigenous to the West Indies.<sup>64</sup> In this interpretation, the risk of disease accumulated not as a result of a conjuncture of environmental conditions but through human activity. As an alternative to a world of interlocking regional climates, Warren drew attention to a world of long-distance commercial networks that conveyed pestilence as well as people and products.

Warren’s successor in Barbados, William Hillary, excoriated this analysis of the causes of yellow fever, instead generating a study that constituted a powerful affirmation of the interplay between global climatic variations and disease occurrence.<sup>65</sup> Hillary claimed to follow the models provided by Hippocrates (the “Father and Prince of Physicians”) and Huxham, by providing detailed information on the local climate alongside his descriptions and treatments of the prevalent diseases.<sup>66</sup> He set out most of this material in an extensive medical-meteorological register of “changes of the air”, which combined thermometer, barometer and rainfall measurements with qualitative descriptions of the weather and the illnesses that had presented in his patients.<sup>67</sup>

---

62 Warren, 3–4.

63 Warren, 4–6.

64 Warren, 6. Warren’s views on overseas disease transmission may have been influenced by Richard Mead’s insistence on the African origins of plague. Richard Mead, *A Short Discourse Concerning Pestilential Contagion, and the Methods to Be Used to Prevent It* (London: printed for Sam Buckley and Ralph Smith, 1720). On this point see Seth, *Difference and Disease*, 77–78. Warren dedicated his essay on yellow fever to Mead.

65 William Hillary, *Observations on the Changes of the Air and the Concomitant Epidemical Diseases, in the Island of Barbados: To Which Is Added a Treatise on the Putrid Bilious Fever, Commonly Called the Yellow Fever; and Such Other Diseases as Are Indigenous or Endemial, in the West India Islands, or in the Torrid Zone*. (London: Printed for C Hitch and L Hawes, in Pater-Noster-Row, 1759).

66 Hillary, i.

67 Hillary, 15–136.

Rejecting the association made by locals between mosquitoes and the swellings in the skin that were especially visible in newcomers to the island, Hillary claimed that these marks (and the fevers that sometimes followed them) were the result of travel from a cold climate to a hot one.<sup>68</sup> He considered the yellow fever that had devastated the Caribbean for a century to be native to the West Indies, and possibly the “Torrid Zone” in general (which would account for the association of the disease in French with Siam).<sup>69</sup> Whereas Warren had defended the innate healthiness of the sugar islands, denuded of their native forests, Hillary reaffirmed the existence of tropical diseases. His vision of the world was one of distinct disease reservoirs presided over by measurably different climatic conditions, linked by the bodies of voyagers conditioned by their home environments.

French medical and meteorological writers also participated in mapping the climatic physiology of the earth. France had no equivalent to Jurin’s centrally-directed meteorological collaboration until the Société Royale de Médecine in Paris launched its own correspondence scheme in 1780.<sup>70</sup> However, by the 1740s the Académie Royale des Sciences was regularly publishing data on weather and epidemics from a more loosely-organised circle of informants. Following a model set in place by Philippe and Gabriel-Philippe de la Hire, Giovanni Domenico Maraldi and Jean-Paul Grandjean de Fouchy provided basic data collected at the Royal Observatory at Paris, including temperatures, rainfall and barometric readings.<sup>71</sup> But other academicians were interested in collating weather records with the incidence of epidemic disease for extremely ambitious medical, meteorological and agricultural objectives. The physician and chemist Paul-Jacques Malouin furnished the Académie

---

68 Hillary, iv.

69 Hillary, 143–44.

70 On this programme see Caroline C. Hannaway, “The Société Royale de Médecine and Epidemics in the Ancien Régime,” *Bulletin of the History of Medicine* 46, no. 3 (1972): 257–73; Rusnock, *Vital Accounts*, 117–19.

71 e.g. Jean-Paul Grandjean de Fouchy, “Observations météorologiques faites à l’Observatoire Royale pendant l’année 1744”, *Histoire de l’Académie royale des sciences*, 1744, Mémoires, 507-9.



with observations (published in the Academie's *Mémoires* from 1746 to 1754) on weather and outbreaks of disease in Paris. He undertook to supply

Assiduous observations on the temperature of the air, & the different weights of the atmosphere, detailed notes on heat, cold, dryness and humidity; a consistent [natural] history of meteors, thunder, winds & rains, in each year, each season, each month & each day; in summary a continual comparison of all these things and their alterations, with the temperament, health & illnesses of men [...]<sup>72</sup>

Malouin's reporting included monthly mortality and birth statistics, as well as qualitative records of the weather and prevalent diseases. He envisioned his efforts as part of an ongoing international collaborative effort for the advancement of practical medicine, considering that if similar careful medical and meteorological observations could be made "over many years, many centuries, & in each country, they will render [...] the art of healing more perfect and more certain, than the most sublime scientific speculations can ever do without this assistance".<sup>73</sup> Observations conducted over this long timespan would allow an accurate forecast of the occurrence of hazardous phenomena: "there is every reason to believe that in time we would be able to predict the return of epidemic diseases & of meteors".<sup>74</sup> This advance warning would allow timely medical interventions to prevent deaths in epidemics, and the huge corpus of data assembled by the observers would also clarify the causes of diseases and suggest the most effective remedies. At last, all those who criticised medicine

---

72 "Des observations assidues sur la température de l'air, & les différens poids de l'atmosphère, un détail circonstancié du chaud, du froid, de la sécheresse & de l'humidité; une histoire suivie des météores, du tonnerre, des vents & des pluies, dans chaque année, dans chaque saison, chaque mois & chaque jour; enfin une comparaison continuelle de toutes ces choses & de leurs vicissitudes, avec le tempérament, la santé & les maladies des hommes [...]" *Histoire de l'Académie royale des sciences*, 1746, Mémoires, 151.

73 "[...] pendant plusieurs années, pendant plusieurs siècles, & dans chaque pays, rendront [...] l'art de guérir plus parfait & plus sûr, que ne le peuvent faire les spéculations les plus sublimes de la Physique dénuées de ce secours". *Histoire de l'Académie royale des sciences*, 1746, Mémoires, 151.

74 "[...] il y a tout lieu de croire qu'on y pourroit prévoir le retour des maladies épidémiques & des météores, au bout d'un certain temps [...]" *Histoire de l'Académie royale des sciences*, 1746, Mémoires, 152.

for its lack of certainty and utility would see that Hippocratic principles of environmental observation delivered tangible results both at the level of theory and of practice.

The conviction that collaborative data collection was in the public interest seems to have been widespread amongst the academicians at this time. From 1741 the Académie printed the “botanico-meteorological” bulletins that the physician, naval engineer and botanist Henri-Louis du Hamel du Monceau supplied from his residence near Pluviers in the Gâtinais. Rather than offering a minute daily record, these reports consisted of meteorological summaries and highlights organised by month, followed by an overview for the year with a thematic breakdown. Entries included wind directions and temperature readings (from one of the Réaumur thermometers), as well as notes of a more qualitative nature. Storms and diseases constituted major preoccupations of the bulletins, alongside notes on the flowering and produce of trees and plants. In April 1743, for instance, violent, icy winds damaged the area’s trees and also occasioned an outbreak of fluxes that proved deadly to some.<sup>75</sup> In March 1745, frequent tempests and heavy rains kept the thermometer below zero, while *fièvres malignes* became widespread, “probably because of the bad weather”.<sup>76</sup> The assumption underlying du Hamel’s reports was that a single climatic system presided alike over the lives of humans and plants; collecting data on each one allowed glimpses of overarching patterns within this system. The practical corollary was that if these patterns could be identified, it would be possible to predict the variations that affected public health and the rural economy. From an early stage Du Hamel recognised that such conclusions would require a vast collaborative enterprise: “it will be necessary to have exact and informed Correspondents in all of the Provinces of the

---

75 "Observations botanico-météorologiques pour l'année [1743]. Faites aux environs de Pluviers en Gâtinois", *Histoire de l'Académie royale des sciences*, 1744, Mémoires, 123-4.

76 *Histoire de l'Académie royale des sciences*, 1745, Mémoires, 167.

Kingdom”, for which purpose he urged the Académie to send a general request across their network of astronomical and meteorological informants to undertake journals along the lines of his own.<sup>77</sup>

Although Du Hamel’s hopes for coordinated observations across France remained unfulfilled for several decades, his ecological approach to health and the weather proved just as exportable to New France as British models of medical meteorology were to the Caribbean. Jean-François Gaultier, the royal physician at Quebec City, became the key proponent of this avenue of research in Canada. Besides his official duties of treating soldiers and marines, Gaultier was also a naturalist with a keen interest in botany, which gave him a close affinity to du Hamel’s work.<sup>78</sup> As a consequence, du Hamel requested Gaultier to keep a journal of “Observations botanico-météorologiques”, which the latter duly did from his arrival in New France in 1742 until 1756.<sup>79</sup> Gaultier forwarded extracts of this journal to du Hamel, who arranged for the Académie to publish abridged versions alongside his own bulletins in four issues of its periodical (1744-47). The layout of the journal was extremely systematic: Gaultier entered instrumental measurements or shorthand notations in six columns, with spaces for recording the temperature in the morning and the afternoon (the latter in summer only), wind directions and a general overview of the day’s weather.<sup>80</sup> In the 1754 diary Gaultier explained the utility he saw in these observational practices, which he described as “always advantageous and interesting for Canada”. Beyond the potential for agricultural progress in acquiring an exact knowledge of climatic conditions in this “entirely new country”, botanico-meteorological observations “will inform us what the most vexatious illnesses

---

77 “il faut avoir dans toutes les Provinces du Royaume, des Correspondants exacts & éclairés”. *Histoire de l’Académie royale des sciences*, 1741, Mémoires, 150.

78 Victoria C. Slonosky, *Climate in the Age of Empire: Weather Observers in Colonial Canada* (Boston, Massachusetts: American Meteorological Society, 2018), chap. 2.

79 “Observations botanico-météorologiques faites à Québec par M. Gautier, pendant l’année 1743”, *Histoire de l’Académie royale des sciences*, 1744, 135.

80 See for instance the weather diary for 1754 at Houghton Library MS Can 42 (1).

are, and the manner by which to treat them successfully”.<sup>81</sup> As Du Hamel noted, “M. Gautier [sic] is inclined to think with Hippocrates and against Sydenham, that great variations in the temperature of the air can easily give rise to illnesses”.<sup>82</sup> However, Gaultier also accepted non-climatic explanations for disease, as when he attributed a gastric malady that afflicted most of the town’s population in 1753 to the arrival of rotten flour from France.<sup>83</sup> The Seven Years War ended Quebec City’s brief tenure as a key site for French botanico-meteorology. In 1756 Gaultier died during an outbreak of typhus, probably introduced by French soldiers, and three years later the town fell into British hands.<sup>84</sup>

Although the cession of New France to Britain in 1763 closed one avenue for French trans-Atlantic natural investigation, others already existed in the form of scientific expeditions to Spanish America.<sup>85</sup> The diverse objectives for these expeditions included the acquisition of information on earthquakes, storms and diseases, and the naturalists who embarked upon them often framed their findings in climatic terms. Among the goals of the priest and astronomer Louis Feuillée’s expedition to Peru and Chile in 1707-12 was to investigate “[t]he winds that predominate, their strengths, & their variations, earthquakes, [and] all the phenomena that appeared new to me, & from which physical inquiries (*la Physique*) could draw some advantage”.<sup>86</sup> Feuillée accordingly kept

---

81 “Les observations Botanico meteorologiques servent toujours avantageuses et interessantes pour le canada [...] elle nous apprendront aussi quelles sont les maladies Les plus facheuses, et La maniere de Les traiter avec succès”. HL MS Can 42 (1), f. 8v.

82 “M. Gautier incline à penser avec Hippocrate & contre Sydenham, que les grandes différences dans la température de l’air peuvent bien occasionner ces maladies”. *Histoire de l’Académie royale des sciences*, 1744, 137.

83 HL MS Can 42 (2), f. 2r.

84 Slonosky, *Climate in the Age of Empire*, 24–25.

85 French scientific expeditions originated in the seventeenth century. See Nicholas Dew, “Scientific Travel in the Atlantic World: The French Expedition to Gorée and the Antilles, 1681–1683,” *The British Journal for the History of Science* 43, no. 1 (2010): 1–17.

86 “Les vents qui regnent, leurs forces, & leurs variations, les tremblemens de terre, tous les phenomenes qui me paroïtroient nouveaux, & dont la Physique pourroit retirer quelque avantage”. Louis Feuillée, *Journal des observations physiques, mathematiques et botaniques, faites par l’ordre du Roy sur les côtes orientales de l’Amerique meridionale, & dans les Indes occidentales, depuis l’année 1707. jusques en 1712* (A Paris: chez Pierre Giffart, 1714), vol. 1, pp. 6–7.

meteorological records with barometric readings and notes on particular weather events (including storms) and seismic tremors. He also planned “[t]o try to inform myself exactly about the ordinary sicknesses among the different peoples of the Indies, their symptoms, & the remedies they use to cure them”.<sup>87</sup> Expeditionaries conceived themselves as climatic cartographers, charting the various patterns and hazards of the geographies they travelled through as if discovering hitherto unknown territories. In his expedition of 1712-14, the engineer Amédée François Frézier found himself frequently comparing the climates he visited with those of his home country. As far as he could tell, it never rains at Lima, “[a] Phenomenon so contrary to what we see in our Climates”.<sup>88</sup> Indeed, if Peru were not so troubled with earthquakes, its “happy climate” (*heureux climat*) would seem like a terrestrial Paradise.<sup>89</sup> The French naturalists involved in these voyages sometimes considered that their brand of climatic natural knowledge made them intellectually superior to the inhabitants of the Spanish colonies: in 1709 Feuillée ridiculed *limeños* as “extrêmement superstitieux” when they worried that the appearance of a globe of fire in the sky might portend a major earthquake.<sup>90</sup> In reality, however, the French travellers found the extreme environmental hazards of South America both fascinating and frightening. Terrible coastal storms threatened Feuillée with shipwreck on more than one occasion.<sup>91</sup> The seismic activity that he recorded in his journal occasionally disrupted his scientific instruments, but also gave him cause for personal concern and involved him in the concerns of others around him. Woken by tremors one day in 1709, he reflected that earthquakes

---

87 “De tâcher de m’informer exactement des maladies ordinaires parmi les differents peuples des Indes, leurs symptomes, & les remedes dont ils se servent pour les guerir, &c.” Feuillée, vol. 1, p. 7.

88 “Un Phenomene si contraire à ce que nous voyons dans nos Climats [...]” Amédée François Frézier, *Relation du voyage de la mer du Sud aux côtes du Chily et du Perou,; fait pendant les années 1712, 1713 & 1714. : Avec une réponse a la preface critique du livre intitulé, Journal des observations physiques, mathematiques & botaniques du R.P. Feuillée, contre la Relation du voyage de la mer du Sud ...* (A Paris,; Chez Nyon, Chez Didot, Chez Quillau, 1732), 190.

89 Frézier, 209.

90 Feuillée, *Journal des observations*, vol. 1, pp. 409–10.

91 Feuillée, vol. 1, p. 270, vol. 2, p. 639.

allowed very little time to save oneself; after a second shock later in the morning he found himself ministering as a priest to the disconcerted local community.<sup>92</sup> Pierre Bouguer, one of the members of the “geodesic” expedition that set out from France in 1735 to measure the shape of the earth, described how storms not only interfered with the team’s instruments but “often reduced us to the vexing necessity of thinking only of our own preservation”.<sup>93</sup> The expedition endured weeks of rain and fierce winds at Tarqui (Ecuador), where Charles-Marie de la Condamine was shocked to witness an arc of lightning kill two Indians in front of him.<sup>94</sup>

To transform the individual experiences of the expeditionaries into definitive climatic assessments required a historical perspective that could demonstrate a pattern of repetition. The paradox of the self-presentation of the expeditionaries as intrepid explorers of uncharted lands — “new Argonauts”, in the words of Bernard de Fontenelle<sup>95</sup> — was that they relied heavily on locals (both indigenous and creole) to supply them with the crucial historical information. Thus Feuillé not only collected data on the earthquakes he himself experienced but also on past catastrophes, such as an earthquake at Pisco in 1682.<sup>96</sup> He also took note of the way in which the Spanish colonists had learned over time to adapt to these events in planning their buildings and towns.<sup>97</sup>

---

92 Feuillée, vol. 1, p. 411, vol. 2, p. 639.

93 “[...] nous réduisoient souvent à la fâcheuse nécessité de ne penser qu’à notre propre conservation”. Pierre Bouguer, *La figure de la terre: déterminée par les observations de messieurs Bouguer, et de la Condamine, de l’Académie Royale des Sciences, envoyés par ordre du roy au Pérou, pour observer aux environs de l’équateur; avec une relation abrégée de ce voyage, qui contient la description du pays dans lequel les opérations ont été faites* (Paris: Charles-Antoine Jombert, 1749), v.

94 Charles-Marie de La Condamine, *Journal du voyage fait par ordre du roi, à l’équateur: servant d’introduction historique à la Mesure des trois premiers degrés du méridien*, (A Paris: De l’Imprimerie royale, 1751), 178.

95 Cited in Mary Terrall, “Heroic Narratives of Quest and Discovery,” *Configurations* (Baltimore, Md.) 6, no. 2 (1998): 229.

96 Feuillée, *Journal des observations*, vol. 1, pp. 393–4. The date of the disaster is incorrect: Pisco experienced destructive earthquakes on 12 May 1664 and 20 October 1687. Feuillée was probably referring to the latter episode: on this disaster see the discussion in Ch. 3. The effects of the 1664 earthquake are described in José de Buendía, *Vida admirable y prodigiosas virtudes del venerable y apostólico padre Francisco del Castillo de la compañía de Jesús* (Madrid: A Roman, 1693), 169–73; Josephe de Mugaburu, *Chronicle of Colonial Lima: The Diary of Josephe and Francisco Mugaburu, 1640-1697*, trans. Robert Ryal Miller (Norman: University of Oklahoma Press, 1975), 130.

97 Feuillée, *Journal des observations*, vol. 1, p. 499.

Frézier was even more interested in the calamities that had shaped the landscape and the urban environments of these countries: he had read José de Acosta's sixteenth-century natural history, and had no trouble crediting his claim that great earthquakes had profoundly reshaped South American topography.<sup>98</sup> Bouguer investigated the great volcanic eruption of Cotopaxi in 1533 both by personally examining the massive rocks it had thrown out and by reading the historical descriptions of Pedro Cieza de León, Garcilaso de la Vega and Antonio de Herrera y Tordesillas.<sup>99</sup> Frézier found Arica mostly destroyed and depopulated as a result of seismic disasters and the attacks of English raiders, while in Santiago de Chile he uncovered information about the catastrophic earthquake of 1647.<sup>100</sup> Antonio de Ulloa y de la Torre-Giral and Jorge Juan y Santacilia, the Spanish contingent of the geodesic expedition, kept a careful record of the times of the day at which they experienced tremors in 1742, but they also inquired closely into every major earthquake in Lima from 1582 onwards.<sup>101</sup> In the process of avidly collecting these details about the past, the expeditionaries were learning from the inhabitants of Peru and Chile to situate earthquakes within an ecology that was both natural and human, topographical and medical. Earthquakes supposedly posed a threat to human health by releasing poisonous subterranean effluvia: Frézier was told (and evidently believed the account) that another seismic disaster in Santiago in 1657 had released so many noxious vapours into the air that almost the entire population of the city had died.<sup>102</sup> Furthermore, these catastrophic

---

98 Frézier, *Relation du voyage de la mer du Sud aux côtes du Chily et du Perou*, 103.

99 Pierre Bouguer, "Relation abrégée du voyage fait au Pérou par Messieurs de l'Académie Royale des Sciences, pour mesurer les Degrés du Méridien aux environs de l'Équateur, & en conclurre la Figure de la Terre", *Histoire de l'Académie royale des sciences*, 1744, Mémoires, 270-271. Bouguer also recounted the story that the eruption had been foreseen by the emperor Huayna Capac as a sign that the Inca would be conquered by foreigners.

100 Frézier, *Relation du voyage de la mer du Sud aux côtes du Chily et du Perou*, 91, 135–36.

101 Antonio de Ulloa, *Relacion historica del viage a la America Meridional hecho de orden de S. Mag. para medir algunos grados de meridiano terrestre, y venir por ellos en conocimiento de la verdadera figura, y magnitud de la tierra, con otras varias observaciones astronomicas, y phisicas* (En Madrid: Por Antonio Marin, 1748), vol. 3, pp. 102–7.

102 Frézier, *Relation du voyage de la mer du Sud aux côtes du Chily et du Perou*, 91. The link between subterranean effluvia and disease had deep roots. See for instance Hooke's speculation about the connection between the 1687 Lima earthquake and disease in London in the preceding chapter.

upheavals had consequences for the character of the land as well as the built environment: in Lima, Frézier heard that the earthquake of 1678 had left the province's soil infertile, while that of 1687 had ruined much of the city.<sup>103</sup> On the other hand, Bouguer recognised that volcanic eruptions had probably contributed a great deal to soil fertility.<sup>104</sup> The French travellers found that to understand the nature and effects of earthquakes and other hazards required the construction of an archive of information that was historical as well as geographical. In turn, this archive revealed how hazards intersected with the other facets of life that together made up the geography and climate of each region.

Although French expeditionaries tended to downplay their reliance on local informants and savants, these collaborators played a crucial role in deepening French awareness of the connections between the atmosphere, geography, hazards and humans. Indeed, eighteenth-century Peruvian investigators themselves generated important studies of hazardous phenomena that simultaneously sought to emphasise the special natural risks in the viceroyalty while situating them within a global framework. These inquiries built upon the seventeenth-century Peruvian corpus of astro-meteorological observations (described in chapter 2), which had encouraged the simultaneous monitoring of many kinds of environmental variables. One of the heirs to this tradition — and a source of information for Bouguer — was Juan de Barrenechea, a substitute professor of mathematics at the University of San Marcos in Lima. In 1729 Barrenechea published a lunar table or clock (“Relox Astronómico”) for predicting earthquakes, followed in 1734 by a technical essay that both set out the theory behind the table and expanded the method to cover seismic events in

---

103 Frézier, 188. The claim that an earthquake had ruined the wheat industry was widely repeated among Peruvians, although the event in question was usually presumed to be the 1687 earthquake. This story may have been invented in the eighteenth century, partly to obscure the real causes of the problems with the grain supply: Pablo Emilio Pérez-Mallaina Bueno, “La Fabricación de Un Mito: El Terremoto de 1687 y La Ruina de Los Cultivos de Trigo En El Perú,” *Annuario de Estudios Americanos* 57, no. 1 (2000): 69–88.

104 Bouguer, *La figure de la terre*, 64.



various regions of the world.<sup>105</sup> Barrenechea drew his earthquake data from his own experience, the reports of gazettes and accounts in historical works such as the Peruvian chronicles of Bernardo de Torres (1657) and the Guatemalan history of Francisco Vázquez (1714). He also consulted a number of meteorological and natural philosophical treatises, including Juan de Figueroa's *Opusculo de astrologia* (1660), José de Zaragoza's *Espheera en comun* (1675) and Johann Zahn's *Specula physico-mathematico-historica* (1696). An adherent of the combustion theory of earthquakes, Barrenechea believed that seismic movements occurred when sulphur, saltpetre, carbon, nitre and other naturally-occurring minerals ignited beneath the ground, forming fiery air (*Aire igneo*) by means of a “voracious exhalation” (*voraz exhalacion*) that attempted to force its way out of the earth.<sup>106</sup> However, he believed that these explosive reactions could only occur in specific periods; the rest of the time they were inhibited by the presence of seawater, which the tidal flux and reflux drove into subterranean conduits (the hydrophilactic channels that Kircher had identified in his *Mundus subterraneus*). Barrenechea's predictive method consisted in identifying when these phases occurred: a process he referred to as the “new Periodic observation” (*nueva observacion Periodica*).<sup>107</sup> Since the moon's movements governed the tides, and these operated in a regular fashion, he reasoned that astronomical calculations of lunar orbits could furnish the basis for determining the times in which earthquakes could and could not take place.

Barrenechea's method, which sought to trace interconnections between phenomena in the earth, the sea and the sky, was a product of Peru's syncretic epistemic environment, to which astrology had made important contributions. Since French natural philosophers had long repudiated astrology, to

---

105 Juan de Barrenechea, *Nueva observacion astronomica del periodo tragico de los Temblores grandes de la Tierra. Exactamente arreglada à Europa, y Assia, y de la America, à los Reynos del Perú, Chile, y Guathemala* (Lima: Por Juan Joseph Gonzales de Cossio, 1734). The *Relox astronómico* forms an annex in this later publication.

106 Barrenechea, ff. 1r, 5v.

107 Barrenechea, f. 9r.

the minds of expeditionaries this aspect lent a dubious quality to Peruvian learning which seemed to echo the perceived superstition of the populace and served to confirm the imagined superiority of French natural knowledge. As Bouguer derisively commented, “[y]ou will not be astonished that in Peru judicial Astrology has set about predicting earthquakes and volcanic fires. People maintain the taste for this vain science in all the countries where the true sciences have made little progress”.<sup>108</sup> Since he considered Barrenechea an exemplar of “this vain science”, he denigrated the latter’s predictions, while acknowledging that the tides and moon phases could indeed play a role in earthquake causation.<sup>109</sup> However, Barrenechea’s relationship to astrology was not as straightforward as Bouguer suggested. Certainly, the very idea of associating earthquakes with celestial events had clear astrological origins. Nevertheless, Barrenechea characterised his practice as astronomical rather than astrological, and described astronomy as the “Queen of all the Mathematical Sciences”.<sup>110</sup> He contrasted the error-prone and “useless” prediction of individual prosperity or misfortune (the traditional province of judicial astrology) with the “rigorous calculations and laws” of the true astronomy.<sup>111</sup> On the other hand, Barrenechea had inherited from astrology the notion of mapping celestial objects onto specific terrestrial places. Astrologers had

---

108 “On ne s’étonnera pas que l’Astrologie judiciaire ait entrepris au Pérou de prévoir les tremblemens de terre & les incendies des volcans. On conserve du goût pour cette science vaine dans tous les pays où les vraies sciences n’ont fait que peu de progres”. Bouguer, *La figure de la terre*, 72.

109 However, Bouguer thought that sea water (and rains) had the opposite effect, causing subterranean combustion through a chemical reaction with the flammable mineral deposits. He saw confirmation of this hypothesis in the fact that several of Peru’s great earthquakes had occurred during October and November, when the equinox brought high tides. Bouguer, 72–76. Ironically, the argument that sea water helped to produce combustion was also made in one of the prefatory *aprobaciones* to Barrenechea’s book by Joseph Pavon, an Augustinian professor of philosophy and theology at the Universidad Pontificia de San Ildephonso. In a flowery account that actually contradicted Barrenechea’s theory, Pavon claimed that the interaction of sea water with underground fires produced a boiling that generated the crucial exhalation. Bouguer does not mention this alternative explanation.

110 “Reyna de todas las Ciencias Mathematicas”. Barrenechea, *Nueva observacion astronomica del periodo tragico de los Temblores*, A1r.

111 “rigurosos calculos y leyes”. Barrenechea, A1v. He offered no comment on natural astrology or astro-meteorology, whose practitioners also attempted to explain or forecast earthquakes and other elemental disruptions using astral observations.

long predicted the earthly effects of comets, for instance, by attempting to ascertain the geographical locations over which their tails and other parts had passed.<sup>112</sup> Furthermore, his identification of the dominant zodiac signs of various regions recalled the older practice of associating specific cities or kingdoms with certain star signs. However, Barrenechea did not adhere to the doctrines of correspondences and sympathies that astrologers had traditionally used to theorise the relationship of celestial movements to natural occurrences. Instead, he embraced a mathematical cartography of the sky, in which the constellations, nodes and houses simply connoted spatial reference points that could be precisely ascertained by astronomical means and represented geometrically as circles, lines and vertices. Barrenechea conceded a terrestrial influence only to the moon, in its function of altering the tides. Nevertheless, he accentuated that influence to the point that it became a lever for geological activity across the globe.

Considering the tradition of a global earthquake accompanying the death of Christ, Barrenechea claimed that the greatest *natural* seismic event could shake only half the world at once.<sup>113</sup> This was because he insisted on a division of the world into four parts; the sea (both above and below ground) in two of these quadrants is always at flood tide while the water ebbs in the others. These tidal movements followed the movement of the moon, which makes an east-west transit through all the planetary meridians in 24 hours and 50 minutes. Barrenechea thought that God had deliberately set in place these geographical limits on earthquakes as an act of benevolence to lessen the world's afflictions.<sup>114</sup> The *Relox astronómico* consisted of four charts which listed, respectively, ebb tide periods, conjunctions of the sun and moon, eclipses and longitudinal coordinates of the celestial

---

112 Sara Schechner Genuth, *Comets, Popular Culture, and the Birth of Modern Cosmology* (Princeton, N.J.: Princeton University Press, 1997), chap. 3.

113 Barrenechea, *Nueva observacion astronomica del periodo tragico de los Temblores*, f. 5r.

114 Barrenechea, f. 5v.

movements and apogees. Applying a set of calibrating procedures to these charts would, in theory, allow any person to determine periods of earthquake danger. The charts could not pinpoint the day, hour or location in which a seismic disaster would occur — Barrenechea considered such precise predictions to be the province of astrologers, whose earthquake prophecies were notoriously unreliable.<sup>115</sup> However, he considered that the identification of more general periods of seismic risk would be of public utility: amongst other things it could tell people when they should prepare for aftershocks and when they would be safe remaining in a city. For instance, he pointed out that during the Lima earthquake of 1687 it was the second shock that caused most of the damage.<sup>116</sup> Barrenechea further claimed that in 1726 the Chinese emperor's astronomers had accurately warned him of a coming earthquake in Peking; by taking the prudent precaution of moving his court to pavilions in the countryside the emperor managed to remain safe during the ensuing catastrophe.<sup>117</sup>

Although Barrenechea's chief focus was on Peru, he also extended his observations to the rest of the world. He identified four geographical zones of seismic activity: Peru, Chile, Guatemala and Eurasia. The last location was rather vague in extent, but the first three occupied precise geographical coordinates that could be projected mathematically as two-dimensional geometric shapes and associated with specific lunar and stellar positions. Since the histories he consulted did not mention notable earthquakes in Africa, he inferred that they seldom afflicted this continent, no doubt because there was less subterranean fire beneath it to produce the necessary *aire igneo* — a deduction confirmed by the fact that Africa only possessed nine volcanoes (one of them on Tenerife).<sup>118</sup> Although allowing that some earthquakes were purely miraculous in nature, and thus

---

115 Barrenechea, ff. 21r-v.

116 Barrenechea, ff. 4r-v.

117 Barrenechea, f. 30r.

118 Barrenechea, f. 30v.

beyond his system, Barrenechea insisted that major seismic events could only *naturally* occur in a given geographic zone when the moon's north or south nodes (the *caput draconis* or dragon's head and *cauda draconis* or dragon's tail) were in the stellar signs that dominated that region.<sup>119</sup> Even minor tremors occurred with more repetitions at those times.<sup>120</sup> In Europe and Asia the draconic lunar nodes were in Aries and Libra or Cancer and Capricorn, in Peru they had to be in Aquarius or Scorpio, in Chile, Cancer or Capricorn and in Guatemala in Aries or Libra.<sup>121</sup> To demonstrate these propositions, Barrenechea offered a compilation of historical earthquakes with references to the lunar node configuration at the time of occurrence, complete with precise instrumental measurements (insofar as these were available). He separated these lists into the four geographical zones, supplying data for earthquakes in Peru from 1582 to 1732 (with a projection of future earthquake periods up to 1846), Chile from 1570 to 1730, Guatemala from 1530 to 1717, and Eurasia from 22 CE (the destruction of the twelve cities in the reign of Tiberius) to 1732.<sup>122</sup> Each of these events, he maintained, had occurred during the periods he had outlined. As for those periods in which earthquakes should have occurred according to his system but did not, he explained the absence of earthquake reports by suggesting that the shaking had occurred at sea or in wilderness areas (such as Peru's vast jungles), leaving behind no written records.<sup>123</sup> Despite Bouguer's scornful criticisms, Barrenechea's theory amounted to an extremely ambitious attempt to apply mathematics and astronomy to the prediction of disaster events. Had it worked as reliably as he imagined, it would perhaps have constituted the first regular warning system for earthquakes. As it was, it

---

119 Barrenechea, C1r-v, f. 9r.

120 Barrenechea, f. 9r.

121 Barrenechea, C1r-v.

122 Barrenechea, ff. 14v-30r.

123 Barrenechea, f. 9r.

represented a sophisticated contribution to the broader project of mapping the global and regional geography of hazards.

Another Peruvian who linked terrestrial disasters with celestial observations was Pedro de Peralta y Barnuevo, a creole savant who befriended Frézier and subsequently assisted the geodesic expedition.<sup>124</sup> Peralta held the chair of mathematics at the University of San Marcos (making him Barrenechea's academic superior), with the associated post of chief astronomer (*cosmógrafo mayor*) of the Kingdom of Peru.<sup>125</sup> Catastrophes occupied an important place equally in Peralta's natural philosophical inquiries, his literary *oeuvre* and his practical engineering work. His first literary endeavour was a poem in Greek (*Apolo Funébre/Mournful Apollo*) penned in 1688, in which the young Peralta lamented the destruction of Lima and Callao in the earthquake and tsunami of the previous year.<sup>126</sup> He subsequently sat on a viceregal commission to plan the protection of the port of Callao from future tidal waves and storms, and the cofferdam and stone sea wall that he proposed served this purpose until they were destroyed in another massive earthquake-tsunami in 1746.<sup>127</sup> Within his magnum opus, the epic poem *Lima Fundada* (1732), he described the most notable disasters of Peruvian and Chilean history, along with extensive prose footnotes (complete with citations) that discoursed on the history and natural philosophy of earthquakes, volcanic eruptions and other destructive elemental phenomena. Here the examination of disasters simultaneously contributed to

---

124 Frézier, *Relation du voyage de la mer du Sud aux côtes du Chily et du Perou*, 31–35; La Condamine, *Journal du voyage fait par ordre du roi, à l'équateur*, 22; Luis Alberto Sánchez, *El doctor Océano; estudios sobre don Pedro de Peralta Barnuevo* (Lima: Universidad Nacional Mayor de San Marcos, 1967), 15–16; Larrie D. Ferreiro, *Measure of the Earth: The Enlightenment Expedition That Reshaped Our World* (New York: Basic Books, 2011), 53, 122.

125 For the context of Spanish imperial cosmography, see María M. Portuondo, *Secret Science: Spanish Cosmography and the New World* (Chicago: University of Chicago Press, 2009).

126 Pedro de Peralta Barnuevo, *Obras dramáticas cortas*, ed. Elvira Ampuero (Lima: Biblioteca Universitaria, 1964), 47; Sánchez, *El doctor Océano; estudios sobre don Pedro de Peralta Barnuevo*, 56. He also witnessed the earthquakes of 1690 and 1699: Enrique Silgado Ferro, "Algunos Aspectos de La Ciencia En La Época de Peralta," *San Marcos; Revista de Artes, Ciencias y Humanidades*, 2, 11 (1969): 37.

127 Pedro de Peralta Barnuevo, *Obras dramáticas*, ed. Irving A. Leonard (Santiago de Chile: Imprenta universitaria, 1937), 11; Irving A. Leonard, "Pedro de Peralta: Peruvian Polygraph (1664-1743)," *Revista Hispánica Moderna* 34, no. 3/4 (1968): 692.

a municipal narrative of Lima's multiple founding moments and served as a bridge to contemporary and historical catastrophes in the rest of the world. In a lengthy verse and prose account of the 1687 Lima earthquake, Peralta compared the disaster to the destruction of the twelve cities of Asia Minor (drawing on Tacitus's *Annals*), Kircher's description of the engulfing of a Calabrian town in 1638, and the earthquake that rocked Sicily in 1693.<sup>128</sup> Peralta accompanied his remarks on comparative disaster history with a list of major and minor earthquakes in Peru between 1582 and 1725 and volcanic eruptions between 1539 and 1660.<sup>129</sup> He also confirmed the connection between earthquakes, epidemics and soil infertility through the mechanism of subterranean effluvia.<sup>130</sup> Beyond Peru, he offered an account of the earthquake that devastated Santiago de Chile in 1647 and the similarly destructive earthquake-tsunami in the Chilean city of Concepción in 1730, which may have taken place while he was writing the poem.<sup>131</sup> Describing these events also gave him an opportunity to outline the physical causes of seismic movements, which he drew entirely from the explanation that Lémery had offered at the Académie Royale des Sciences in 1700.<sup>132</sup>

Astronomy and astrology — which Peralta jointly described as “the high science” (*la alta ciencia*) — played a major part in his views on natural processes.<sup>133</sup> Peralta was deeply involved in conventional astronomical work: he took instrumental readings on eclipses in 1713, 1717 and 1725, sending his data to the Académie to assist in their calculations of longitudes.<sup>134</sup> His affiliations with French savants and his correspondence with the Spanish polymath Benito Jerónimo Feijóo y

---

128 Pedro de Peralta Barnuevo, *Lima fundada*, ed. David F. Slade and Jerry M. Williams (Chapel Hill, N.C.: University of North Carolina Press, 2016), 313–18.

129 Peralta Barnuevo, 296, 318.

130 Peralta Barnuevo, 317.

131 Peralta Barnuevo, 293–94, 357–60.

132 Peralta Barnuevo, 294.

133 Peralta Barnuevo, 336.

134 The 1717 and 1725 observations were published in the *Histoire de l'Académie Royale des Sciences*, 1729, Mémoires, 375-7. See also Manuel Moreyra Paz Soldán, “Peralta Astronomo, 1966,” *Revista Histórica* 29 (1966): 111–12.

Montenegro in Spain implied a certain acceptance within mainstream European natural philosophical circles.<sup>135</sup> On the other hand, his astrological inclinations (which were well-known in Peru but apparently not elsewhere) would have made him a very unorthodox figure among these same scholars. An unpublished manuscript of uncertain date entitled *Sistema astrológico demostrativo para observaciones matemáticas* (“Astrological system demonstrated by means of mathematical observations”) conveyed his faith in the power of mathematical proofs to produce an *astrologia sana* that would answer the critics of celestial predictions.<sup>136</sup> His perspective on the importance of stellar influences in the occurrence of natural hazards is visible in the almanacs (entitled *El Conocimiento de los Tiempos*, after the long-standing French series *La Connoissance des Temps ou calendrier et éphémérides...*) that he published yearly from 1719 till his death in 1743, and whose publication he took over from the preceding *cosmógrafo mayor*, Juan Ramón Koenig.<sup>137</sup> These presented a hybrid approach between traditional astrological prognostication and natural philosophical compilation. The frontispieces promised not only a *prognostico* of planetary movements and their aspects, but also calculations drawn from distinguished European registers, including the astronomical tables of Philippe de la Hire at the Observatoire Royale in Paris and of John Flamsteed at the Royal Observatory in Greenwich.<sup>138</sup>

In the Peruvian syncretic style of disaster investigation, Peralta combined older astrological ideas with current European astronomical work and with climatic views that traced interconnections between different environmental effects. He had expressed a commitment to this heterogeneous perspective on disasters from early in his career: in a treatise on monsters of 1695, published under a

---

135 Feijóo vaunted Peralta’s abilities and erudition in Benito Jerónimo Feijoo, *Teatro crítico universal: ó discursos varios en todo género de materias, para desengaño de errores comunes* (Madrid: En la Imprente de Antonio Perez de Soto, 1765), vol. 4, pp. 129–31, 140.

136 Sánchez, *El doctor Océano; estudios sobre don Pedro de Peralta Barnuevo*, 28.

137 Leonard, “Pedro de Peralta,” 692–93; Silgado Ferro, “Algunos Aspectos de La Ciencia En La Época de Peralta,” 34.

138 See for instance the 1727 and 1729 issues of *El conocimiento de los tiempos*.



pseudonym, he stated that although earthquakes, storms, plagues and famines proceeded from natural causes, they were also divine punishments, and to bring one to a halt it was therefore necessary to implore God for mercy.<sup>139</sup> Similarly, eclipses, comets and parhelia could be “natural signs of natural effects, [i.e.] of storms, earthquakes, famine, drought and plague”, or portents for the coming of Christ.<sup>140</sup> By the time of Frézier’s expedition, Peralta seems to have exchanged some of the old interest in prodigies for modern French astronomy and natural philosophy, but he never relinquished the sense that disasters occurred through the interplay of divine, astral and elemental forces. His poetic and prose descriptions in *Lima Fundada* closely linked astral events to disasters, as when a solar eclipse in 1719 was followed by drought, widespread food shortages and a deadly epidemic that killed over 60,000 people in southern Peru.<sup>141</sup> Here he indicated a chain of determinants on the local environment that were spiritual as well as physical and astral: Peru occupied a geographical region dominated by Aquarius, but divine providence superseded stellar influences and could inflict or assuage calamities.<sup>142</sup>

By keeping in mind the interconnection of these different causative forces, Peralta thought a savant could make predictions that would enable him to guide the ship of state through the many perils of nature. In his view, astrology was a crucial tool for this job. Peralta proudly announced the accuracy of his own forecasts in *Lima Fundada*, boasting about a correct prediction of heavy rains in his 1724 almanac.<sup>143</sup> In the 1729 issue of *El Conocimiento de los Tiempos* he proclaimed that only “a

---

139 José de Rivilla Bonet y Pueyo [Pedro de Peralta Barnuevo], *Desvios de la naturaleza: O Tratado de el origen de los monstruos. A que va anadido un compendio de curaciones chyrurgicas en monstruosos accidentes* (Lima: En la Imprenta Real por Joseph de Contreras, y Alvarado impressor, 1695), f. 40r.

140 “[...] signos naturales de efectos tambien naturales, de tempestades, terremotos, hambre, esterilidad, y peste [...]”. Rivilla Bonet y Pueyo and Peralta Barnuevo, ff. 40r-v.

141 Peralta Barnuevo, *Lima fundada*, 336.

142 Peralta Barnuevo, 336–37.

143 Peralta Barnuevo, 337.

divine and infallible Astrology” could “promise us prosperity in this year”.<sup>144</sup> The 1732 issue warned that in the autumn the dominance of Mercury and Mars would bring “an entourage of unpleasant sicknesses”, potentially including epidemics of smallpox and measles.<sup>145</sup> However, Peralta’s frequent predictions of earthquakes in these publications apparently proved so unreliable that a contemporary, don José Bermúdez, remarked, “[t]oday the earth is to shake according to doctor Peralta’s almanac, so I am going to sleep on the highest part of the Santo Domingo turret!”<sup>146</sup> Not all limeños shared this sceptical attitude: in his prefatory remarks to Peralta’s *Historia de España vindicada* (1730), Fermin de Irisarri, a professor at the university of Cusco and at the Jesuits’ Colegio Máximo de San Pablo in Lima, wrote that “[t]he Prognostications that he writes for us every year are witnesses to his skills in Interpreting the Heavens; through the frowns of the Stars and the wrath of the Planets, or through their benign aspects, he prognosticates either calamities or felicities”.<sup>147</sup> The medical and meteorological emphases in the almanacs reflected Peralta’s own research interests as well as his views on the intellectual diversity that he thought the study of hazardous phenomena required. A prefatory essay to the 1732 almanac set out his thoughts on the interdependence of the various branches of natural knowledge, in the form of a dialogue between Nature and her three “Estates” — Philosophy, Astrology and Medicine — represented by such luminaries as Descartes, Gassendi, Emmanuel Maignan, Francesco Giuntini and Lucio Belancio. Defending astrology from its detractors, Nature pointed out that without reference to celestial influences there could be no

---

144 “[...] una divine ê infalible Astrologia nos puede prometer prospero en este Año [...]”, *El conocimiento de los tiempos*, 1729.

145 “[...] un sequito de enfermedades bien molestas [...]”, *El conocimiento de los tiempos*, 1732.

146 Cited in Leonard, “Pedro de Peralta,” 693.

147 “Testigos son de sus aciertos los Prognosticos que nos escribe todos los años, en que como Interprete de los Cielos, por el zeño de las Estrellas, y la colera de los Planetas, ò por sus benignos aspectos, nos prognostica, ò los estragos, ò las felicidades”. “Aprobacion del M.R.O. Fermin de Irisarri...”, in Pedro de Peralta Barnuevo, *Historia de España vindicada: en que se haze su mas exacta descripcion la de sus excelencias y antiguas riquezas ...* (Lima: En la Oficina de Francisco Sobrino, 1730), B1r.

satisfactory explanation of “plagues and famines, rains, storms and winds”.<sup>148</sup> Nature assured her fractious subjects that each type of inquiry was indispensable for the understanding of her “Empire” (*Imperio*). Peralta’s French acquaintances would not have been comfortable with this eclectic vision of natural knowledge, but they nevertheless shared his commitment to unearthing the surprising interconnections between the hazardous forces in nature’s empire.

The interplay between French, Spanish and creole approaches to hazardous phenomena played a key role in cementing the eighteenth-century orientation of disaster investigation towards quantitative and historical data collection in pursuit of grand visions of the world’s climates and the interconnections within environments. The earthquake and tsunami that devastated Lima and Callao in October 1746 formed a particularly important locus of inquiry that attracted the attention alike of creole savants, colonial administrators, expeditionaries and commentators in Europe and North America. This catastrophe, one of the most destructive seismic episodes of the era, killed between 5-6,000 people, including nearly the entire population of Callao, and was followed by a severe epidemic.<sup>149</sup> Peruvians quickly situated the seismic disaster within the region’s long history of earthquakes. One pamphlet supplied a list of events in which Lima had been “ruined” dating back to 1534, along with the patron saints that had interceded with God on Lima’s behalf on each occasion.<sup>150</sup> Leading colonial officials also looked to previous earthquakes for precedents when considering the appropriate spiritual response for the city.<sup>151</sup> José Eusebio Llano Zapata, a gifted *limeño* naturalist, published a detailed record of the catastrophe of 1746 that compared many of its

---

148 “[...] las pestes, y las hambres, las lluvias, las tempestades, y los vientos [...]”. *El conocimiento de los tiempos*, 1732.

149 Pablo Emilio Pérez-Mallaína Bueno, *Retrato de una ciudad en crisis: la sociedad limeña ante el movimiento sísmico de 1746* (Sevilla : Perú: Consejo Superior de Investigaciones Científicas, Escuela de Estudios Hispano-Americanos ; Pontificia Universidad Católica del Perú, Instituto Riva-Agüero, 2001), 60–61; Charles F. Walker, *Shaky Colonialism : The 1746 Earthquake-Tsunami in Lima, Peru, and Its Long Aftermath* (Durham: Duke University Press, 2008), 8.

150 AGI, Lima, 787: Anon., *Noticia annalica y estado, que tiene el puerto del Callao, y la Ciudad de Lima, à el año cumplido de su desolacion, y ruyna, que lo hace en este mes de Octubre de 1747* (n.p.: n.p., n.d.), E2v–3r.

151 AGNP, GO-RE 1, Leg. 7, cuaderno 123, no. 1, f. 1r.

aspects with previous disasters, especially the earthquake of 1687, partly on the basis of the information in Peralta's *Lima Fundada*.<sup>152</sup> He also made comparisons with earthquakes elsewhere: just as in the 1682 earthquake in France, the seismic force appeared to have been concentrated in one area, so that in nearby towns the earthquake was audible but did not cause significant damage.<sup>153</sup> As a follow-up, Llano Zapata published a second "critical-historical-meteorological" journal that spanned March to October of the following year, and which shared some features with European weather diaries.<sup>154</sup> Although the journal did not give thermometer or barometer readings, Llano Zapata set out detailed descriptions of floods and storms, such as the cyclone that uprooted trees and lifted off roofs in the province of Abancay, south of Cusco, on 17 March 1747.<sup>155</sup> He also noted the precise times (in some cases down to the minute) when tremors occurred in Lima and other Peruvian towns, followed by a calculation of the total number of these movements: 547 between 28 October 1746 and the same day in 1747.<sup>156</sup> The second diary also expanded his international comparisons. Earthquakes had occurred in October not only in Lima (1687 and 1746) but also Nicea (740 CE), Havana (1692) and Cologne (1628).<sup>157</sup> He also thought that the seismic disaster of 1746 shared certain features with the earthquakes in Naples (1688), Sicily (1693),

---

152 José Eusebio de Llano Zapata, *Carta, o, Diario que escribe D. Joseph Eusebio de Llano y Zapata, a su mas venerado amigo, y docto correspondiente, el doctor don Ignacio Chirivoga y Daza, canonigo de la Santa Iglesia de Quito ; en que con la mayor verdad, y critica mas segura la dà cuenta de todo lo acaecido en esta capital de el Perú ... con el grande movimiento de tierra ... con una tabla en que se dà el calculo exacto de todo el numero de temblores ... de este escrito*, Diario (Madrid: J. de Zuñiga, 1748), 17.

153 Llano Zapata, 8.

154 José Eusebio Llano Zapata, "Observacion diaria critico-historico-meteorologica, contiene todo lo acaecido en Lima desde primero de marzo de 1747 hasta 28 de octubre del mismo, y se dà la historia de las Santas Imagenes Patronas de los Temblores, que se veneran en esta Corte, y el numero de los que se hán sentido en el periodo de ocho meses. Con muchas particulares noticias de lo que ha sucedido por este tiempo en algunos lugares del Perú, y los temblores memorables que en varias partes del mundo se han experimentado en este siglo," in *Terremotos: Coleccion de las relaciones de los mas notables que ha sufrido esta capital y que la han arruinado. Va precedida del plano de lo que fue el puerto del Callao antes que el mar lo inundase en 1746 y de un reloj astronómico de temblores*, ed. Manuel de Odriozola (Lima: Tip de A Alfaro, 1863).

155 Llano Zapata, 115–16.

156 Llano Zapata, 132.

157 Llano Zapata, 132.

Guatemala (1717), Martinique (1726) and Concepción de Chile (1730).<sup>158</sup> Furthermore, the diary traced connections between different kinds of environmental disruption: in the town of Mocegua (Moquegua) in the bishopric of Arequipa, for instance, an epidemic followed a storm and flood in March 1747. Llano Zapata explained that the sickness arose from corrupted effluvia that had emerged from the earth, and which the storm had presumably spread about.<sup>159</sup>

The shocking news of the disaster at Lima circulated around the Atlantic and formed an object of intense discussion. A French pamphlet dramatically announced that within the space of five minutes Lima had been “entirely destroyed, with the exception of twenty Houses”.<sup>160</sup> A more detailed printed account by an anonymous Peruvian writer was reprinted in Mexico City in 1747 and subsequently circulated in English translation in London and Boston; Benjamin Franklin printed an edition in Philadelphia in 1749.<sup>161</sup> The London edition of 1748 (*A true and particular relation of the dreadful earthquake which happen'd at Lima*) added a considerable amount of geographic and ethnographic material about Peru, partly drawn from Frézier’s travel account. An accompanying natural philosophical essay on the causes of Peruvian earthquakes supplied a chronology of major earthquakes in the viceroyalty, based on information from Frézier, Feuillée, Acosta, Alvaro de

---

158 Llano Zapata, 133–37.

159 Llano Zapata, 115.

160 “[...] entièrement détruite, à l’exception de vingt Maisons [...]”. Anon., *Relation du désastre arrivé aux villes de Lima, & du Callao, au Pérou; le 28 octobre 1746, par un tremblement de terre* (S.l.: De l’Imprimerie de Gonichon, 1747), P. 1.

161 Anon., *Individual, y verdadera relacion de la extrema ruina que padeció la Ciudad de los Reyes Lima, capital del reyno del Perú, con el horrible temblor de tierra acaecido en ella, la noche del 28. de octubre de 1746...* (Lima: en la Imprenta que estaba en la Calle de los Mercaderes, 1746); Anon., *Individual, y verdadera relacion de la extrema ruina que padeció la Ciudad de los Reyes Lima, capital del reyno del Perú, con el horrible temblor de tierra acaecido en ella, la noche del 28. de octubre de 1746...* (Impreso en Lima, reimpresso en Mexico: Por la viuda de J B de Hogal, 1747); Anon., *A True and Particular Relation of the Dreadful Earthquake Which Happen'd at Lima, the Capital of Peru, and the Neighbouring Port of Callao, on the 28th of October, 1746...* (London: printed for T Osborne in Gray’s Inn, 1748); Anon., *A True and Particular Relation of the Dreadful Earthquake, Which Happen'd at Lima, the Capital of Peru, and the Neighbouring Port of Callao, on the 28th of October, 1746...* (Philadelphia: London printed: Philadelphia reprinted, and sold by B Franklin, and DHall, at the new-printing-office, near the market, 1749); Anon., *A True and Particular Relation of the Dreadful Earthquake. Which Happen'd at Lima, the Capital of Peru, and the Neighbouring Port of Callao, on the 28th of October, 1746* (Boston, printed; and sold by D Fowle in Ann-Street, and by Z Fowle in Middlestreet, 1755).

Toledo and others.<sup>162</sup> Having touched upon the experiments of Lémery, the author attempted to explain why the special geography of Peru made it particularly subject to earthquakes in comparison to England. Here he turned to English subterranean combustion theories, suggesting that England's soil contained relatively few of Lister's pyrites, while the Andes were full of sulphur and other flammable materials.<sup>163</sup> Presented in this form, the 1746 earthquake served as an opportunity to connect the natural knowledge of Englishmen, Peruvians and French expeditionaries. It had become simultaneously an instructive episode for English natural inquiry and a key to understanding the intricacies of a foreign climate. The compilation of historical incidents served to place the latest catastrophe within an intelligible framework, "[a]s the Relations of different Earthquakes serve to illustrate one another".<sup>164</sup> It was not enough to furnish a list of past Peruvian earthquakes, however: to further "illustrate the Nature of such surprizing Phænomena", the editor also included Heath's account of the Jamaican earthquake of 1692 and selections from the relations of this disaster that Sloane had supplied to the Royal Society.<sup>165</sup> From the editor's viewpoint, a physical explanation of earthquakes "does not at all hinder but, that the Almighty Power may employ these Instruments of Punishment to a wicked People": noting Frézier's notorious description of Peruvians as lustful, and characterising their devotion to Mary as papist idolatry, he offered the stern moral conclusion that "there was not before the late great Calamity a more licentious Spot upon the Earth".<sup>166</sup> The author also suggested that "the present dismal State of Things" in Peru would afford a good opportunity for an English conquest, aided by indigenous peoples whose oppression under the Spaniards rendered them ripe for rebellion, and who would doubtless share with their English liberators the

---

162 Anon., *A True and Particular Relation*, 1748, 102–30.

163 Anon., 114, 120.

164 Anon., xx.

165 Anon., 327–41.

166 Anon., v–vii. The phrasing of this comment closely echoed Heath's disparaging remarks about Port Royal in 1692.

“immense Riches” of the Inca that they had somehow concealed throughout the period of Spanish rule.<sup>167</sup>

A second English adaptation of the anonymous Peruvian earthquake narrative, also printed in 1748, promised *A true and particular history of earthquakes* that situated the disaster of 1747 within a broader survey.<sup>168</sup> In fact the author plagiarised much of the work, including the geographical overview, the essay on earthquake causes and the accounts of the Jamaica earthquake, from the *True and particular relation*, although he omitted the latter’s chronology of Peruvian catastrophes. However, it is also included a great deal of additional material: roughly half the space in the *True and particular history* consisted of a compilation of English natural philosophical observations culled from the Royal Society’s *Philosophical Transactions*. This included Wallis, Boyle and Pigot’s seventeenth-century descriptions of tremors in England, Benjamin Colman’s account of the New England earthquake of 1727 and various relations of earthquakes in Italy.<sup>169</sup> To these the compiler joined reports of storms, hurricanes, lightning strikes and volcanic eruptions. Although the preface offered no explicit reason for the selection, the clear implication of juxtaposing this diverse material was that the compiler understood the various manifestations of extreme environmental conditions to be connected. This was also evident in the inclusion of the Yorkshire clergyman and naturalist Ralph Thoresby’s account of a minor earthquake that coincided with the Great Storm of 1703.<sup>170</sup> Since the Royal Society reports, as usual, were unconcerned with spiritual interpretation, the printer supplied one in the prefatory comments, confidently ascribing earthquakes, storms, epidemics, floods and

---

167 Anon., xi–xii.

168 Anon., *A True and Particular History of Earthquakes. Containing a Relation of That Dreadful Earthquake Which Happen’d at Lima and Callao, in Peru, October 28, 1746...* (London: printed for the author, and sold by the booksellers in town and country, 1748).

169 Anon., 70–75, 88–93, 164–74.

170 Anon., 93–94.

conflagrations to divine judgements on human wickedness.<sup>171</sup> Although accepting that each of these had natural causes, he maintained that they only had power to injure humans when they received “a special Commission” from God to acts as “Messengers of Divine Justice”.<sup>172</sup> While this dogmatic interpretation offered nothing novel, it showed how easily a doctrinal religious gloss could be applied to natural philosophical disaster research. Both the *True and particular history* and the *True and particular relation* demonstrated the paradoxical situation of early eighteenth-century disaster investigation. On the one hand, news, ideas and investigators were traversing the Atlantic on an unprecedented scale, so that even works printed in London for a popular audience could assemble accounts from Lima, Port Royal, Sicily and Boston. But on the other hand, the cosmopolitan natural philosophy of the Republic of Letters could be harnessed to established religious interpretations, imperial fantasies, national prejudices and sectarian condescension.<sup>173</sup>

Some of the members of the geodesic expedition were also deeply involved in the analysis of the disaster of 1746. Viceroy Manso de Velasco enlisted the expeditionary Louis Godin, who at his invitation had taken up the chair of mathematics at the University of San Marcos, to plan the rebuilding of the city according to Enlightened principles of order.<sup>174</sup> In Fouchy’s elegy for Godin, he described how the expeditionary had turned his learning to the public good in Lima: “for the reconstruction of the town he supplied ideas founded on good Physics, which in such a case made the houses less susceptible to harmful occurrences”. Godin energetically directed the rebuilding, so that “the Astronomer became successively an Engineer and Architect, and, thanks to the extent of

---

171 Anon., iii–vi.

172 Anon., v.

173 On this cosmopolitanism, see Anne Goldgar, *Impolite Learning: Conduct and Community in the Republic of Letters, 1680 - 1750* (New Haven: Yale University Press, 1995).

174 Llano Zapata, *Carta, o, Diario*, 10–11. The documents pertaining to Godin’s acceptance of the post are in the Huntington Library, mss. HM 81071. Further discussion of Godin’s role in the reconstruction is in Pérez-Mallaína Bueno, *Retrato de una ciudad en crisis*, 84, 134; Walker, *Shaky Colonialism*, 91–92.



his knowledge, he fulfilled all these roles as if he had been employed in them all his life”.<sup>175</sup>

Although Godin never published an account of these experiences, Ulloa included an account of the 1746 earthquake in his and Jorge Juan’s multi-volume narrative of the expedition.<sup>176</sup> Like Llano Zapata, Ulloa presented the catastrophe in October not merely as a singular event but as the reoccurrence of a hazard whose significance could be perceived only through the collation of historical reports. Assembling data on these events proved, he thought, that there was something intrinsic to the environment of South America that intensified seismic movement, since this region was “more subject than any other country” to these phenomena.<sup>177</sup> In his view, the frequency of earthquakes could only be understood by observing other parts of the climatic and geographical systems that governed the region: the snow and ice in the Andes, for instance, generated continual streams of water that penetrated the earth (highly porous in these parts) and interacted with combustible minerals underground.<sup>178</sup> He also thought that the volcanoes of the cordillera bore a close relationship to the earthquakes: since the shaking was occasioned by ignited vapours that struggled to escape the earth, each volcanic cone must function as a “ventilation shaft” (*respiradero*), which allowed the inflamed exhalations to escape and replaced them with a fresh supply of air.<sup>179</sup> Bouger similarly thought that obtaining observational and historic data on volcanoes was the key to

---

175 “[...] il donna pour la reconstruction de la ville des idées fondées sur la bonne Physique, qui rendoient en pareil case les maisons moins susceptibles d'accidens fâcheux: il présida à l'exécution & fit reconstruire en entier les fortifications qui assuroient le port du Callao: l'Astronome devint successivement Ingénieur & Architecte, &, grâces à l'étendue de ses connoissances, il remplit toutes ces fonctions comme s'il en avoit été occupé toute sa vie”. “Eloge de M. Godin”, *Histoire de l'Académie royale des sciences*, 1760, 190.

176 Ulloa, *Relacion historica del viage a la America Meridional hecho de orden de S. Mag. para medir algunos grados de meridiano terrestre, y venir por ellos en conocimiento de la verdadera figura, y magnitud de la tierra, con otras varias observaciones astronomicas, y phisicas*, vol. 3, pp. 106–9. Ulloa was not personally present in Lima at the time: he and Jorge Juan had departed for Spain in October 1744. Ulloa, vol. 4, p. 382.

177 Ulloa, *Relacion historica del viage a la America Meridional hecho de orden de S. Mag. para medir algunos grados de meridiano terrestre, y venir por ellos en conocimiento de la verdadera figura, y magnitud de la tierra, con otras varias observaciones astronomicas, y phisicas*, 110.

178 Ulloa, 112.

179 Ulloa, 109–10.

understanding and predicting earthquakes. In his view, Barrenechea's periodic method, which could not account for the timing of the 1746 catastrophe, was defective because it focused on earthquakes by themselves.<sup>180</sup> Seismic movements were too complex, they were too often unrecorded, and it was too difficult to pinpoint the precise spot where they originated. Volcanoes, on the other hand, occupied a specific point of space and could therefore function as a stable referent.<sup>181</sup> Bouguer was also sure that other climatic features, especially rainfall, needed to be taken into account in coming to terms with earthquakes.<sup>182</sup> Thus the events of 1746 helped to crystallise the approach that the expeditionaries had developed over several decades to studying South American hazards: a perspective that emphasised climatic and geographic systems, and the interconnections of natural phenomena within them.

The modalities that dominated disaster investigation in the first half of the century — comparative historical study, quantitative measurement, grand climatic theories and environmental interactions — found their greatest expression in the work of the Scottish physician Thomas Short. In his early research, Short had cultivated a Hippocratic interest in the effects of waters on human health.<sup>183</sup> Subsequently he began to collect data for two closely-related books that took him the better part of two decades to complete: *A general chronological history of the air* (1749) and *New Observations, Natural, Moral, Civil, Political, and Medical, on City, Town, and Country Bills of Mortality* (1750). The first of these was a massive two-volume production totalling over 1,000 pages, dedicated to the celebrated doctor Richard Mead. The bulk of the work consisted of a vast compendium of information of meteorological conditions and their supposed effects on humankind, from the

---

180 Bouguer, *La figure de la terre*, 75.

181 Bouguer, 76.

182 Bouguer, 76.

183 Thomas Short, *A Rational Discourse of the Inward Uses of Water...* (London: printed for Samuel Chandler, at the Cross-Keys in the Poultry, 1725). He quotes Hippocrates' *Aphorisms* on p. 6.

Biblical Deluge to 1748. It is clear that the initial and primary goal of amassing this data was for medical research. Following the increasingly fashionable model of medical meteorology, Short aimed to identify the climatic conditions in which particular diseases occur. This was the motive for simultaneously working on the *General chronological history* and the *New observations* on the bills of mortality: in essence they were two halves of a single project. Short invited readers to consider the former as a compilation of “Facts” and the latter as an account of the “Reason” discoverable in their patterns (although in the event he could not resist appending a long set of “observations and inferences” to the *General chronological history* as well).<sup>184</sup> Short was convinced of the medical utility of the quantitative approach to studying mortality that Graunt and Petty had pioneered, and he believed that “a serious comparing of exact [weather] Journals and Bills of Mortality for a long Series of Years” would make possible precise conclusions on the occurrence of epidemics.<sup>185</sup> Accurate information about the effects of different “constitutions” of air on human bodies had the potential to furnish “just Rules for the certain, laudable, and salubrious Treatment” of diseases, and might even allow for the forecasting of epidemics.<sup>186</sup> Once the patterns of disease recurrence could be established on a sure footing, it would be easy to prevent the “endless warm Disputes and Contentions” that vexed medical theory, as well as the constant speculation about “occult Malignity, Malevolence of the Stars, Anger of the Gods, &c”.<sup>187</sup>

The problem Short had encountered in contemporary medical meteorology was that its ambitions greatly exceeded its means. Since weather diaries were so scattered and inconsistent, “we have not Histories enough of Weather and Epidemics, to enable us even to make a tolerable Guess

---

184 Thomas Short, *A General Chronological History of the Air, Weather, Seasons, Meteors, &c. in Sundry Places and Different Times; ... with Some of Their Most Remarkable Effects on Animal (Especially Human) Bodies, and Vegetables* (London: printed for T Longman; and A Millar, 1749), vol. 1, pp. xiv–xv, vol. 2, pp. 323–463.

185 Prælegomena, §23, in Short, vol. 1.

186 Short, vol. 1, pp. vi–vii.

187 Prælegomena, §3, in Short, vol. 1.

when the latter do return, or in what Order, which Kind will make the next Visit, or of what Duration, Spread, Severity, or Mildness the next will be”.<sup>188</sup> In addition, specific types of epidemics were fleeting or uncommon, so that “’tis not in any one Man's Power to lay in a Stock of Observations of his own” to ground either successful treatment or robust predictions.<sup>189</sup> The result was the proliferation of “many endless, subtile, useless Theories, which swelled into many unprofitable Volumes”.<sup>190</sup> To his mind, the solution was to compile as much meteorological and medical information as possible to construct a giant dataset spanning all of recorded history. On the one hand, this approach involved a degree of collaboration in compiling weather diaries: Short used his own diary of observations (collected at his residence in Leeds) as well as the weather diaries of the physician Clifton Wintringham, the dissenting minister Samuel Say and “the learned and ingenious Dr. Huxham” at Plymouth.<sup>191</sup> However, where Jurin and Malouin looked forward to a centrally-directed network of informants, who would each be able to cover a particular geographical zone, Short recruited most of his collaborators from the ranks of long-dead writers. He described his method as “an exact judicious Review, and tedious Ruminatiion” of scraps of relevant information from obscure authors: “Historians civil, ecclesiastical, and political; Physicians, Divines, Naturalists, Monks, Fryars, Journalists, Travellers, &c”.<sup>192</sup> The practice of systematically mining historical sources for climatic and health information, and combining them with modern weather diaries (complete with quantitative instrumental data) was something novel, and Short was well aware that his project was “the first of its Kind”.<sup>193</sup>

---

188 Prælegomena, §4, in Short, vol. 1.

189 Prælegomena, §2, in Short, vol. 1.

190 Prælegomena, §6, in Short, vol. 1.

191 Prælegomena, §22, in Short, vol. 1.

192 Short, vol. 1, pp. v–vi.

193 Short, vol. 1, p. xiv.

Although Short had originally intended his compilation to show the connections between weather and disease, he found himself collecting information about many other kinds of destructive phenomena as well. Besides plagues and other epidemics, the “general chronology” covered floods (including the Deluge and the Deucalion flood), earthquakes, droughts, fires, famines, locust swarms, volcanic eruptions and heat waves. In addition, everything else in the realm of classical meteorology warranted attention: all kinds of atmospheric conditions, as well as comets, parhelia and strange sights in the sky. In Short’s view, all these phenomena shared important connections with each other and with epidemics. The second volume of the *General chronological history* contained lists of the dates and places of these occurrences, divided into 36 categories, which included earthquakes (up to 1734), comets (to 1737), “Plagues and Diseases” (to 1730), and six categories of storms (thunder and lightning, tempests, hurricanes, hailstorms, snowstorms and rainstorms).<sup>194</sup> Short’s understanding of the interconnection of these various natural phenomena is clear from a number of special cross-listed categories, in which he enumerated the epidemics, earthquakes and famines that coincided with years featuring remarkable rains and other atmospheric conditions.<sup>195</sup> The inclusion of lists of (“Battles between Armies seen in the Air”, “Unnatural Rains” and even the bizarre category of “Breads reckon’d ominous”) indicated an astonishing open-mindedness about the degree to which information about alleged apparitions might have some relevant insight into the effects of climatic changes. Short cautioned his readers to be wary of ancient superstitions: “though [the compiler] be obliged profitably to converse a good deal with ancient Monks and Friars, yet let him not meddle in disposing (as they too often and weakly did) of the Almighty's Arrows and Judgments; nor with their superstitious Stories of Padfoots and Barguests, Apparitions, Hobgoblins, and

---

194 Short, vol. 2, pp. 165–215.

195 Short, vol. 2, p. 194.

Dæmons, invented only to serve mean Purposes”.<sup>196</sup> Similarly, he counselled his readers to reject astrological interpretations, which were too often sectarian and partisan in nature.<sup>197</sup> However, he did not deny that God directed calamities: some plagues and other disasters were purely supernatural in origin, and while readers should read historical records carefully, it would be wrong to act like an “infidel” in discrediting apparently supernatural occurrences too hastily.<sup>198</sup> Short was prepared to accept that the appearance of comets, eclipses and other celestial phenomena might have a bearing on terrestrial calamities: the list of comets included careful notes on subsequent plagues, famines, floods, earthquakes and other disasters.<sup>199</sup> A similar category related the epidemics that attended monstrous rains, as in 652 CE: “Ashes and Fire fell from Heaven on Constantinople, a Plague quickly after”.<sup>200</sup> His entry on *anno mundi* 3736 recounted blood oozing from the earth and rains of milk, followed by an epidemic that was “so great, that we are not to enquire how many died, but how few survived”.<sup>201</sup> We cannot know the extent to which Short believed in the literal occurrence of these episodes, but his motive in including them in the *General chronological history* was to uncover all the possible connections between disasters and other kinds of environmental and atmospheric phenomena. In his view, the only way to uncover the invisible web that connected disease to the other parts of Creation was to retrieve, observe and record everything of potential significance.

This was the ultimate expression of eighteenth-century data collection on disasters: the prospect of unlimited inquiry that stretched across the whole gamut of the human experience of nature. By the time that Short published his magnum opus in 1749-50, disaster investigation had undergone an immense transformation. Over the first half of the century, four key elements rose to dominate

---

196 Short, vol. 1, p. xii.

197 Short, vol. 1, pp. xii–xiii.

198 Prælegomena, §16, in Short, vol. 1.

199 Short, vol. 2, pp. 170–73.

200 Short, vol. 2, p. 180.

201 Short, vol. 1, p. 45.

disaster research: the collaborative collection of quantitative data, the compilation of historical records, an awareness of large-scale geographies and a desire to reveal patterns in the connections between different parts of nature. Many of these features were present in embryonic form in the previous century, but eighteenth-century naturalists, physicians and cosmographers developed them on a far larger scale. The meteorological and medical collections conducted under the aegis of the Royal Society and the Académie Royale des Sciences represented a vast expansion on earlier piecemeal efforts. In parallel with this, investigators began to imagine disasters in much larger and more integrated natural systems, inspired by climatic theories. Behind these developments lay crucial trans-Atlantic connections: the correspondence between people in Europe, Quebec City, Boston and Barbados gave the study of epidemics a global character that incorporated both local climatic specificities and transoceanic networks. The movement of people was also critical: the French and Spanish scientific expeditions not only helped to bring the extreme features of South American environments to European attention but also set in motion an exchange of ideas and information between the travellers and creole savants. The culmination of these processes was an ambitious programme of collecting that harnessed all the available channels of information, past and present, to the goal of understanding disasters as interconnected environmental dynamics.

## **Chapter 6: The calamities of 1755 and the shape of disaster knowledge**

The intensive collecting activity of the first half of the eighteenth century shaped disaster investigation into an endeavour characterised by transnational collaborations, quantitative data and historical compilation. Building upon these developments, the period between 1750-88 marked the apogee of early modern disaster inquiry. Bureaucratic surveys, the collections of scientific societies and the work of individual researchers amassed more disaster information than ever before. These collecting and synthesising activities were greatly stimulated by the earthquake-tsunamis of November 1755 which famously destroyed much of Lisbon but also had severe impacts in Spain and North Africa. A focus on responses in southern Spain, rather than the events in Portugal that have hitherto dominated the attention of historians, allows us to recognise the continued reliance of disaster investigations upon knowledge about catastrophes in the Americas and the Caribbean. Once again, the circulation of information and people across the Atlantic proved crucial to the development of disaster ideas. On the other hand, the established connection between American geographies and earthquakes also presented problems for explaining the events on the Iberian peninsula. Coming to terms with the November disasters and the consequent effects on tides across the Atlantic necessitated a reassessment of the relationship between land and sea. New studies of coastal, mountain and marine topography applied the collection of data on present and past disasters to global visions of natural processes.

Alongside these developments emerged a more methodical approach to religious interpretation, which allowed the spiritual aspects of disaster to be either integrated as variables in a systematic analysis or distinguished from physical explanations as a separate topic of study. Contrary to the oft-repeated scholarly claim that the Lisbon Earthquake heralded the end of providential disaster



interpretation, the 1750s witnessed a large-scale reinvigoration of religious readings of catastrophe. However, under the influence of the broader systematising trends in disaster epistemology, clerical commentators elevated some interpretive elements over others. Providential analyses sought to trace patterns in sequences of disasters and attempted to give these trends moral significance within the natural order created by a benevolent God. Although preachers continued to speak of divine warnings and judgements, they increasingly emphasised the ability of religion to provide consolation. Ultimately, religious commentary came to focus not on doctrinal but ethical responses, conceived in relation to the universal concerns of humanity rather than the membership of individual confessions.

The earthquake at Lima in 1746, which attracted strong international interest, had given fresh impetus to the collection of information about similar events on both sides of the Atlantic. As a result, the seismic activity of the 1750s drew a level of attention from natural philosophers, clergy and laymen that exceeded even the flurry of interest in the 1680s-90s. A “smart shock of an Earthquake” in southeastern England in February 1750 and repetitions in March, although very minor, generated sufficient panic in London for large numbers of people to evacuate the city and for fearful crowds to take refuge in Hyde Park.<sup>1</sup> This extreme reaction seemed “shameful” to one twentieth-century historian, but it becomes more explicable when we realise that many contemporaries derived their knowledge of earthquakes from the dramatic reports of recent catastrophes elsewhere.<sup>2</sup> Even the politician Horace Walpole, who by April was laughing at “this ridiculous panic”, had discussions with acquaintances who assessed the events in England in relation

---

1 Peter Collinson to Pieter Camper, 23 February, 1750 (N.S.), APS Mss.B.M82.3, f. 2.

2 T. D. Kendrick, *The Lisbon Earthquake* (London: Methuen, 1956), 26–27.

to major earthquakes in Jamaica and Italy.<sup>3</sup> Events in the Americas soon added further examples to reinforce the impression of the destructive potential of seismic events. In March the following year a significant earthquake shook Santiago de Guatemala, damaging the cathedral and other churches.<sup>4</sup> In May an earthquake and tsunami levelled the Chilean city of Concepción and destroyed the Spanish settlement in the Juan Fernández islands, where the governor and all of his family perished.<sup>5</sup> A witness in Concepción described “wave upon wave, of such a height that, exceeding their limits and surmounting the whole City, they entered with more violence than a charging Horse”, destroying so many structures that “this City was left denuded, like the barest town square”.<sup>6</sup> The destruction was sufficiently severe and the prospect of a repetition so grave that local officials, in coordination with the Consejo de Indias in Spain, decided to abandon the ruins and shift the city to a new site.<sup>7</sup> In the Caribbean, two major earthquakes in October and November 1751 caused “ruines abominables” in the French settlements on Saint-Domingue, particularly Port-au-Prince.<sup>8</sup> Another sequence of seismic events emerged in 1755. An earthquake devastated Quito on 26 April, appearing to generate “waves like those of the Sea, when the Towers and churches [...] in their shuddering cracked like eggshells”, and with half of the cathedral in ruins, “everyone expected that the earth would swallow them”.<sup>9</sup> A series of tremors in New England in November did little

---

3 Horace Walpole to Sir Horace Mann, 11 March 1750 and 2 April 1750, in Horace Walpole, *The Yale Edition of Horace Walpole's Correspondence*, ed. W. S. Lewis (New Haven: Yale University Press, 1937), 130–31, 135.

4 Anon., *Tragica descripción del lamentable estrago, que ocasionó el terremoto de el día quatro de Marzo en este año de 1751 en esta ciudad de Santiago de Goathemala* (Santiago de Guatemala: Impr. de Joachin de Arevalo, 1751).

5 "Tosca narracion de lo acahecido en la Ciudad de la Concepcion de Chile el dia 24 de Maio de 1751", BNE MSS/6952, ff103r-105r.

6 “[...] ola sobre ola con tanta altura, que exediendo sus limites supuro, y Coronó toda la Ciudad, entrando Con mas biolencia que la Carrera de un Cavallo [...] quedo esta Ciudad Como la plaza mas escueta [...]”. BNE MSS/6952, f. 104r.

7 AGI, Chile, 147.

8 P.-L.-A. Gouraud, *Ode sur les désastres arrivés à Saint-Domingue et sur la mort de mon frère causée par le tremblement de terre du 21 novembre 1751* (Angers: A-J Jahyer, 1752), 3.

9 “[...] olas como olas del Mar quando las Thorres y templos empesaron a sentir mas extrañesas en su extremesimiento partiendose como si fueran cascarones d. huevos [...]”; “[...] que esperaba cada uno que le tragase la

damage, however the proximity in time to another major disaster — this time centred in Portugal — raised serious alarm and provoked intense introspection about the spiritual preparedness of the colonists.<sup>10</sup> As Edmund Quincy wrote from Portsmouth, New Hampshire, “People seem to be stird up here in some measure, but I fear not so much as they ought to be”.<sup>11</sup> A cascade of printed sermons and tracts attempted to exhort New Englanders to greater piety.<sup>12</sup> The proclamation of a day of humiliation by the Lieutenant-Governor of Massachusetts, Spencer Phips, closely tied the events in New England to the “terrible and destructive Earthquakes and Innundations in divers

---

tierra [...]”. “<...> individual noticias de la Positura que h<a dis>frutado esta Ciudad de Quito en el Reyno del Perú, y el descaecimiento en que oy se alla a causa d. haver padesimo un terremoto q.e comenso el 26 d. Abril d. este año de 1755 que la dexó arruynada”, BNE MSS/23148/32, ff. 2-rv.

10 Annotations by an unknown hand in an almanac give a brief account of the tremors and their effects: “[November] 18. There was an Earth Quak at half after 4 O Clock which was very Hard and wass supposed in Jeneral to Last 2 minnits and Did a vast Deal of Damige in throwing Down Chimneys and In Shaking Sugarhouses so as to Throw Down all most all the moulds in them in heaps [November] 22 We had a small shock of an Earth Quake betwene 8 and 9 o Clock in The Evening”, MHS Ms. S-303.

11 Edmund Quincy to Samuel Sewall, MHS Misc. Bd. 1755 November 22; Quincy to Sewall, MHS Misc. Bd. 1755 December 17.

12 These included: Thomas Prince, *An Improvement of the Doctrine of Earthquakes, Being the Works of God, and Tokens of His Just Displeasure...* (Boston, New-England: printed and sold by D Fowle in Ann-Street, and by Z Fowle in Middle-Street, 1755); Jonathan Mayhew, *The Expected Dissolution of All Things, a Motive to Universal Holiness: Two Sermons Preached in Boston, N.E. on the Lord's-Day, Nov. 23, 1755; Occasioned by the Earthquakes Which Happened on the Tuesday Morning, and Saturday Evening Preceeding.* (Boston: Printed by Edes & Gill, and sold at their printing-office, next to the prison in Queen-Street; and by R Draper, in Newbury-Street, 1755); James Cogswell, *The Danger of Disregarding the Works of God: : A Sermon, Delivered at Canterbury, November 23, 1755. Being the next Sabbath after the Late Surprizing Earthquake.* (New-Haven: Printed by James Parker, and Company, at the post-office, 1755); Charles Chauncy, *Earthquakes a Token of the Righteous Anger of God: A Sermon Preached at the Old-Brick-Meeting-House in Boston, the Lord's-Day after the Terrible Earthquake, Which Suddenly Awoke Us out of Our Sleep in the Morning of the 18th of November, 1755* (Boston: Printed and sold by Edes and Gill, at their printing office, next to the prison in Queen-Street, 1755); Mather Byles, *Divine Power and and Anger Displayed in Earthquakes: A Sermon Occasioned by the Late Earthquake, in New-England, November 18. 1755. And Preached, the next Lord's-Day, at Point-Shirley.* (Boston: Printed and sold by S Kneeland, in Queen-Street, 1755); John Burt, *Earthquakes, the Effects of God's Wrath: A Sermon Preached at Bristol, the Lord's Day after a Very Terrible Earthquake, Which Was on Tuesday, November 18, 1755. a Few Minutes after Four o'clock in the Morning.* (Newport R.I.: Printed by J Franklin, at the printing-office under the town-school-house, 1755). See also Charles Edwin Clark, “Science, Reason, and an Angry God: The Literature of an Earthquake,” *The New England Quarterly* 38, no. 3 (1965): 340–62; Marguerite Carozzi, “Reaction of British Colonies in America to the 1755 Lisbon Earthquake a Comparison to the European Response,” *Earth Sciences History* 2, no. 1 (1983): 17–27; Lauri Bauer Coleman, “‘Rain down Righteousness’: Interpretations of Natural Events in Mid-Eighteenth-Century Boston,” in *Remaking Boston: An Environmental History of the City and Its Surroundings*, ed. Anthony N. Penna and Conrad Edick Wright (Pittsburgh, PA: University of Pittsburgh Press, 2009); Whitney Barlow Robles, “Atlantic Disaster: Boston Responds to the Cape Ann Earthquake of 1755,” *The New England Quarterly* 90, no. 1 (2017): 7–35.

Parts of Europe”.<sup>13</sup> It seems clear that by this point trans-Atlantic comparisons had become the standard way of assessing the true significance of seismic events.

Contemporary responses to the sequence of earthquakes in the 1750s thus suggested that a knowledge of distant disasters was an essential prerequisite for the analysis of any single episode. Half a century of investigation had firmly established the principle that detailed studies of climates and geographies would provide the key to understanding disastrous phenomena, as integral parts of natural systems. Moreover, the flow of meteorological and medical reports from the Americas and the Caribbean, the widely-publicised expeditions to South America and the work of creole savants themselves had all shown the importance of firsthand testimonies in building an accurate picture of how, when and why hazardous phenomena occurred. South American earthquakes in particular had become crucial points of comparison for coming to terms with those elsewhere. When the English natural philosopher and clergyman Stephen Hales published a book on earthquakes in 1750, following the London tremors, he juxtaposed his theoretical essay on them with an account of the Lima earthquake of 1746 and long disquisitions on Peruvian nature and society.<sup>14</sup> Even this was insufficient for a reviewer in the French *Journal de Trévoux*, who scathingly suggested that as Hales had never visited Peru, his tendentious remarks on the people, environment and religion of that land needed to be read with a sceptical eye. The Englishman’s descriptions of earthquakes, not least the account of the destruction of Port Royal in 1692 (derived from Heath’s letters) should be placed on

---

13 Spencer Phips, *By the Honourable Spencer Phips, Esq; Lieutenant-Governour and Commander in Chief, in and over His Majesty’s Province of the Massachusetts-Bay in New-England. A Proclamation... Given at the Council- Chamber in Boston, the Twenty-Fourth Day of December 1755 ...* (Boston: Printed by John Draper, printer to His Honour the lieutenant-governour and Council, 1755).

14 Stephen Hales, *The Theory and History of Earthquakes...* (London: printed for and sold by J Newbery in St Paul’s-Churchyard..., 1750). Hales’ theory first appeared in print in the *Philosophical Transactions*, vol. 46, issue 497, 1750. Another version appeared as Stephen Hales, *Some Considerations on the Causes of Earthquakes: Which Were Read before the Royal Society, April 5, 1750. By Stephen Hales, D.D, F.R.S* (London: printed for R. Manby and H. S. Cox, on Ludgate-Hill, 1750). A French translation followed: Stephen Hales, *Considerations sur la cause physique des tremblemens de terre: Lues à la Société Royale de Londres. Par M. Hales, ... Avec la lettre pastorale de M. l’Evêque de Londres, sur la cause morale du même phénomène* (Londres: chez Jacob Tompsond, 1751).

the same plane of credibility and usefulness as the stories in Herodotus. The account Hales presented of the 1746 earthquake was so wanting in factual accuracy that it even misnamed the Viceroy, confusing Manso de Velasco with his predecessor. Anyone who wanted an accurate description of the 1746 earthquake, the reviewer suggested, would be far better served by consulting Llano Zapata's account, which had the great virtue of being informed by the personal observations of the author.<sup>15</sup> Thus even for theorists based in Europe, a detailed knowledge of South American disasters was critical. If they had no personal experience of Peru themselves then they at least needed to source reliable Peruvian accounts.

When a great earthquake occurred in Europe in late 1755, dwarfing even the catastrophe of 1746, research on earthquakes acquired a new sense of importance and urgency. On November 1, a trio of disasters devastated the city of Lisbon, killing tens of thousands.<sup>16</sup> First, an earthquake damaged or destroyed many of the opulent churches, palaces and public buildings, along with vast numbers of private residences. A tsunami then hammered the low-lying districts, swallowing streets and sweeping away or drowning hundreds of terror-stricken residents. As Padre Bazona, the confessor to the Spanish queen, put it: "for this lamentable Ruin not only the elements of the earth and air were stirred up, but the water as well".<sup>17</sup> As if these two colossal blows had not been severe enough, several fires that had begun in different parts of the city coalesced into a towering inferno

---

<sup>15</sup> *Journal de Trévoux*, vol. 52, 1752, 2267-2278.

<sup>16</sup> One of the most detailed contemporary accounts of the catastrophe is Antonio da Silva Figueiredo, *Descripçam antilógica physico-moral do terremoto, e lamentavel estrago de Lisboa: no primeiro de novembro de 1755* (Lisboa: Na Officina Patriarcal de Francisco Luiz Ameno, 1756). Translated into English as Antonio Pereira de Figueiredo, *A Narrative of the Earthquake and Fire of Lisbon by Antony Pereria, of the Congregation of the Oratory, an Eye-Witness Thereof. Illustrated with Notes. Translated from the Latin* (London: printed for G Hawkins, 1756). A valuable recent account is in Mark Molesky, *This Gulf of Fire: The Destruction of Lisbon, or Apocalypse in the Age of Science and Reason* (New York: Knopf Publishing Group, 2015).

<sup>17</sup> "No solo se con mobieron para esta lamenttable Ruina los elementos de ayre y tierra, sino el agua [...]". BNE MSS/17873, f. 170r.

that annihilated most of the built environment and burned uncontrollably for many weeks.<sup>18</sup>

Beyond Portugal, the earthquake also shook a vast area of Europe and North Africa, causing serious damage in Seville and generating tidal waves on the Spanish coast. The following days and weeks saw an immense circulation of information across the Iberian peninsula in both manuscript and print. Some of this was driven by royal command: the Spanish and Portuguese governments in November and January, respectively, embarked upon the most comprehensive bureaucratic collection of information about a single disaster ever attempted, and the scale of these surveys would remain unrivalled until the nineteenth century.<sup>19</sup>

The Spanish monarch Fernando VI was alarmed by the tremors of November 1, which he felt at the Escorial palace, but the notes that passed between him and his Portuguese wife, Maria Bárbara, show that he did not initially suspect that a disaster had occurred. In fact, he sang a Te Deum in the church of San Jerónimo el Real on November 4, “in order to give due thanks to God, for having delivered us from such a Great Danger”.<sup>20</sup> Despite some indication of damage at Segovia and elsewhere, he was thankful that the worst news thus far was the death of two boys, killed by the fall of part of a church tower. Over the next few days, however, he began to receive reports from different parts of the peninsula that left him shaken. Nevertheless, the royal couple found the lack of regular news frustrating, not least because Maria Bárbara was anxious about her Portuguese relatives. Over two weeks after the event she was still exclaiming, “I don’t know to what to attribute the lack of any further news, notwithstanding the many letters that have been dispatched from here

---

18 Mark Molesky, “The Great Fire of Lisbon, 1755,” in *Flammable Cities: Urban Conflagration and the Making of the Modern World*, ed. Greg Bankoff, Uwe Lübken, and Jordan Sand (Madison: University of Wisconsin Press, 2012).

19 For the Portuguese project, see Molesky, *This Gulf of Fire*, 335.

20 “para dar las devidas Gracias a Dios, de havernos librado de un Peligro tan Grande”. Fernando VI to Maria Bárbara, 3 November 1755, AHN, Estado, 2507 no. 137A.

— there should have been some reply to them by now”.<sup>21</sup> On November 8, encouraged by his prime minister Ricardo Wall, Fernando ordered the Supreme Council of Castile to remedy the information deficit by sending a survey to officials in towns across Spain, with a view to constructing a complete picture of the earthquake and the resultant circumstances in each part of the kingdom.<sup>22</sup> This *encuesta* was intended to uncover three types of information. Firstly, it aimed to chart the extent of the earthquake and its effects, by determining which towns had felt the shaking. Secondly, officials were to report any damage to buildings or deaths of people and animals — standard objects of governmental concern. However, the questionnaire also addressed physical topics, since it included queries about the earthquake’s timing and duration, movements discerned in the built environment and in waters, and any signs that seemed to have heralded or caused the earthquake. Local government representatives were to solicit observations from “the most perceptive persons of their respective towns who can give the most reasoned account of what occurred”.<sup>23</sup> The responses, from every significant population centre in the country, generated over one thousand documents.<sup>24</sup> These were arranged alphabetically, from Álava to Zaragoza; some towns contributed several reports.

Among the worst-affected Spanish towns was the southern port of Cádiz. Although the shaking itself did only minor damage to the city, its location on a spit of land jutting out into the ocean left it

---

21 “no se à q. atribuir el no aver venido mas noticia alguna no obstante los muchos correos q. se han despachado de aqui de los q. devia yà aver buuelto alguno”. Maria Bárbara to Fernando VI, 18 November 1755., AHN Estado, 2507 no. 138A-B.

22 The text of the order is reproduced in Fernando Rodríguez de la Torre, “Documentos en el Archivo Histórico Nacional (Madrid) sobre el terremoto del 1 de Noviembre de 1755,” *Cuadernos Dieciochistas* 6 (2005): 86.

23 “oyendo los Corregidores y Justicias a las personas más advertidas de sus respectivos pueblos y que más razón puedan dar de lo ocurrido”.

24 These are held jointly in the Real Academia Histórica and the “Estado” section of the Archivo Histórico Nacional. Transcriptions of all these documents are supplied in José Manuel Martínez Solares, *Los efectos en España del terremoto de Lisboa (1 de Noviembre de 1755)* (Madrid: Dirección General del Instituto Geográfico Nacional, 2001). There is evidently some dispute over which scholar should be credited for this work: Rodríguez de la Torre, “Documentos en el Archivo Histórico Nacional (Madrid) sobre el terremoto del 1 de Noviembre de 1755,” 115, n. 26.

completely at the mercy of the sea.<sup>25</sup> The resultant tsunami smashed into the strip of wall between the western forts of San Sebastián and Santa Catalina, destroying the parapet in several places. While the bulk of the wall remained standing, the water rushed behind it through two gates and into the La Viña quarter on the west side of the town. Panicked residents made for the Puerta de Tierra on the eastern side of the city, but waves surged over the shoreline, destroying the artificial promontory (*arrecife*) that linked Cádiz to the mainland via the Isla de León and sweeping away the people on it — including Jean de Racine, grandson of the famous French playwright. When the sea eventually withdrew it left behind damaged houses full of mud, silt and dead leaves. Officials in Cádiz dispatched a dozen letters with four detailed testimonies of the events and their effects on the city (some of them initially transmitted through other channels).<sup>26</sup> Governor Antonio de Azlor actually anticipated the issuing of the royal *encuesta* by several days with an efficient account of the disaster and his own administrative responses.<sup>27</sup> Having received the royal order on 18 November, Azlor transmitted a further series of reports, including that of the town's chief engineer, who gave a precise description of the damage to the walls and fortifications.<sup>28</sup> Some of the reports that flowed through Spanish bureaucratic channels were written by naturalists who were clearly influenced by the vogue among eighteenth-century disaster investigators for quantitative methods and the precise recording of meteorological data. One anonymous Jesuit witness provided detailed observations of

---

25 The general course of events is described in, amongst other sources: Antonio de Azlor to Don Diego de Roxas y Contreras, 4 November 1755, AHN, Estado, 3183, no. 1; “Relaz.s sobre el terremoto, y efectos de el en la mar acaecidos en Cadiz”, BNE MSS/17873, ff. 103r-105v; “Relation intéressante du Tremblement de Terre arrivé à Cadix”, BNF S-5304, no. 16. For modern accounts see Paul-Louis Blanc, “The Tsunami in Cadiz on 1 November 1755: A Critical Analysis of Reports by Antonio de Ulloa and by Louis Godin,” *Comptes Rendus - Géoscience* 340, no. 4 (2008): 251–61; Bernard Vincent, “Le Seisme de 1755 à Cadix,” *Atlantes. Revue d'études Romanes* 1 (2014): 221–32.

26 No.s 219-232 in Martínez Solares, *Los efectos en España del terremoto de Lisboa (1 de Noviembre de 1755)*, 220–40.

27 AHN, Estado, 3183, no. 1; No. 219 in Martínez Solares, 220–21.

28 AHN, Estado, 3.183-1.o; No. 224 in Martínez Solares, 225–26.



the weather at the time of the earthquake (fine and clear, with only a slight nor-easterly wind).<sup>29</sup> The author similarly made a careful note of the effects of the earthquake on various objects: a large painting that had been attached to a wall by iron hoops and nails sprang from its fastenings and crashed to the floor, while church bells began to ring by themselves. The dramatic vibrations of the hanging street lamp indicated the direction of the shocks, from southwest to northeast, while a measurement of the lamp's oscillations yielded the arc of the vibrations. The author also observed changes in the water: the contents of wells and church fountains began to move violently and with a great noise, while a French captain informed him that he had felt his ship vibrating madly beneath him, just as if it was a building on land.<sup>30</sup> Wherever possible the Jesuit writer was precise, as in the timing of the earthquake (at exactly 9.45am), but he was also content to accept the opinion of "Personas de Autoridad, é inteligentes" on the duration of the shaking (between 9-10 minutes).<sup>31</sup> This scrupulous attention to details simultaneously reflected the writer's adherence to the broader trend for meticulous observation in disasters and suggested that every scrap of information might have a bearing on a physical analysis of the episode.

Although the *encuesta* was a Spanish domestic affair, some of its participants quickly brought to bear comparisons from other places and times to shed light on the events of November 1. Cádiz's position as Spain's chief Atlantic port in the eighteenth century not only gave it a monopoly on colonial trade but also made it the gateway for information about disasters in Spain's American territories. Furthermore, a number of its residents in 1755 were what one writer called "hombres expertos", with personal experience of both earthquakes and tsunamis in Spanish America, including

---

29 "Relacion del terremoto, y Retirada del Mar acaecidos en la Ciudad de Cadiz sabado 1.o de Nov.e de 1755", AGI, Indiferente General, 1991. This account was enclosed in a letter from Estevan Joseph de Abaria to Julián Manuel de Arriaga Rivera de San Martín (*intendente* of the province of Cádiz and president of the Casa de Contratación), dated 6 November 1755.

30 AGI, Indiferente General, 1991, f. 3v.

31 AGI, Indiferente General, 1991, f. 2r.

the disaster of Lima and Callao a decade earlier.<sup>32</sup> Their presence helped to ensure that among the contributions to the *encuesta* were several natural philosophical accounts informed by broad geographical thinking. Among these *hombres expertos* were three former members of the geodesic expedition — Antonio de Ulloa, Jorge Juan and Louis Godin. The brief observations by Ulloa that appeared in the Royal Society’s *Philosophical Transactions* began by comparing the earthquake in Cádiz to the 1746 disaster in Lima.<sup>33</sup> Godin’s observations were even more conditioned by his Peruvian experiences. On his belated return to Paris in 1751, Godin had found himself *persona non grata* at the Académie, which had terminated his status as *pensionnaire* when he took up the chair of mathematics at the University of San Marcos.<sup>34</sup> Rebuffed by the French community of naturalists, Godin’s former subordinate Ulloa (by this point a man of some influence in Spain) helped him to obtain a position as head of the observatory and director of the naval guards’ school in Cádiz.<sup>35</sup> In his elegy upon Godin’s death in 1760, Fouchy reflected that the French astronomer “was apparently destined to observe close-up the effects of earthquakes [...] One should have said that Providence led him by

---

32 "Relacion del terremoto, y Retirada del Mar acaecidos en la Ciudad de Cadiz sabado 1.o de Nov.e de 1755", AGI, Indiferente General, 1991, f. 3v.

33 *Philosophical Transactions of the Royal Society*, vol. 49, 1755, 427-8. Ulloa’s connections with the Royal Society were the result of a surprising turn of events. During his return voyage to Spain in 1744-45 the captain brought his ship into Louisbourg (in modern Nova Scotia), not realising that the English had recently captured it from France. Ulloa was taken prisoner and transported to England. While in English custody, he managed to impress the Royal Society with his accounts of the expedition and was elected a Fellow before being released in 1746. On his capture, see Antonio de Ulloa, *Relacion historica del viage a la America Meridional hecho de orden de S. Mag. para medir algunos grados de meridiano terrestre, y venir por ellos en conocimiento de la verdadera figura, y magnitud de la tierra, con otras varias observaciones astronomicas, y phisicas* (En Madrid: Por Antonio Marin, 1748), vol. 4, pp. 448–9. As England and Spain were at war in 1755, the Royal Society did not obtain Ulloa’s report directly but rather from the Spanish ambassador at the Hague (as is clear from the heading of the account in the *Philosophical Transactions*). Paul-Louis Blanc questions the authenticity of some of the details in this report, on the basis that it contradicts another version that Ulloa provided to the Swedish Royal Academy. Blanc, “The Tsunami in Cadiz on 1 November 1755,” 259–60.

34 *Histoire de l’Académie royale des sciences*, 1760, 189-90.

35 *Histoire de l’Académie royale des sciences*, 1760, 191. Ulloa also offered Godin’s son a post as an infantry lieutenant, but the young man died from smallpox soon after the move to Spain.

the hand everywhere that his talents could be useful”.<sup>36</sup> After the November earthquake and tsunami, Godin contributed a report to the *encuesta* that he also shared with the Académie, no doubt still hoping to regain his standing in Paris.<sup>37</sup> This account was read at a meeting of the academicians on December 6 by his old fellow expeditionary Bouguer.<sup>38</sup> In this report Godin made several comparisons to what he had seen in Lima and Callao. Indeed, he thought that even on the basic question of the timing of the earthquake his opinion was more reliable than that of other Cádiz residents because he “had quite often felt such [earth movements] in Peru” and was therefore more disposed to pay careful attention to them.<sup>39</sup> Imitating the diligence with which the expeditionaries had noted the precise time and duration of tremors, he enclosed a rudimentary table listing the first five shocks and the intervals between them.<sup>40</sup> He recalled that the Peruvian earthquake had occurred at the same season of the year, and hinted that he would describe some of the more remarkable incidents of the Callao tsunami “[o]n another occasion”.<sup>41</sup>

Other testimonies of the Cádiz disaster also furnished South American comparisons. Among the *encuesta* collection was an unsigned paper that consisted of a detailed discussion of the nature and

---

36 “Il étoit apparemment destiné à observer de près les effets des tremblemens de terre [...] On eût dit que la Providence le conduisoit comme par la main par-tout où ses talens pouvoient être utiles.” *Histoire de l'Académie royale des sciences*, 1760, 192.

37 Académie des Sciences, *Registre de procès verbaux des séances*, T74 (1755).

38 The copy in the *Procès verbaux* is subtitled “translated from the Spanish”, but the two extant copies of Godin’s report to the Spanish bureaucrats are both in French. In his covering note for the latter, Godin claimed to have written the original account in Spanish, and then translated it into French. If this was true, Godin’s action seems highly mysterious. He had actually been ordered by Don Juan de Iriarte to produce an account in Latin, and excused himself on the basis of the scarcity of people “*de buenas letras*” in Cádiz. Louis Godin to Ricardo Wall, 25 November 1755. AHN 3.173-1.o; No. 227 in Martínez Solares, *Los efectos en España del terremoto de Lisboa (1 de Noviembre de 1755)*, 228. Ferreiro’s speculation that Godin “was in fact now thinking in Spanish rather than in his native French” is implausible. (Ferreiro was unaware of the *encuesta* documents.) Larrie D. Ferreiro, *Measure of the Earth: The Enlightenment Expedition That Reshaped Our World* (New York: Basic Books, 2011), 332.

39 “[...] “pour moi qui en ai aussi senti bien souvent dans le Perù [...]” Académie des Sciences, *Registre de procès verbaux des séances*, T74 (1755), 774.

40 Académie des Sciences, *Registre de procès verbaux des séances*, T74 (1755), 779.

41 Académie des Sciences, *Registre de procès verbaux des séances*, T74 (1755), 781. It seems he never followed through on this promise.

causes of earthquakes, supported by extensive knowledge of events in Spanish America.<sup>42</sup> The author was almost certainly the Peruvian scholar Llano Zapata, who had moved to Cádiz in 1755 to advance his career.<sup>43</sup> The manuscript bears several close similarities with a printed essay of Llano Zapata's about the 1755 earthquake, which was presented in the form of a reply to an imaginary question of Fernando VI on the natural causes of earthquakes and the building materials that best resisted such shocks.<sup>44</sup> Both documents employed an identical typology of earthquakes based on varieties of motion, and both critiqued Bouguer's hypothesis that the influx of the sea helped to produce subterranean combustion.<sup>45</sup> A further piece of suggestive information in the *encuesta* paper is the author's claim to have personally experienced the earthquake and tsunami in Chile in May of 1751. Godin, Ulloa and Juan could all draw on experiences of seismic movement in Peru, but all had left the continent prior to the Chilean disaster. Llano Zapata's slow relocation from Peru to Spain, on the other hand, involved a journey of five years along the American coastline, which he used as an opportunity to collect books and take notes in preparation for writing a major natural history of South America.<sup>46</sup> This itinerary included a lengthy sojourn in Chile that probably began at Concepción in December 1750 and lasted until the end of 1751,<sup>47</sup> thus placing him in the country at

---

42 AHN Estado, 3173; No. 231 in Martínez Solares, *Los efectos en España del terremoto de Lisboa (1 de Noviembre de 1755)*, 236–40.

43 This attribution of authorship is my own. The manuscript in the AHN is evidently an extract from a letter, however there is no indication in the extant document of the identity of the original addressee, or the path by which the extract entered the *encuesta* files. The writer frames his remarks as a commentary on his interlocutor's paper on earthquakes, but is chiefly concerned with developing his own ideas.

44 José Eusebio Llano Zapata, *Respuesta dada al Rey Nuestro Señor D. Fernando El Sexto sobre la pregunta que S. M. hizo a un Matemático y Experimentado en las tierras de Lima sobre el terremoto, acaecido en el día primero de Noviembre de 1755* (Sevilla: Imprenta Real de la Viuda de D. Diego López de Haro, 1755).

45 In the *Respuesta* Llano Zapata describes Bouguer's tidal theory as "mere conjecture" (*mera conjetura*): Llano Zapata, 3. The critique in the *encuesta* manuscript is more emphatic and detailed, but both assessments focus on the correct identification of the calendrical periods of seismic activity as the key point.

46 Víctor Peralta Ruiz, "Un patronazgo frustrado. El ilustrado peruano José Eusebio Llano Zapata en Lima y Cádiz a través de su correspondencia (1743-1780)," *Colonial Latin American review* 16, no. 1 (2007): 51.

47 F. Álvarez Brun, "José Eusebio de Llano Zapata," *Nueva Corónica* 1 (1963): 79. For much of this time he was in Santiago.

the time of the disaster in May. There seems to be some confusion surrounding the date of Llano Zapata's arrival in Cádiz, on the other hand: if he was indeed the author of the *encuesta* document, he must have been resident there before November 1, since the author gives vivid details about his personal experience of the earthquake on that day. This accordingly indicates a necessary revision to the biographical scholarship on Llano Zapata, which has posited an arrival in December 1755 or the first half of 1756.<sup>48</sup>

Having experienced two similar catastrophes in Peru and Chile, Llano Zapata used his experience of the 1746 disaster to portray himself, like Godin, as an *hombre experto* on earthquakes and tsunamis. The *encuesta* manuscript presented a flourish of erudition that showcased the author's familiarity with both classical and recent natural philosophical theories on the causes of earthquakes. It also demonstrated his historical learning: he drew lessons from the Quebec earthquake of 1663, the disasters in Jamaica and Sicily in 1692 and 1693, the emergence of islands in the Aegean at various times, and the oft-cited earthquake in the reign of Tiberius. These he fortified with his personal observations in Callao, Chile and Cádiz. Llano Zapata may have hoped to employ this impressive display of his disaster knowledge as a way to overcome some of the prejudice that had blocked his acceptance among the Spanish savants.<sup>49</sup> By emphasising that the personal experience of seismic phenomena conferred additional authority upon an analysis, he was able to turn the very thing that diminished his credentials among the Spanish elite — his Peruvian origins — into a point of strength. The *Respuesta* declared that the only way to solve the endless theoretical disputes about

---

48 Álvarez Brun, 84; Peralta Ruiz, "Un patronazgo frustrado. El ilustrado peruano José Eusebio Llano Zapata en Lima y Cádiz a través de su correspondencia (1743-1780)," 55; Víctor Peralta Ruiz, "Las tribulaciones de un ilustrado católico. José Eusebio Llano Zapata en Cádiz (1756-1780)," in *Memorias histórico, físicas, crítico, apologéticas de la América Meridional*, by José Eusebio Llano Zapata, ed. Antonio Garrido Aranda et al. (Fondo Editorial de la Pontificia Universidad Católica del Perú, 2015), 2.

49 On this exclusion see Álvarez Brun, "José Eusebio de Llano Zapata," 59; Peralta Ruiz, "Un patronazgo frustrado. El ilustrado peruano José Eusebio Llano Zapata en Lima y Cádiz a través de su correspondencia (1743-1780)"; Peralta Ruiz, "Las tribulaciones de un ilustrado católico. José Eusebio Llano Zapata en Cádiz (1756-1780)."

the causes of earthquakes was “to look for a resolution to the Dispute in experience”, and as Llano Zapata possessed such experience in abundance, “being naturally instructed in this material, as one born and raised in Lima, which is the place where these attacks are seen with the greatest frequency”, he was well placed to comment on them.<sup>50</sup> In the *encuesta* manuscript he claimed that Peru experienced fifty great earthquakes in fifty years, in addition to many smaller ones.<sup>51</sup> Llano Zapata’s familiarity with these phenomena suggested to him that the November 1 earthquake was not as powerful as the *gaditanos* made it out to be (at least, not in Cádiz itself). He noted that many people had made a connection between the tsunami at Cádiz and that of Callao in 1746 but Llano Zapata alone knew why the sea had caused so much more havoc in the earlier incident. He pointed out that Callao was very low-lying and situated in the midst of very deep water, lacking an *arrecife* like that of Cádiz, so that the waves could move with undiminished force directly against the walls of the city.<sup>52</sup> To demonstrate how tsunamis worked he employed a combination of physical reasoning, an imaginary experiment (which involved shaking a vase of water) and the experience of a Chilean ship anchored off Valparaíso at the time of the 1751 disaster.<sup>53</sup> Knowledge of the Chilean events also proved indispensable for assessing the possible spatial extent of earthquakes. Whereas some natural philosophers looked to vague reports of ancient cataclysms (and even the myth of Atlantis) in considering the question of earthquake spread, he could say with certainty that the earthquake in 1751 had stretched across the Andes from the Chilean coast to Córdoba and Tucumán (now in

---

50 “[...] buscar en la experiencia la decision de la Disputa, y siendo natural, que yo estuviesse instruido en la materia, como nacido, y criado en Lima, que es Lugar, donde con mas frecuencia se ven estos insultos [...]” Llano Zapata, *Respuesta Dada al Rey Nuestro Señor D. Fernando El Sexto Sobre La Pregunta Que S. M. Hizo a Un Matemático y Experimentado En Las Tierras de Lima Sobre El Terremoto, Acaecido En El Día Primero de Noviembre de 1755*, 1.

51 Martínez Solares, *Los efectos en España del terremoto de Lisboa (1 de Noviembre de 1755)*, 238.

52 Martínez Solares, 240.

53 Martínez Solares, 240.

Argentina), while the tsunami assailed the Juan Fernández archipelago at precisely the same moment as Valparaíso, over 600 km away — a rapidity that recalled the movement of electricity.<sup>54</sup>

If the disasters of November 1755 allowed some writers to show off their trans-Atlantic knowledge, they also provided a challenge to some of the reigning assumptions in natural philosophical disaster research. One of the key convictions undergirding inquiries into earthquakes as well as storms and diseases in the first half of the century was that hazardous phenomena could be linked to climatic and geographical systems. Disaster investigators accordingly tried to map out these phenomena at both regional and global levels. The geographic impulse gradually became so powerful that it took on a literal dimension through nautical cartography. In the 1740s, for instance, Spanish cartographers produced a map of part of the West African coastline (published in 1755), in which they marked out rocks and shallows, with tiny anchors to indicate safe berths.<sup>55</sup> The legend also offered observations on local storms and an earthquake in the Rio de Oro. The expanding networks of lighthouses performed a similar function of indicating the spatial location of local hazards. When Benjamin Franklin narrowly escaped shipwreck off Falmouth in New England in 1757 he extolled the “Utility of Lighthouses” and vowed to construct many more of them on the American coastline on his return.<sup>56</sup> However, the catastrophes of November 1 called into question the core assumption that earthquakes and tsunamis could be understood adequately through the identification of hazardous geographies. The research on American environments conducted by the expeditions and by creole savants, as well as by observers in the Caribbean, Italy and the East Indies, had indicated that great earthquakes were functions of particular kinds of environments. Naturalists

---

54 Martínez Solares, 239.

55 *Carta Plana de la Costa Occidental de Africa y de todo el mar en que se debe hazer la pesca de la mucha diversidad de pezes que hai en su continente*, BNE, MR/42/380.

56 Benjamin Franklin, *Autobiography and Other Writings*, ed. Ormond Seavey (Oxford; New York: Oxford University Press, 1993), 171–72.

like Ulloa, Godin and Llano Zapata, who associated seismic activity with Peru and Chile, had constructed elaborate explanations that involved subterranean mineral deposits, the geology of the soil, rainfall and the action of the tides. Above all, they believed that it was the presence of the Andes cordillera, supposedly filled with hollow cavities and stocked with combustible materials, that made the South American earthquakes so frequent and so intense.

The events in the Iberian peninsula in November presented problems for this framework because Portugal lacked a comparable mountain range, had no volcanoes and did not possess a history of great earthquakes on the level of Lima or Santiago. Llano Zapata thought that the Portuguese coastal hills held sufficient quantities of pyrites and subterranean caverns to create occasional earthquakes, such as that of 1531, but they were unlikely to generate seismic disasters on the scale of Peru and Chile. Moreover, he considered the geology of the Cádiz area totally unsuited to producing earth movements, since the ground was too rocky and did not contain the right mixtures of flammable minerals.<sup>57</sup> The fixation of theorists on suitable and unsuitable geographies led to some convoluted explanations for the earthquake at Lisbon. Bearing in mind the South American lessons on the potential for earthquakes to move across large distances, as well as the direction his own body was pushed at the time of the shock, Llano Zapata concluded that the earthquake must have begun not on the Iberian peninsula but in North Africa. Accounts from Fez, Meknès, Oran and elsewhere had indeed reported severe damage and many deaths.<sup>58</sup> More

---

57 Martínez Solares, *Los efectos en España eel terremoto de Lisboa (1 de Noviembre de 1755)*, 238.

58 "Efecttos al terremoto y tormenta que ácaezio en óran el dia V de 9re. de 755 escriptto pr. El Gov.r de Castillo [...] en Cartta de 17 de dho. mes y año", BNE MSS/17873, ff106r-v; UV BH Var. 369(09) Miguel das Almas Santas, *Relacion: escrita por el Padre Guardian del Real Convento de Mequinèz, y Vice-Prefecto Apostólico de las Santas Misiones, que en las partes de Berberia conserva la Religiosa Provincia de San Diego de RR. PP. Franciscos Descalzos, al Padre Procurador de ellas, con motivo del Terremoto acaecido en Ceuta, Tetuàn, Larache, Mámora, Tánger, y Marruecos, en los dias 1. y 18. de Noviembre de este año de 1755.* (Valencia: en la Imprenta de Agustin Laborda, 1755); Anon., *Relation des terribles ravages occasionnés en Afrique par le cruel tremblement de terre qui a détruit la plus grande partie du royaume de Maroc: avec un détail de tout ce qui y est arrivé depuis le premier novembre jusqu'à présent* (s.l.: s.n., n.d).



importantly, the Maghreb had more geologically suitable terrain for earthquakes, in his view, in the form of the Atlas Mountains.<sup>59</sup> However, Llano Zapata's attempt to reconcile the obviously greater severity of the earthquake at Lisbon with a presumed origin far to the south presented the odd prospect of an earthquake traversing the Strait of Gibraltar, snaking around the southwest of the Iberian peninsula, entering Lisbon from the Atlantic and then moving eastwards. His additional suggestion that the earthquake might have affected a pyramidal area, with its base in the Atlas and its tip in Bayonne, relied on characterising the shaking reported further away in England and Ireland as the product of a subsequent "sea quake" (*temblor de agua*) rather than the earthquake proper.<sup>60</sup> He accounted for the greater intensity at Lisbon by speculating that the supposedly combustible geology of coastal Portugal was connected under the sea with the ground of Mauretania.<sup>61</sup> The attempt to link Lisbon to the Atlas was highly creative, recalling the trans-oceanic pyrophilactic channels that naturalists had described in the 1680s-90s, but it was an improvisational attempt to deal with a problem that cut to the heart of natural philosophical disaster theory.

The tsunamis also presented a puzzle, particularly because of their astonishing reach. Beyond the heavily damaged zones of the Iberian peninsula and North Africa, observers reported strange tides as far away as Barbados, Antigua and Martinique — the result of a tele-tsunami that swept across the Atlantic.<sup>62</sup> These and other reports inspired the Royal Society to collect and print twenty-seven accounts of unusual "agitations of the waters" from all over Britain and Europe.<sup>63</sup> John

---

59 Martínez Solares, *Los Efectos En España Del Terremoto de Lisboa (1 de Noviembre de 1755)*, 238.

60 Martínez Solares, 238–39.

61 Martínez Solares, 238.

62 Quincy to Sewall, MHS Misc. Bd. 1755 December 17; Captain Affleck and Charles Gray, "An Account of the Agitation of the Sea at Antigua, Nov. 1, 1755. By Capt. Affleck of the Advice Man of War. Communicated by Charles Gray, Esq; F. R. S. in a Letter to William Watson, F. R. S.," *Philosophical Transactions of the Royal Society of London* 49 (1755): 668–70.

63 Various authors, "An Extraordinary and Surprising Agitation of the Waters...," *Philosophical Transactions of the Royal Society of London* 49 (1755): 351–98.

Huxham contributed observations from Plymouth, complete with meteorological data. He had seen abnormally large tides before, “[b]ut when I heard, that at Portsmouth, Holland, in Ireland, Germany, &c. the waters were so strongly agitated on the very same day, it roused my attention greatly, though I am quite lost in conjecture of the cause”.<sup>64</sup> According to John Perkins in Boston, who printed an essay on this topic, such “commotions of the sea” had no precedent in recorded history.<sup>65</sup> The explanation he offered for both earthquakes and tsunamis departed from the combustion theory. Instead, he suggested that the slow “settling” downwards of mountains, partly occasioned by rainfall, produced friction and vibration as the base of the mountains ground upon the adjacent rock.<sup>66</sup> Although this hypothesis bears some remarkable commonalities with modern tectonics, the centrality of mountain ranges to Perkins’ theory again required some complex manoeuvres to explain the earthquake at Lisbon. Perkins thought that the sinking of the Pyrenees was responsible, claiming that the vibrations of their settling process would have been much more intense closer to sea level, in the vicinity of Lisbon. However, it remained somewhat unclear why Lisbon in particular had received the brunt of this force rather than some other part of Europe.

The investigation of the tsunamis fostered a reimagining of the relationship between land and sea. Natural philosophers in the previous century had attempted to theorise how mountains and other geographical features arose — in Hooke’s case by reference to earthquakes — but now it became necessary to think more seriously about how terrestrial terrain related to the topography of coasts and the ocean floor. The most ambitious response came from a member of the Académie in Paris, who simultaneously pursued a vast project to compile information on earthquakes and

---

64 *Philosophical Transactions*, vol. 49, 1755, 372-3.

65 John Perkins, *An Essay on the Agitations of the Sea, and Some Other Remarkables Attending the Earthquakes of the Year M,DCC,L,V: To Which Are Added, Some Thoughts on the Causes of Earthquakes* (Boston: Printed and sold by B Mecom, at the new printing-office, near the Town-House, 1761), 3.

66 Perkins, 17–20.

produced a complex set of theories about the connection between terrestrial and submarine topography. Philippe Buache, First Geographer to the King of France and a member of the Académie in Paris, believed that in order to advance the understanding of physical geography it was necessary to compile all of the extant information on earthquakes.<sup>67</sup> However, the task of amassing “one of the most complete research Collections” on this subject was an enormous one.<sup>68</sup> Initially he confined the parameters of the project to the earth movements that occurred in Western Europe between November 1 1755 and March 1756. For this purpose, he took notes on the very large number of papers presented to the Académie, which included accounts of seismic shocks all over Europe.<sup>69</sup> However it soon became obvious to Buache that in order to understand the real significance of these earthquakes it would be necessary to bring together information on similar events throughout time, drawing upon histories that described “the destruction of Towns, the Overturning of Lands and the Eruptions of Volcanoes”.<sup>70</sup> In addition to the Académie’s papers and historical works, Buache also harvested information from gazettes, pamphlet accounts and existing publications on earthquakes. The latter included the pastor and natural philosopher Élie Bertrand’s *Mémoires historiques et physiques sur les tremblemens de terre* (1757), which offered a chronology of seismic events with an emphasis on the Swiss territories.<sup>71</sup> Buache used his research to develop his own theories on the causation of earthquakes and on the earth’s structure. The ultimate product of this work was a huge collection spanning over 700 pages, largely handwritten, now contained in two large volumes at the Bibliothèque Nationale de France. The collation and organisation of Buache’s

---

67 BNF NAF 20236, f. 4v.

68 “[...] une Collection des plus complètes par la recherche [...]”. BNF NAF 20236, f. 4v.

69 Buache was present at the 1755 session of the Académie where Bouguer read out Godin’s paper: Académie des Sciences, *Registre de procès verbaux des séances*, T74 (1755).

70 “[...] la destruction des Villes, du Bouleversement des Terres et des Éruptions de Volcans”. BNF NAF 20236, ff. 4r-v.

71 Élie Bertrand, *Mémoires historiques et physiques sur les tremblemens de terre* (La Haye: Edition de Pierre Gosse, Junior, 1757).

papers was itself the result of a subsequent project which took place in the early 1770s, when members of the Académie desired “to bring together in a body all that concerned the earthquakes that have occurred since 1755”.<sup>72</sup> Buache’s meticulous research thus formed a reservoir for ongoing efforts to understand the nature and effects of seismic phenomena.

Although never published, the first fruits of Buache’s researches were presented in April 1756 to the Académie and to its patron, Louis XV, in a highly innovative form.<sup>73</sup> Buache provided tables of locations in western Europe where tremors had been felt since November of the preceding year, in alphabetical order, along with a chronological table of seismic events since 1,000 BCE. However, the centrepiece of this presentation was a large map that set out the data on the most recent earthquakes in a visual form. Here geographical areas were colour-coded to indicate the areas that had jointly experienced tremors on a certain date. For instance, the areas in red were ones were those that had submitted to the Académie reports of shaking between November 1 and December 6 1755, while regions in yellow had experienced seismic shocks between December 9 and 19. Notations above the place-name indicated the specific day on which the shaking had been noticed, while those below referred to the succession of tremors on subsequent dates. Further symbols represented the occurrence of meteorological phenomena such as aerial fires, which might conceivably have some connection to the earthquakes.

One of the primary achievements in this presentation of the data was to demonstrate the interrelationship of the tremors that had been reported in many different places. In the past,

---

<sup>72</sup> “[...] de faire un corps de tout ce qui regarde les Tremblemens de terre arrivés depuis 1755”. BNF NAF 20236, f. 2r.

<sup>73</sup> BNF NAF 20236, from f. 4r. See also the useful discussion of this text in Grégory Quenet, *Les tremblements de terre aux XVIIe et XVIIIe siècles : la naissance d'un risque*, Epoques (Seyssel: Champ Vallon ; Paris Diffusion, Presses universitaires de France, 2005), 332–38.

commentators had often observed that smaller shakes followed a large earthquake, leaving nearby inhabitants in constant terror of another major event. However, the relationship between these tremors — whether they constituted different earthquakes or part of a single seismic event — was always very unclear. By tabulating the information across many countries in chronological and geographical lists, and then placing that data in a spatial layout, Buache paved the way for an important reconceptualisation. Having obtained a clear idea of the intensity of shocks over time and space, he could separate with confidence the sequences of tremors following a certain number of principal events. He determined that there were four such events between November 1755 and the following March, since as his data made clear, “each of these happened at the same time in diverse places very distant from one another”. The subsequent tremors could therefore be seen not as separate episodes but as lesser echoes of the four original events. These echoes were presumably brought about by the ongoing “Communication of the matter” that had triggered the original convulsions.<sup>74</sup> This important discovery (or rather confirmation) of the operation of aftershocks was essentially a product of the grouping of earthquakes, on the basis of the comparative analysis of an extraordinarily wide-ranging and detailed dataset.

Although this research had quantitative features, it was also heavily dependent on much older techniques of information management. This is clearly visible in Buache’s treatment of his printed sources. At times he simply obtained a copy of a news pamphlet concerning an earthquake, or an issue of a gazette; in the latter case he underlined the sections relevant to his research.<sup>75</sup> Most often, however, he laboriously copied long excerpts by hand. In assembling his chronological lists, he

---

74 “On croit qu'il faut distinguer quatre Commotions depuis le 1er Novembre 1755 jusqu'à présent; puisque chacune d'elles est arrivée à la même heure en divers Lieux tres éloignés les uns des autres, et que les secousses, qui les ont suivies, paroissent une suite de la Communication des matieres”. BNF NAF 20236, f. 5r.

75 As at BNF NAF 20236, ff. 164r-169v.

would write on a slip of paper a brief description of an event, with its place, date and the source from which he had derived the information, and paste the paper into a page devoted to a specific year. This technique bore some analogy to the excerpting practices associated with “commonplace books” — a format for organising information and notes that was popular among scholars throughout the early modern period.<sup>76</sup> The organisational rigour of this process was apparently difficult to maintain, however: later Buache seems to have discarded the chronological order and simply created entries as he found them in his sources, juxtaposing ancient and medieval events with modern ones of varying dates.

As “assistant geographer” to the Académie, a post created especially for him,<sup>77</sup> Buache’s interest in earthquakes was closely related to his focus on understanding the layout and composition of the earth. However, he was also deeply interested in the connection between earthquakes and the topography of aquatic environments. In the early 1740s during a series of major floods of the Seine Buache became involved in studying the river to inform hydrological engineering projects that would reduce the potential for inundations.<sup>78</sup> This work helped to stimulate a life-long passion for understanding fluvial and submarine terrain. By 1755, when he became the geography tutor for the children of the Duke of Burgundy, Buache had published several important works on river systems (1751) and the Arctic sea (1754). His map of the canal of La Manche (1752) offered an innovative visualisation of sounding data by displaying contour lines at ten-fathom intervals to show the varying depths of the canal’s basin. Most importantly, however, his hydrographical work led him to develop a new theory of global geography. His map of the area between west Africa and Brazil, published in

---

76 Ann M. Blair, “Humanist Methods in Natural Philosophy: The Commonplace Book,” *Journal of the History of Ideas* 53, no. 4 (1992): 541; Ann Blair, *Too Much to Know: Managing Scholarly Information before the Modern Age* (New Haven: Yale University Press, 2010), ch.s 2-3.

77 “Buache, Philippe”, in Charles Coulston Gillispie et al., *Complete Dictionary of Scientific Biography* (Detroit, Mich.: Charles Scribner’s Sons, 2008).

78 *Histoire de l’Académie royale des sciences*, 1741, Mémoires, 335-7; 1742, 371-378.

1745, was the first to display a hypothetical view of the topography of the Atlantic basin. Buache used this depiction to make a visual argument that the chains of mountains that ran through Africa and South America formed an intricate, unbroken pattern: where coasts seemed to interrupt the mountains he postulated the continuation of these chains beneath the sea.<sup>79</sup> This insight built upon the research of the Bolognese nobleman Luigi Ferdinando Marsigli, discussed by the Académie in 1710, which had used ocean soundings to demonstrate a submarine continuity between the Provence Alps and the island of Saint Honorat.<sup>80</sup>

Studying earthquakes gave Buache the means of stipulating the central role of mountains in the earth's structure and processes. His vast earthquake data reaffirmed the widespread belief that these phenomena occurred more frequently and with greater intensity in mountainous regions. However, Buache set aside the assumption that other savants had made (including the French expeditionaries and the Peruvian scholars) that regions like Peru and Chile were more prone to earthquakes than other countries specifically because they possessed a great mountain range or particularly copious quantities of flammable mineral deposits. On the contrary, Buache asserted that mountains were the "frame" or "skeleton" (*charpente*) of the earth as a whole and thus formed a closely integrated global system.<sup>81</sup> No region was beyond the reach of these expansive ranges. Developing the claims he had made in his 1745 map of the Atlantic, his *Planisphère physique* (1756) clearly depicted this vision of mountain chains encircling the earth, continuing their march beneath the oceans and meeting up on the coasts. A series of lines showed that the South American cordillera extended eastwards through Brazil and across the Atlantic, and northwards from West Africa through the Maghreb to the Iberian peninsula. By identifying these submarine ranges, Buache had quite literally discovered the missing

---

79 *Histoire de l'Académie royale des sciences*, 1745, Histoires, 76-7.

80 *Histoire de l'Académie royale des sciences*, 1710, Histoires, 23-29.

81 *Histoire de l'Académie royale des sciences*, 1752, Mémoires, 399-416.

link between the earthquake-producing mountains and the coastal areas ravaged by the earthquakes of November 1755. This was a truly global solution to the problem of earthquake propagation that worked within the paradigm of combustion theories. As the physical geographer Nicolas Desmarest observed in his own work on earthquake transmission (*Conjectures physico-mechaniques sur la propagation des secousses*, 1756), Buache had given the clearest available explanation of the connection between the mighty mountain chains of America, Africa and Europe. Seismic shocks could be conceived as a continuous set of explosions which followed the chain of mountains like a line of gunpowder. On the basis of this global system “it is easy to make you see in two words how the mountains concur in the propagation of tremors in general earthquakes”.<sup>82</sup>



Figure 1. Detail from Philippe Buache, *Planisphere physique où l'on voit du pôle septentrional ce que l'on connoit de terres et de mers, avec les grandes chaînes de montagnes qui traversent le globe*, 1756. Source: Bibliothèque nationale de France, BNF GE D-12539. Thick shaded lines on the map indicate mountain ranges.

82 “[...] il est facile de vous faire concevoir en deux mots, comment les montagnes concourent à la propagation des secousses dans les tremblemens généraux”, Nicolas Desmarest, *Conjectures physico-mechaniques sur la propagation des secousses dans les tremblemens de terre, et sur la disposition des lieux qui en ont senti les effets* (s.l.: s.n., 1756), 8–9, 17–18.





The earthquakes and tsunamis of 1755 also provoked intense discussion among ecclesiastical writers. Some historians continue to maintain that the November catastrophes constituted a decisive moment in Europe's supposed shift toward a secular understanding of disasters.<sup>83</sup> Other scholarship, however, has begun to shed light on the tremendous vitality of the religious response in several countries.<sup>84</sup> In fact, the torrent of pious tracts far exceeded in quantity the religious commentary on any previous disaster episode. The scale of this response should indicate that the catastrophes of 1755, along with the ensuing physical, literary and philosophical debates about them, not only failed to strike a mortal blow to providential disaster interpretation but actually incited a powerful reinvigoration of it. In some cases, especially in the immediate aftermath, this interpretation emphasised the traditional motifs of divine punishment and deliverance. Three days after the earthquake and tsunami, Tomás del Valle, the Bishop of Cádiz, wrote to his superior that the calamity was a divine correction provoked by the sins of the city, especially pride, indecency and profanity.<sup>85</sup> He pleaded for the closure of the comedy theatre, which in his view was a school of iniquity, claiming that the walls of the city would never protect it from harm while the walls of the theatre remained standing. The bishop also reflected the opinion of many *gaditanos* by suggesting that the "vengeance of God" (*venganza de Dios*) had been halted only through pious prayer and the timely intercession of Mary and the patron saints San Servando and San Germano. This insistence

---

83 Molesky, *This Gulf of Fire*, 356–57.

84 See for instance, Martin Stuber, "Divine Punishment or Object of Research? The Resonance of Earthquakes, Floods, Epidemics and Famine in the Correspondence Network of Albrecht von Haller," *Environment and History* 9, no. 2 (2003): 173–93; Philippe Loupès, "Castigo de Dios, le tremblement de terre de 1755 dans les publications espagnoles de circonstance," *Lumières*, no. 2e semestre (2005): 77–94; Robert G. Ingram, "The Trembling Earth Is God's Herald: Earthquakes, Religion and Public Life in Britain during the 1750s," in *The Lisbon Earthquake of 1755: Representations and Reactions*, ed. Theodore E. D. Braun and John B. Radner, SVEC, 2005:02 (Oxford: Voltaire Foundation, 2005).

85 AHN, Estado, 3173; No. 220 in Martínez Solares, *Los efectos en España del terremoto de Lisboa (1 de Noviembre de 1755)*, 222.

on a miraculous deliverance became a general theme both at Cádiz and in other Spanish towns.<sup>86</sup> A plaque outside the Palm Chapel on the Calle de la Cruz testifies to one particular miracle story, in which a priest brandishing a holy artifact, the cross of the Image of the Palm, is supposed to have turned back the encroaching flood waters: “from hence you will not pass, he says to the furious sea, / and at that point the sea turns and becomes totally calm”.<sup>87</sup> This was a miracle that closely imitated Jesus' calming of the storm in Mark 4.37-40 and in Luke 8.23-25.<sup>88</sup> By successfully emulating Christ, the plaque averred that the priest had effectively averted the “final punishment for mortals”.<sup>89</sup> The official response in Iberian towns echoed the well-established propitiatory formula of processions and masses. In Cádiz, del Valle mandated a fast and a general procession with the town's chief relics, followed by a solemn mass and a Te Deum to thank God for preserving the city.<sup>90</sup>

However, once the disasters on the Iberian peninsula became a matter of pan-European and trans-Atlantic concern, the question of God's chastisement of sinners in the affected areas receded in importance.<sup>91</sup> Although divine punishment and deliverance remained an essential part of the religious discussion, commentators dispersed over vast distances increasingly considered the events

---

86 Francisco Aguilar Piñal, “Conmoción espiritual provocada en Sevilla por el terremoto de 1755,” *Archivo Hispalense* 56, no. 171 (1973): 37; Ana Crespo Solana, “Manifestaciones culturales y actitudes sociales y religiosas ante las catastrofes naturales en la España del Antiguo Regimen: el maremoto de 1755 en Cádiz,” in *Naturalia, mirabilia & monstrosa en los imperios ibericos: siglos XV-XIX*, ed. Eddy Stols, Werner Thomas, and Johan Verberckmoes (Leuven/Louvain: Leuven University Press, 2006), 143–68; Vincent, “Le Seisme de 1755 à Cadix.”

87 “[...] de aquí no pases dice al mar furioso, / y al punto el mar se vuelve y todo calma. / Por caso tan notable y prodigioso [...]” (My transcription of the plaque, located on Calle Virgen de la Palma.)

88 “he arising, rebuked the wind and the rage of the water. And it ceased: and there was a calm”. Vulgate, Douay-Rheims translation.

89 “El ultimo castigo â los mortales”.

90 AHN, Estado, 3183, no. 1; No. 219 in Martínez Solares, *Los efectos en España del terremoto de Lisboa (1 de Noviembre de 1755)*, 221; Tomás del Valle, *Don Fr. Thomás del Valle ... obispo de Cadiz, y Algeciras ... a todos los fieles de esta ciudad ... Despues de la terrible, espantosa, y á nuestros ojos jamás vista tormenta del temblor de tierra, y enfurecida brabeza de el mar ...* (n.p.: n.p., 1755). For the similar ritual responses in Seville, see Aguilar Piñal, “Conmoción espiritual provocada en Sevilla por el terremoto de 1755,” 41–46.

91 Analogous shifts in emphasis had occurred on a smaller scale in the past, for instance during the debates over the earthquakes of the 1680s-90s, but the vast scale of disaster commentary in the 1750s gave this reorientation a greater influence.

from a perspective that transcended the purely local. The archbishops of Lima, Mexico and Guatemala issued pastoral letters that counselled the inhabitants of their dioceses to consider the destruction at Lisbon as a divine warning, urging them to perform rites of penitence and to undertake moral reform, just as if the catastrophe had occurred in their own regions.<sup>92</sup> These prelates singled out the rarity of such large earthquakes in Europe and North Africa, and indeed “in Countries that, for the most part, up till now were believed to be exempt from this calamity”.<sup>93</sup> By attempting to evoke in their readers sympathy for these remote disasters and astonishment at the rigour of God’s justice, the archbishops were endeavouring to turn remote catastrophes into proximate ones, thus transcending or expanding the geographical limits of compassion.<sup>94</sup> They felt this task could be accomplished by reminding readers of recent disasters in their own countries. The archbishop of Mexico, Manuel Joseph Rubio Salinas, suggested that the earthquakes in Europe and Africa were simply larger versions of familiar Mexican phenomena, so that “although distant they fall very close to us, being akin to those we have suffered in this very Nation, in this very Town”.<sup>95</sup> The archbishop of Guatemala, Francisco Joseph de Figueredo y Victoria, reminded his readers that

---

92 Francisco Joseph de Figueredo y Victoria, *Carta Pastoral Exortatoria a Penitencia* (s.i.: en la imprenta de Joachin de Arevalo..., 1756); Manuel Joseph Rubio Salinas, *Carta Pastoral que ... D. M. Rubio Salinas ... dirige al clero y pueblo de su diocesi, con motivo de las noticias, que ... se han recibido de España, del Temblor de Tierra, que en el dia 1 de Noviembre del año ... de 1755 se sintió ... en todo aquel Reyno* (En Mexico: En la Imprenta de la Bibliotheca Mexicana, 1756); Pedro Antonio Barroeta y Angel, *Carta pastoral, que el Illmo. S.D.D. Pedro Antonio de Barroeta y Angel, arzobispo de los Reyes, dirige al venerable clero, y amado pueblo de su diocesis, con ocasion de las noticias, que se han participado de España del gran terremoto, que el dia primero de noviembre de 1755. se experimentó con grandes estragos en la Europa, y otras partes, para que con la prompta penitencia aplaquen la divina justicia, que allá castiga, y acá nos amenaza* (Impressa en Lima: En la Plazuela de San Christoval, 1756).

93 “[...] en Países que, por la mayor parte, hasta ahora se creian essemptos de esta calamidad [...]”. Rubio Salinas, *Carta Pastoral que ... D. M. Rubio Salinas ... dirige al clero y pueblo de su diocesi, con motivo de las noticias, que ... se han recibido de España, del Temblor de Tierra, que en el dia 1 de Noviembre del año ... de 1755 se sintió ... en todo aquel Reyno*, A1v; Figueredo y Victoria, *Carta Pastoral Exortatoria a Penitencia*, ff. 4v-5r.

94 For other eighteenth-century responses to this problem, see Carlo Ginzburg, “Killing a Chinese Mandarin: The Moral Implications of Distance,” *Critical Inquiry* 21, no. 1 (1994): 46–60.

95 “aunque distantes nos caen muy cerca, como que los hemos padecido en nuestra misma Nacion, y en nuestro mismo Pueblo”. Rubio Salinas, *Carta Pastoral que ... D. M. Rubio Salinas ... dirige al clero y pueblo de su diocesi, con motivo de las noticias, que ... se han recibido de España, del Temblor de Tierra, que en el dia 1 de Noviembre del año ... de 1755 se sintió ... en todo aquel Reyno*, B1v.

Santiago de Guatemala was “the land of earthquakes”.<sup>96</sup> His expectation was that if Guatemalans felt “compassionate laments about Lisbon”, they would also shed “tears of penitence about Guatemala”, implying that a telescoped view of disasters would be an important catalyst for domestic moral reform.<sup>97</sup>

Behind these attempts to cultivate international compassion lay a shift in ethical focus from identifying and condemning the sins of others to a contemplation of the duties of humanity. While the archbishops concentrated on exploiting sympathy for the November disasters for an agenda of spiritual reform, contemporaries elsewhere harnessed it to charitable purposes. Under the influence of broader cultural changes around sympathy and charity, an emergent ethics of benevolence helped to inspire aid at both private and governmental levels.<sup>98</sup> This manifested, for instance, in King George II’s donation of £100,000 and stocks of provisions to Lisbon, which was considerably more generous than the relief that he had provided to his own subjects after a deadly fire in Charleston in 1740.<sup>99</sup> The gradual unfolding of ideals of governmental and humanitarian benevolence also underpinned the expansion of both private and public charitable relief after Caribbean hurricanes in the following decades.<sup>100</sup> After a catastrophic fire in Guayaquil in 1764, the city council petitioned Carlos IV for a remission of the *alcabala* tax for twenty years, justifying the request partly on the basis of “the notable Compassion and pity that this Municipality deserves because of the misfortune

---

96 “la tierra de los temblores”. Figueredo y Victoria, *Carta Pastoral Exortatoria a Penitencia*, ff. 4v-5r.

97 Figueredo y Victoria, f. 6r.

98 Other aspects of eighteenth-century charity are examined in Caroline Shaw, *Britannia’s Embrace: Modern Humanitarianism and the Imperial Origins of Refugee Relief* (Oxford: Oxford University Press, 2015), chap. 1; Catherine S. Arnold, “Affairs of Humanity: Arguments for Humanitarian Intervention in England and Europe, 1698–1715,” *The English Historical Review* 133, no. 563 (2018): 835–65.

99 Cynthia A. Kierner, *Inventing Disaster: The Culture of Calamity from the Jamestown Colony to the Johnstown Flood* (Chapel Hill: University of North Carolina Press, 2019), 92.

100 Matthew Mulcahy, *Hurricanes and Society in the British Greater Caribbean, 1624-1783* (Baltimore: Johns Hopkins University Press, 2006), ch.s 6-7; Stuart B. Schwartz, *Sea of Storms: A History of Hurricanes in the Greater Caribbean from Columbus to Katrina* (Princeton: Princeton University Press, 2015), chap. 3.

[we have] related”.<sup>101</sup> Following another great fire in Montreal in 1765, a charitable pamphlet exhorted Britons to set aside any confessional animosity against French Catholics and to give generously, both to cement the loyalty of this recent addition to the British empire and to satisfy “the social Virtues of Humanity”. “A solicitude for the preservation of fellow-creatures”, the writer maintained, was both an integral facet of ecumenical Christianity and a noteworthy characteristic of the British people.<sup>102</sup>

As the condemnation of sin gradually diminished in relative importance, some of the weight of ecclesiastical censure shifted from the impiety of ordinary people to the actions of troublemakers during and after disasters. Looters, always an object of revulsion, attracted special condemnation after the 1755 catastrophes. One account claimed that in Lisbon “there was such a number of thieves and villains dispersed about the town, that no house was safe from being robbed, no church from being sacrilegiously plundered. And such was the cruelty and avarice of some, that they did not even spare the dead bodies, but stripped the men of their swords, watches, and buckles, and the women of their fans, rings, and jewels”.<sup>103</sup> The Pombaline government responded with harsh summary justice, hanging thirty-four alleged looters within a few days.<sup>104</sup> Voltaire’s *Candide* contained a vivid depiction of looting and callousness after the earthquake.<sup>105</sup> The outrage about the immorality of thieves on land in disaster situations was paralleled by an increasing disgust at coastal dwellers who pillaged wrecked ships. These criminals were not typically described as sinners but rather as barbarians violating collective human duties of care in the wake of a catastrophe. The entry

---

101 “la notable Compacion y lastima que por el relacionado infortunio merese este pobre Vesindario”. AGI, Quito, 296, no. 22, f. 40r.

102 “The Case of the Canadians distressed by Fire at Montreal” and “Motives for a subscription towards the relief of the sufferers at Montreal in Canada”, BL Add MS 35915 ff. 1r-2v; pp. 5-6.

103 Figueiredo, *A Narrative of the Earthquake and Fire of Lisbon*, 18.

104 Figueiredo, 18.

105 Voltaire, “Candide,” in *Candide and Other Stories*, trans. Roger Pearson, New ed. (Oxford; New York: Oxford University Press, 2006), 12–13.

on Shipwreck (*Naufrage*) in Diderot and D'Alembert's *Encyclopédie* (1751-72) traced the origin of wreck pilferers to the barbarians of classical antiquity, who used disaster to enrich themselves instead of attending to the victims with "all the services of humanity" (*tous les services de l'humanité*).<sup>106</sup> In a sermon of December 1754, the Dorset vicar Thomas Francklyn contrasted the "humane treatment" received by Saint Paul after his shipwreck at Malta, and the generous assistance provided to wrecked sailors by the Indians of Virginia, to the "amazing Barbarity" of English and Welsh villagers who rushed to seize goods from shattered merchant vessels.<sup>107</sup> John Brekell, a Presbyterian minister in Liverpool and a scholar of Hebrew and Greek, thought the contrast between the hospitality of the Maltese heathens and the plundering on British coasts was a stain on Christendom: "O pity! that *Heathens* should discover more generosity and compassion than some *Christians*: that the worshippers of *Juno* should have more humanity than professed disciples and followers of Jesus! Tell it not in *Gath!* publish it not in the gates of *Askelon!* lest the daughters of the *Philistines* rejoice, and a reproach be brought upon the *Christian* name!"<sup>108</sup> The jurist William Blackstone lauded England's "very humane regulations" that "assist the distressed, and prevent the scandalous illegal practices on some of our sea coasts", which included wreck plundering, violence towards shipwreck victims and the placing of false lights to lure ships into danger.<sup>109</sup> Ricardo Wall, the leading Spanish minister, remarked approvingly in 1753 on recent English laws created "[t]o punish more effectively

---

106 Denis Diderot and Jean Le Rond d'Alembert, eds., *Encyclopédie, ou, Dictionnaire raisonné des sciences, des arts et des métiers* (Paris: Chez Briasson, David, l'aîné Le Breton, Durand, 1751), vol. 11, pp. 50–51.

107 Thomas Francklyn, *Serious Advice and Fair Warning to All That Live upon the Sea-Coast of England and Wales...* (London: printed for A Linde, in Catherine Street in the Strand, 1756), 27, 44, 58.

108 John Brekell, *Enrocydon: Or the Dangers of the Sea: Considered, and Improved, in Some Reflections upon St. Paul's Voyage and Shipwreck. Acts XXvii* (London: printed for J Noon, at the White Hart, in Cheapside; R King, at the Bible and Crown, in Fore-Street; M Waugh, at the Turk's Head, in Grace-Church-Street; R Fleetwood, in Liverpool; M Bryson, in Newcastle; T Cadell, in Bristol; J Eaton, in Yarmouth; and J Munby, in Hull, 1744), 48.

109 William Blackstone, *Commentaries on the Laws of England*, 4th ed. (Oxford: Printed at the Clarendon Press, 1770), 293–94.

those Persons that rob or withhold goods from shipwrecks”.<sup>110</sup> On the other side of the Atlantic, Connecticut passed an *Act concerning Wrecks of Sea* in 1750 that compelled locals to render aid to ships and crews in distress and to protect their cargoes, insisting that “there shall be no Violence, or Wrong Offered to their Persons, or Goods”.<sup>111</sup> These laws had the dual purpose of protecting private property and commerce and of excising immorality. Preachers therefore urged their congregations to abide by these rules while excoriating the cruelty of those who violated them as un-Christian. As Brekell put it, “a shame it is to say, and shocking to think, what cruelties and barbarities are sometimes exercised upon these melancholy occasions, even in a *christian* country”.<sup>112</sup> By channelling some of the old zeal for the moral reform of society after disaster into the more modest encouragement of humane benevolence and the condemnation of barbarous immorality, the clergy discovered a mission that dovetailed neatly with the enforcement of laws, the maintenance of social order and the protection of property.

The clerical imperative to uncover new roles and functions after disaster was given further impetus by the increasingly evident separation between natural philosophical and spiritual inquiries. It had long been possible for writers to discuss destructive phenomena in exclusively physical terms, and this capacity was encouraged by the norms of scientific academies, which tended to shun theological matters in order to avoid conflicts of belief among their members.<sup>113</sup> Nevertheless, in many ways natural and supernatural analyses of calamities in the seventeenth century continued to

---

110 “Para castigar mas effectivamte aquellas Personas, qe. robaren, ó retuvieren bienes provenientes de los naufragios”, Ricardo Wall to Joseph de Carvajal y Lancaster May 17, 1753, AGS EST, LEG, 6924, f. 1r.

111 *Acts and Laws of His Majesty's English Colony of Connecticut in New-England in America* (New London (Conn.): Printed and sold by Timothy Green, printer to the governour and Company of the abovesaid colony, 1750), 256.

112 Brekell, *Eurochydion*, 47–48.

113 See for instance, Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life: Including a Translation of Thomas Hobbes, Dialogus Physicus de Natura Aeris, by Simon Schaffer* (Princeton, N.J.: Princeton University Press, 1985), 337; Ann Blair, “Science and Religion,” in *The Cambridge History of Christianity*, ed. R. Po-Chia Hsia, vol. 6 (Cambridge, UK: Cambridge University Press, 2007), 436.



constitute “interlocking parts of a single interpretative chain”.<sup>114</sup> As the debates on earthquakes in the 1680s-90s demonstrated, pious commentators and natural philosophical virtuosi even towards the end of the century continued to share many of the same questions, classical authorities and historical sources concerning disasters. However, as eighteenth-century naturalists progressively emphasised quantitative techniques, environmental interconnections and climatic systems, theological and natural philosophical approaches to disasters increasingly inhabited distinct discursive registers. This change in language did not necessarily represent an alteration in the importance of faith: as in other areas of scholarship in the early modern period, outward verbal expression did not equate to private belief.<sup>115</sup> Writing in a natural philosophical register neither precluded a personal religious commitment nor a conviction that religion and nature shared deep interconnections. However, contemporaries were well aware that these separate registers existed and that they carried different expectations in terms of the content and tone of discussion. They were also conscious that the same writer could move between registers as the audience and occasion required, without contradiction and without betraying his or her intellectual commitments. Francis Welles, the rector of Prestbury in Gloucestershire, penned a long description of a storm in 1731 which included reflections on providence and divine mercy. Welles gave his brother permission to share the account with an acquaintance, but asked him to convey “that he must consider I wrot [sic] to a Sister and not to a natural Philosopher; and design’d only to tell what was done Providentially, not to account for it naturally by immediate causes, nitrous particles &c [...]”<sup>116</sup> Preachers and tract writers dealing with the earthquakes of the 1750s commonly reminded their audiences that they were

---

114 Paul Slack, *The Impact of Plague in Tudor and Stuart England* (London ; Boston: Routledge & K. Paul, 1985), 29.

115 On this disjunction between public and private, see Michael Hunter, *Boyle: Between God and Science* (New Haven: Yale University Press, 2009), chap. 10.

116 BL Add MS 4432 f. 143r.

speaking in a providential register, even though they might equally be capable of supplying natural explanations. In Newport, Rhode Island, the minister John Burt told his congregation in 1755 that “[a]n Inquiry into the natural Causes of Earthquakes, would be inconsistent with my design'd Brevity, and might divert your Thoughts from the great first Cause of All; I shall therefore only mention them as Works of God, and the Means he uses to accomplish his Pleasure”.<sup>117</sup> Natural philosophical writers similarly advertised their chosen register. At a lecture at Harvard College in Massachusetts, John Winthrop, the Hollisian professor of mathematics and natural philosophy, entreated his audience to “take notice, that I speak here only of *physical* or *natural* ends. For though I make no doubt, that the laws of nature were established, and that the operations of nature are conducted, with a view, *ultimately*, to *moral* purposes; and that there is the most perfect coincidence, at all times, between God's government of the *natural* and of the *moral* world; yet it would be improper for me to enter into these disquisitions at this time, since my province limits me to consider this subject, only in the relation which it bears to *natural philosophy*”.<sup>118</sup> The English minister and antiquarian William Stukeley prefaced his influential book on earthquakes by explaining that his work had two segments: a “philosophical part” which he had presented to the Royal Society and a “theological” one that he had delivered as a sermon to his congregation.<sup>119</sup> While religion and natural philosophy continued to coexist, to exert mutual influence and even to possess substantial points of intersection, the frequent references by contemporaries to appropriate types of writing and speaking confirm the awareness of distinct boundaries, however permeable, between separate

---

117 Burt, *Earthquakes, the Effects of God's Wrath*, 6.

118 John Winthrop, *A Lecture on Earthquakes: Read in the Chapel of Harvard-College in Cambridge, N.E. November 26th 1755. On Occasion of the Great Earthquake Which Shook New-England the Week Before* (Boston; New-England: Printed and sold by Edes & Gill, at their printing-office next to the prison in Queen-Street, 1755), 29.

119 William Stukeley, *The Philosophy of Earthquakes, Natural and Religious.: Or an Inquiry into Their Cause, and Their Purpose. By William Stukeley, M. D. Rector of St. George's, Queen-Square; Fellow of the College of Physicians, and of the Royal and Antiquarian Societies. The Third Edition. To Which Is Added, Part III. on the Same Subject.* (London: printed for A and C Corbett, at their Correct State Lottery-Office over-against St Dunstan's Church, Fleetstreet, 1756), 3.

discursive spheres. This was particularly apparent in the anonymous Jesuit account of the earthquake and tsunami at Cádiz, which focused on the relation of matters of fact and contained very little reference to religion, despite the author's clerical position. Although he noted that the Dominicans had brought out the image of the Virgin of the Rosary in their portico (turning its face to the bay to ward off danger from the sea), and expressed his personal hope that the whole episode would have a conversionary effect on residents of the town, he neglected to record any of the miracle stories then circulating or to mention the role of saintly intercessors.<sup>120</sup>

The state of separate coexistence between discursive registers did not preclude conflict and disagreement. Some of those conflicts derived from changes and disputes within religion itself. Broader developments in religion in the later seventeenth and early eighteenth centuries, including the rise of "rational religion", had generated a criticism of religious fanaticism, which in England became associated with "enthusiasm" and in Catholic countries with "superstition".<sup>121</sup> In addition, general changes in the perceived character of God downplayed His stern, wrathful character and encouraged an emphasis on God's mercy and benevolence.<sup>122</sup> These "gradual and subtle modifications of the shape and colour" of religion should be understood not as a change in belief itself but of the "style of religiosity": as a result, while they did not reduce the importance of the

---

120 AGI, Indiferente General, 1991, f. 6r. By contrast, a colourful description of the religiosity of the residents, including their loud invocations of Mary, can be seen in BNE MSS/17873 ff.104v-105r.

121 John Spurr, "Rational Religion' in Restoration England," *Journal of the History of Ideas* 49, no. 4 (1988): 563–85; Lorraine Daston and Katharine Park, *Wonders and the Order of Nature, 1150-1750* (New York: Zone Books ; Cambridge, Mass., 1998), 337–38; Alexandra Walsham, *Providence in Early Modern England* (Oxford ; New York: Oxford University Press, 1999), pp. 333-34; Alexandra Walsham, "Deciphering Divine Wrath and Displaying Godly Sorrow: Providentialism and Emotion in Early Modern England," in *Disaster, Death and the Emotions in the Shadow of the Apocalypse 1400-1700*, ed. Jennifer Spinks and Charles Zika, Palgrave Studies in the History of Emotions (London: Palgrave Macmillan, 2016), 34–35; Alexandra Walsham, "The Happiness of Suffering: Adversity, Providence, and Agency in Early Modern England," in *Suffering and Happiness in England 1550-1850: Narratives and Representations: A Collection to Honour Paul Slack*, ed. M. J. Braddick and Joanna Innes (Oxford: Oxford University Press, 2017), 61–62.

122 C. John Sommerville, *Popular Religion in Restoration England* (Gainesville: University Presses of Florida, 1977), 77–79; Blair Worden, "The Question of Secularization," in *A Nation Transformed: England after the Restoration*, ed. Alan Craig Houston and Steven C. A. Pincus (Cambridge, U.K. ; New York: Cambridge University Press, 2001), 35–36.

spiritual interpretation of disaster they did slowly change the parameters within which it operated.<sup>123</sup> Eighteenth-century people assessed the acceptability of religious disaster interpretations by applying categories whose nuances can be perplexing and elusive for modern scholars. In his *Journal of the Plague Year*, for instance, Defoe's fictional narrator critiques both the credulity of those who believe in portents and the enthusiasm of fire-and-brimstone preachers, but also expresses an ardent belief in divine punishment, and attacks the "Atheistical profane mirth" of "scoffing" people, who accuse him of enthusiasm in their turn.<sup>124</sup> It is clear, however, that by the mid-eighteenth century people could draw on a range of labels to differentiate acceptable and unacceptable aspects of religious commentary, on a highly subjective basis.

Clerical writers who attempted to unite theological and natural reasoning at times ran the risk of incurring opprobrium as enthusiasts. After the minor New England earthquake in 1755, Thomas Prince revised his 1727 tract, *Earthquakes the works of God*, both to update his collection of examples of historical and recent episodes and to incorporate a hypothesis of electrical causation that derived from Stukeley's *Philosophy of earthquakes*.<sup>125</sup> In the revised pamphlet Prince proposed to go beyond the typical confines of a sermon to examine earthquakes "as the very Works or Operations of God", by applying a hybrid approach — "a reverend Mind, and not a mere natural but divine Philosophy" — to unveil simultaneously their physical and supernatural causes.<sup>126</sup> Prince controversially alleged that the lightning rods invented by Benjamin Franklin may have caused the tremors at Boston, either

---

123 Walsham, "Deciphering Divine Wrath and Displaying Godly Sorrow: Providentialism and Emotion in Early Modern England," 35; Walsham, "The Happiness of Suffering: Adversity, Providence, and Agency in Early Modern England," 61.

124 Daniel Defoe, *A Journal of the Plague Year: Being Observations or Memorials of the Most Remarkable Occurrences, as Well Publick as Private, Which Happened in London during the Last Great Visitation in 1665*, ed. Louis A. Landa, Revised edition (London, New York: Oxford University Press, 2010), 19–21, 56–60.

125 Thomas Prince, *Earthquakes the Works of God, and Tokens of His Just Displeasure...* (Boston: printed and sold by D Fowle in Ann-Street, and by Z Fowle in Middle-Street, 1755).

126 Prince, 9.

by drawing electricity into the earth or by arousing God’s anger at this attempt to reduce the impact of storms. This intrusion of the theological register into natural philosophical discussion generated strong reactions, particularly from Winthrop, who supplied printed refutations of Prince’s views.<sup>127</sup> In his annotations on a copy of Winthrop’s Harvard lecture, a young John Adams fulminated against the “superstitious” element of Boston society, of which he took Prince to be an exemplar, that represented “Thunder, Earthquakes, Pestilence, Famine &c [...] merely as Punishments of Sin and Warnings to forsake”.<sup>128</sup> The difference in positions between Prince on the one hand and Winthrop and Adams on the other was not necessarily one of religious faith, however: like Prince, Winthrop was a devout believer who took pains to emphasise God’s active superintendence of the harmony of the Creation.<sup>129</sup> He had concluded his Harvard lecture with a brief expostulation on the beneficence of providence in ordering even the most destructive of natural phenomena.<sup>130</sup> Indeed, in 1756 he privately told the congregationalist minister Ezra Stiles that he saw a “grand moral purpose” in earthquakes.<sup>131</sup> Adams seems to have broadly followed Winthrop’s opinion. On the one hand, his notes display an annoyance that New Englanders “consider Thunder and Lightning as well as Earthquakes, only as Judgments, Punishments, Warnings &c”. However, while certainly expressing frustration at religious fanaticism, the notes do not necessarily indicate a hostility to providential interpretation *tout court*. Here the key is the word “only”: because Bostonians *only* reached for the

---

127 These appeared as an appendix to his printed lecture: Winthrop, *A Lecture on Earthquakes*, 32–38; John Winthrop, *A Letter to the Publishers of the Boston Gazette, &c.: Containing an Answer to the Rev. Mr. Prince’s Letter, Inserted in Said Gazette, on the 26th of January 1756* (Boston: Printed by Edes and Gill, 1756). On this debate see Eleanor M. Tilton, “Lightning-Rods and the Earthquake of 1755,” *The New England Quarterly* 13, no. 1 (1940): 85–97; Zoltán Haraszti, “Young John Adams on Franklin’s Iron Points,” *Isis* 41, no. 1 (1950): 11–14; Clark, “Science, Reason, and an Angry God”; Bauer Coleman, “‘Rain down Righteousness’: Interpretations of Natural Events in Mid-Eighteenth-Century Boston”; Robles, “Atlantic Disaster.”

128 BPL Adams 170.9 (1).

129 Louis Graham, “The Scientific Piety of John Winthrop of Harvard,” *The New England Quarterly* 46, no. 1 (1973): 112–18. For John Adams’ complex and evolving religious beliefs, see John Fea, “John Adams and Religion,” in *A Companion to John Adams and John Quincy Adams*, ed. David Waldstreicher (John Wiley & Sons, Ltd, 2013), 184–98.

130 Winthrop, *A Lecture on Earthquakes*, 31.

131 John Winthrop to Ezra Stiles, 17 April 1756, YU BL GEN MSS 1475, Series I, Box 17, Folder 1398.

simplest providential explanation — divine punishment — they missed the more complex one, that God had appointed “Uses [...] in Nature” for earthquakes, such as in renewing the fertility of the soil.<sup>132</sup> For his part, Prince was not motivated by the pious “Jealousy” of new technology that Adams thought lay beneath the public animosity to lightning rods. Ironically, as recently as 1752 Prince had championed smallpox inoculation, the very thing that Adams employed as an example of a useful invention opposed by religious enthusiasm.<sup>133</sup> The negative reactions to Prince’s earthquake theories embodied not so much a fundamental opposition of ideas as a concern to safeguard the separation between natural and religious registers.

While Adams complained about his contemporaries’ reluctance to see beyond direct providence in explaining earthquakes, many religious commentators on disaster in the 1750s diagnosed an imbalance in favour of natural explanations, both within the press and in wider society. John Wesley, one of the founders of Methodism, offered a clear example of this tendency in a printed sermon on the catastrophes of 1755. Like many other clerical writers, Wesley was not opposed to natural explanations of disaster. He approvingly quoted Halley’s prayer that God prevent a comet from colliding with the earth, and also cited Newton’s calculations on cometary heat.<sup>134</sup> Wesley also possessed some familiarity with the combustion and wind-based theories of earthquakes. In some cases, as with the sudden shearing off of rocks on a Yorkshire ridge, he admitted no other explanation than direct divine providence, having noted the absence of any clear evidence of the operation of wind, water or fire. However, his quarrel was not with naturalists in general but with those individuals who accepted *only* natural explanations, or who relegated God to the position of

---

132 Winthrop discusses this and other possible purposes of earthquakes, within the benevolent order of Creation, at pp. 29-31 of the *Lecture*.

133 MHS Misc. Bd. 1752 July 27. See also the discussion on inoculation in the previous chapter.

134 John Wesley, *Serious Thoughts Occasioned by the Earthquake at Lisbon. : To Which Is Subjoin’d an Account of All the Late Earthquakes There, and in Other Places*, The sixth edition (London: n.p., 1756), 13–14.

clockmaker alone — “a lazy, indolent, Epicurean Deity” — thus denying any function to special providence. According to Wesley’s reading, Scripture plainly and unambiguously declared that God was in charge of all nature, and that “natural” occurrences were simply His method of acting in the world. Consequently, Wesley declared that systems of thought that allowed only for physical processes and did not consider the workings of God were no more than “idle Cobwebs of the Brain”.<sup>135</sup> While expressed in an idiosyncratic way, Wesley’s contention that natural explanations alone were insufficient was widely echoed in sermons and tracts of the 1750s. The Archbishop of Mexico enjoined the members of his diocese not to give ear to “the rash presumption of those who, not recognising God in his Works [...] make believe that [earthquakes] cannot proceed from another cause, and want to attribute all of them to natural causes, raising an altar in their mad fantasy to their Idol of nature”.<sup>136</sup> Such rhetoric was designed to counterbalance the dangers of a separation of natural from spiritual discourse. Many clergy feared that members of their communities who paid too much attention to natural interpretations and neglected spiritual ones would lose sight of the crucial importance of disasters as providential warnings, and ignoring the hand of God in His most awful works might even lead them to a more general neglect of Christian tenets. The repeated emphasis on the need for an understanding of disaster on a providential plane was not generally directed at the rejection of physical causation *per se* but rather at combating the potential for the development of atheism in society.

Eighteenth-century clerical disaster investigators tended to emphasise not only the rightness of providential interpretations but also their social utility. Contemporary natural philosophical inquiries

---

135 Wesley, 17–18.

136 “la temeraria presuncion de aquellos que desconociendo à Dios en sus Obras, cierran los ojos, para no vér en ellas aquel caracter, que les imprime su omnipotente mano, y hace conocer, que no pueden proceder de otra causa, y que todo lo quieren atribuir à las naturales, levantando en su loca fantasia un altar á su Idolo de la naturaleza [...]”. Rubio Salinas, *Carta Pastoral que ... D. M. Rubio Salinas ... dirige al clero y pueblo de su diocesi, con motivo de las noticias, que ... se han recibido de España, del Temblor de Tierra, que en el dia 1 de Noviembre del año ... de 1755 se sintió ... en todo aquel Reyno*, B1v.

— including studies of earthquakes and the grand collaborative projects of medical meteorology — often aspired to be useful by supplying accurate forecasting, better methods of treatment or guides to producing more resilient buildings. However, the results typically fell far short of such ambitious aims. Recognising these deficiencies but sharing the sense of social mission, religious commentators claimed to provide a more practically useful approach. Whereas naturalists might be able to explain the causes of a storm or an earthquake, spiritual interpretation sought to furnish the meaning behind it. At the simplest level, this amounted to pastoral care: supplying meaning was, at least in theory, an effective act of consolation for traumatised and bereaved people. On the other hand, a purely physical account of “afflictive Incidents” as “the fortuitous Concourse and Agency of blind, material Causes” was of little practical use and might even exacerbate the distress of victims.<sup>137</sup> Many of the critics of Voltaire’s *Poème sur le désastre de Lisbonne* (published in 1756) were revolted by his depiction of disasters as part of a continually revolving wheel of misfortunes, leaving humans as nothing more than “tormented atoms on this pile of mud / That death swallows up & fate plays with”.<sup>138</sup> In a similar fashion to Rousseau, Wesley remarked that if this stark vision were allowed to predominate, “what Hope, what Help, what Resource is left, for the poor Sufferers [...] but to lie down and die?”<sup>139</sup> The concern about the disappearance of consolation was clearly articulated in verses that the French poet and playwright Jean-Jacques Le Franc, Marquis de Pompignan, addressed to the writer

---

137 Wesley, *Serious Thoughts Occasioned by the Earthquake at Lisbon.*, 12.

138 “Atômes tourmentés sur ces amas de bouë, / Que la mort engloutit, & dont le sort se jouë”. Voltaire, *Poèmes sur la religion naturelle et sur la destruction de Lisbonne*, par M. de V\*\*\* (s.i.: s.n., 1756), l.s 173-4.

139 Wesley, *Serious Thoughts Occasioned by the Earthquake at Lisbon.*, 12; Jean-Jacques Rousseau, *Oeuvres de M. Rousseau de Genève*, Nouvelle édition (Amsterdam: Chez Marc-Michel Rey, 1769), vol. 1, p. 425. The first version of Voltaire’s poem famously ended “mortals it is necessary to suffer / To submit in silence, to love, & to die”. (“[...] mortels il faut souffrir, / Se soumettre en silence, adorer, & mourir”). For the direct response of Albrecht von Haller, Charles Bonnet and others to Voltaire along similar lines as Wesley, see Stuber, “Divine Punishment or Object of Research?,” 183, 185.



Louis Racine as an attempt to comfort him after the death of his son in the tsunami at Cádiz.<sup>140</sup> Like Wesley, Le Franc believed that the providential interpretation of disasters served a crucial consolatory function, since purely physical explanations deprived sufferers of any spiritual comfort. Putting to Racine the rhetorical question, “Who will support you in your losses? / What resources are offered?”, Le Franc emphasised the uselessness of mechanical philosophy, “an impious and frivolous system” that provided no consolation and reduced the afterlife to “the expectation of nothingness”.<sup>141</sup> The naturalist “pupils of Democritus”, in replacing a single divine engine (“le vrai moteur”) suggested specific physical causes such as subterranean combustion, which accounted for only a single phenomenon at a time. These explanations, in his view, were bizarrely abstracted from the genuine experience of suffering, since in real-life situations the immediate physical trigger of the phenomenon was insignificant compared to the misery that it inflicted.

Despite the discursive and methodological differences between natural and religious interpretations, the theological analysis of disasters was deeply influenced by the dominant currents of contemporary disaster investigation, and in particular the practice of tracing connections between events and between phenomena. Whereas eighteenth-century natural philosophers prioritised the exploration of geographical and climatic systems, religious investigators attempted to locate providential meaning in sequences of calamitous occurrences. Wesley drew together a whole series

---

140 Jean-Jacques Le Franc de Pompignan, “Ode à M. Racine, sur la mort de son fils,” in *Lumières voilées: œuvres choisies d'un magistrat chrétien du XVIIIe siècle: Le Franc de Pompignan (1709-1784)*, ed. Theodore E. D. Braun and Guillaume Robichez (Saint-Etienne: Publications de l'Université de Saint-Etienne, 2007). Theodore E.D. Braun has suggested that the poem was most likely written in December 1755 or January 1756, and was intended in part as a rebuttal of Voltaire's poem: Theodore E. D. Braun, “Voltaire and Le Franc de Pompignan: Poetic Reactions to the Lisbon Earthquake,” in *The Lisbon Earthquake of 1755: Representations and Reactions*, ed. Theodore E. D. Braun and John B. Radner, SVEC, 2005:02 (Oxford: Voltaire Foundation, 2005), 150.

141 “Qui vous soutiendra dans vos pertes? / Quelles ressources sont offertes [...] / Point d'avenir qui vous console, / Un système impie et frivole, / Et l'espérance du néant.”

of destructive phenomena that he termed “Marks of God’s Displeasure”.<sup>142</sup> Just as other churchmen had done in the 1690s, he pointed to the prophecy of “earthquakes in divers places” from Matthew 24:7, referring to recent seismic events “in Portugal, in Spain, in Africa, in America, in Italy, in Holland, in England, in Ireland, and not improbably in many other Places too, which we are not yet informed of”.<sup>143</sup> His reading of the Greek in the Septuagint passage suggested that it connoted not just major earthquakes but also “various *Concussions* or *Shakings*”; in other words, seismic phenomena of all magnitudes, whether destructive or not.<sup>144</sup> As with the verse in Matthew, which promised epidemics and famines alongside terrestrial convulsions, Wesley’s list included phenomena with very different physical symptoms. These events did not begin with the destruction of Lisbon but ran as far back as the Port Royal earthquake of 1692. On the other end, they included such recent occurrences as the catastrophic Lima earthquake of 1746, the frightening but mostly harmless tremors in England in 1750, storms in London and cattle disease elsewhere in the kingdom. Wesley even extended his list into the future, speculating that the series of calamities might culminate in Halley’s comet striking the earth in 1758, thereby wiping out all human life on the planet. Alongside these terrifying events, Wesley took special note of two apparently minor recent episodes: the spontaneous splitting of rocks on a ridge in Yorkshire and the agitation of waters in England generally. These smaller incidents took their meaning from the larger ones: in other words, by setting them in a list of noteworthy happenings, alongside the train of major calamities, they could be understood as part of a global and national pattern of divine messages or

---

142 Wesley, *Serious Thoughts Occasioned by the Earthquake at Lisbon.*, 5.

143 Wesley, 10.

144 Wesley, 10.

warnings. It was above all the sequence of events that demonstrated “that it is not Chance, which governs the World”, and that there was something more to them than a series of natural accidents.<sup>145</sup>

Wesley similarly thought that the naturalistic interpretation of disasters appeared to authorise the dissociation of troubling events by disintegrating the once unified category of calamity into distinct fields of analysis and into separate episodes. Under these schemes, the cattle disease had nothing whatsoever in common with the Yorkshire ridge collapse, while a cometary impact was completely unrelated to a storm or earthquake. Wesley’s railing against impiety was thus partly a lament for the declining authority of an old information order, which had once been able to turn confusing and alarming incidents into an intelligible scheme of judgements, and which offered appropriate (Christian) prudential responses. It was all very well for natural philosophers to issue the common disclaimer that their physical explanations of destructive phenomena did not discount the role of divine providence in their causation. Without a clear epistemic link between the different kinds of phenomena, the insistence of preachers that a single motive force presided over “the whole Sphere of created Being” lost much of its force and could be relegated to an alternative and perhaps secondary register of thought, even among otherwise devout believers.<sup>146</sup> Similarly for Le Franc, all great troubles were united by an afflictive quality, and constituted a much deeper truth than anything naturalists could hope to uncover. Given their identical manifestation on a personal level and their single divine origin, he preferred to think of calamities as a uniform category, which he variously termed “adversities” (*adversités*), “misfortunes” (*malheurs*) and “terrible phenomena” (*phénomènes terribles*). Compartmentalised naturalistic investigations — “researches full of imposture / Which find all within nature / Outside the power of its Author” — were therefore of little value to

---

145 Wesley, 11.

146 Wesley, 17.

humanity.<sup>147</sup> Such sentiments seemed to indicate the desirability of a return to the old miscellaneous category of calamity, rolling back the epistemic developments of the last century. The result was an unresolved tension in religious commentary: on the one hand, providential interpretation sought to identify patterns in phenomena that paralleled the climatic and geographic systems of natural investigation, while on the other the imperative to provide overarching meaning perpetuated old, ambiguous classifications.

As a consequence of this dilemma, two possible directions emerged for religious disaster investigations: the close study of events as systems and the provision of solace for adversities in general. Viewing the past from a modern perspective we might be tempted to emphasise the latter trajectory: the development of a mainstream religion that seems far quieter, gentler and more forgiving than the stern recriminations of a figure like Wesley. However, in the middle decades of the eighteenth century both paths were equally possible. Two Guatemalan examples illustrate the possibility that existed in the second half of the eighteenth century for a systematic investigation informed by religious principles and directed at social utility. Cristóbal Hincapié Meléndez, a leading doctor and surgeon in the colony with eclectic interests in chemistry, alchemy and astrology, kept a careful record of the major calamities that befell the city of Santiago de Guatemala. Scrawled in a notebook concerned with chemical and pharmaceutical matters, his diary of notable events from 1747 to the 1770s included — alongside notorious murders and other current topics of conversation — floods, a volcanic eruption, earthquakes, a fire and a plague of locusts. Hincapié had earlier published an essay about the catastrophic earthquake of 1717, which had devastated the colony when he was a teenager and had raised a polemical debate about whether the city should be

---

147 “Recherches pleines d'imposture,  
Qui trouvent tout dans la nature  
Hors le pouvoir de son Auteur.”

moved.<sup>148</sup> Within his personal notebook, he concentrated particularly on describing a smaller (though still substantial) seismic disruption on 4 March 1751. Although in size this was but “a third part” of the earlier event, “and not so unpleasant or noteworthy”, nevertheless it is clear that (in common with other Guatemalans) he ascribed an importance to it beyond its material impact, precisely because he located it within an historical pattern of disasters.<sup>149</sup>

In the style of other naturalist observers, Hincapié noted the precise timing of the earthquake — in fact there had been two convulsions, one in the morning and the other in the afternoon — as well as the trajectory along which the shocks moved. However, he also believed that the event had been anticipated by divine warnings in the form of portents, which had unfortunately passed beneath the notice of contemporaries. The evening prior, a serving girl had allegedly encountered a spectral procession, and, frightened, ran into the cathedral. A Recollect monk within to whom she had breathlessly confided her tale rushed into the street but could not see the procession, although he could nevertheless discern ghostly voices singing the Litany of the Saints. This was a chant that implored God and the heavenly host to save the faithful from, amongst other things, earthquakes, storms, plagues, wars and famines, and functioned as a standard form of devotion in periods of crisis. For Hincapié there was only one possible interpretation of this strange apparition: the leader of the Litany was surely one of Guatemala’s patron saints, and the chorus must have consisted of the ghosts of children who had died during recent epidemics. Those holy infants had now returned to plead intercession with God on behalf of their city. As if this was not warning enough for the town, the massive cross at the entrance to the cathedral twisted so that its base pointed to the Plaza

---

148 Cristóbal de Hincapié Meléndez, *Breve relación del fuego, temblores y ruina de la muy noble y muy leal ciudad de los Caballeros de Santiago de Guatemala, año 1717*, reproduced in Tomás de Arana, Cristóbal de Hincapié Meléndez, and Agustín Gómez Carrillo, *Terremotos: ruina de San Miguel, 29 de setiembre de 1717, Santa Marta, 29 de julio de 1773* ([Guatemala]: Editorial José de Pineda Ibarra, 1980).

149 “cuio tamaño fue como la tercia parte del de 17 de septiembre de 1717 y no tan sacudido, y saltante”. WL WMS/Amer.79, 214.

Mayor to the west. Hincapié regarded this as a specific forecast of the earthquakes, which had moved from east to west.<sup>150</sup> The divine messages did not cease with the earthquakes the following day, however. Two weeks later, during the morning of 18 March, in the midst of a cloudless sky an image miraculously appeared in the shape of a gigantic cross, with a palm at its base. Still the obdurate populace “ignored its meaning”, so that the marvels continued.<sup>151</sup> That same morning a girl of two years old died, having been injured as she rescued her grandmother from their collapsing house in the day of earthquakes: expiring, the pious child’s final words were that she had “fulfilled her obligation”.<sup>152</sup> Determined to record every sign that might serve to warn of an imminent catastrophe or indicate its meaning, Hincapié also resorted to astrology. One of his celestial observations made after heavy flooding in 1749 had yielded an evil forecast, to which he appended the prayer “God and his saints help us amen”.<sup>153</sup> The day after the earthquakes in 1751 he made a careful observation of the quadrature of the moon with Saturn and Mars. The position of the moon in this case was identical to that of the eclipse of 1750, a point whose significance he did not make clear, but which may have related to the common astrological view that eclipses were harbingers of dreadful earthquakes and other calamities. In any case, he took this astral configuration to be an ill prognostication, particularly for the year 1755.<sup>154</sup> To read Hincapié’s diary is to trace a chain of misfortunes, interspersed with dire forebodings of a religious and astral nature, which together convey a sense of creeping doom.

For many Guatemalans, including the priest and historian Domingo Juarros, that perception of impending calamity must have seemed validated when the city was finally destroyed in a colossal

---

150 WL WMS/Amer.79, 218-20.

151 “Ygnoramos su significado”, WL WMS/Amer.79, 221.

152 “diciendo avia cumplido con su obligacion”. WL WMS/Amer.79, 222.

153 “Dios y sus santos nos auiden amen”. WL WMS/Amer.79, 236.

154 WL WMS/Amer.79, 222.

earthquake in 1773, never to be rebuilt.<sup>155</sup> Just as the catastrophe of 1717 had influenced the young Hincapié, the events of 1773 appear to have left an indelible mark on the twenty-one-year-old Juarros, who graduated the same year with his Bachelor of Theology.<sup>156</sup> His *magnum opus*, a history of Guatemala printed just over three decades later, included a chapter that surveyed all the major disasters of the colony from its foundation to 1780 (entitled “On the most notable calamities that have afflicted the City of Guatemala”).<sup>157</sup> This catalogue of calamities included earthquakes, volcanic eruptions, storms, epidemics, a fire, a flood, a landslide, the sack of the city by Indians, lightning strikes and the rampage of a frenzied mountain lion. He interleaved the descriptions of these events with notes on some of the prodigies and miracles that had been observed, along with frightening comet sightings. Juarros conceived this as a “history of misfortunes and calamities”, and justified it by pointing out that “[s]ince our first ancestors were expelled from Paradise, adversities, misfortunes and calamities have played a very essential role in History”.<sup>158</sup> This was a narrative chronicle rather than a natural philosophical analysis, and Juarros for the most part did not speculate on the physical causes of the various disasters, except where one could be said to have triggered another (such as when landslides followed torrential rains). It was also a politically sanitised version of Guatemalan history, which mostly passed in silence over the bitter conflicts that erupted between the President of the Audiencia of Guatemala and the Archbishop after the earthquakes of 1717 and 1773.<sup>159</sup>

---

155 Instead, after much acrimonious debate, the population moved to a new location in the Valle de la Ermita: AGI, Guatemala, 658.

156 “Juarros, Domingo”, Flavio Rojas Lima, *Diccionario histórico biográfico de Guatemala* (Ciudad de Guatemala: Asociación de Amigos del País, Fundación para la Cultura y el Desarrollo, 2004).

157 “De las calamidades, mas notables, que han afligido à la Ciudad de Guatemala” Domingo Juarros, *Compendio de la historia de la ciudad de Guatemala*, vol. 1 (Guatemala: Por D. Ignacio Beteta, 1808), chap. 11, pp. 223–36.

158 “la historia de los infortunios, y calamidades”; “Desde que nuestros primeros Padres fueron arrojados del Paraiso, hacen las desgracias, infortunios, y calamidades un papel muy esencial en la Historia”. Juarros, 1:229, 223.

159 Juarros did mention a terrible “schism” between the citizens in 1773 over the question of whether to abandon the earthquake-damaged city and build elsewhere, but did not name the participants. His account of the aftermath of the 1717 disaster omitted the political conflict altogether.

On the other hand, the account is characterised by a strong religious tone, as befitted Juarros' position as Secular Presbyter for the archbishopric. On several occasions Juarros described a calamity as a divine punishment, but he stopped short of specifying the sins that had elicited that chastisement, and was more concerned to detail the spiritual response of the citizens to the various events. He focused in particular on rogative ceremonies beseeching God for mercy and on the processions in which images of saints and the Virgin were carried through the streets. In Juarros' narrative the train of disasters followed a religious rhythm, a style of perception that may have reflected his own views but to a large extent must have characterised his historical sources as well. He noted with care the particular saints' days on which those sources recorded the calamities to have occurred or begun, which often provided the names by which the community referred to disasters. Thus the earthquake of 1757 was known as "San Francisco", that of 1765 as "the Holy Trinity" earthquake, and a third as "San Rafael".<sup>160</sup> The saints' days on which a disaster ended could also be highly important: in several places Juarros recorded that the citizens had chosen the relevant saint as a new patron, in the assumption that his or her intercession had functioned to lift the divine punishment on that occasion. For instance, Saint Dionisius became a patron of Guatemala when the earthquakes of 1607 ended on his feast day.<sup>161</sup> Similarly, Juarros found it significant to note when the procession of a particular image or prayers to a certain saint brought a calamitous period to an end. After a volcanic eruption in 1705 covered the sky with ash and blotted out the sun, so that Guatemalans had to light candles at midday as if they were the Egyptians in the Book of Exodus, they carried in procession the images of Christ crucified and Nuestra Señora de Socorro (Our Lady of Succour). As the images were led back to the cathedral, facing the volcano, the sky

---

160 Juarros, *Compendio de la historia de la ciudad de Guatemala*, 1:232–33.

161 Juarros, 1:227.



immediately cleared — an affair that drew from Juarros the exclamation “¡cosa maravillosa!” (“marvellous thing!”).<sup>162</sup>

Taken as a whole, these details amounted to the systematic observation of the efficacy of specific religious actions within certain disaster scenarios. They could even reveal which holy image should be carried in procession in a given calamity, since it could be shown to have successfully alleviated the problem in the past. Thus Juarros recorded that the epidemics of 1601 and 1686 ended when the images of the madonnas of Loreto and of Almolonga, respectively, were borne in procession. In the latter case two notaries witnessed the effigy sweating or weeping, “and from this day onwards the plague ceased, nobody becoming ill, and those who were sick recovering”.<sup>163</sup> On some occasions processions and prayers seemed to have no effect at all, as in 1717, whether because God had resolutely determined to chastise the city or because Guatemalans had appealed to the wrong saints. During the smallpox epidemic of 1733, the colonists accordingly attempted to preempt the latter possibility by taking almost all the holy images in procession at the same time (although on this occasion Juarros does not reveal whether the measure was effective).<sup>164</sup> Even though he was relatively uninterested in the physical causes of the calamities, Juarros’ descriptions resemble the methodical harvesting of historical sources undertaken by eighteenth-century natural philosophers to understand disasters. They seem to evoke the slow progress of a practical spiritual knowledge gained through long experimentation. As Hincapié’s diary makes clear, Juarros did not invent that type of knowledge: he was recording and elaborating upon an eighteenth-century culture which built upon the miracle stories that circulated around and between Spanish colonial

---

162 Juarros, 1:229.

163 “y desde este dia cesó la peste, no enfermando ninguno de nuevo, y sanando los que estaban enfermos”. Juarros, 1:229.

164 Juarros, 1:231.

communities. A careful chronicle of past calamities in this manner could be much more than a list of remote events: it constituted a practical guide for future generations. The final entry in the chapter, concerning the smallpox outbreak of 1780, departs somewhat from the model of spiritual response. In this case, Juarros demonstrated instead the efficacy of inoculation, then employed in Guatemala for the first time. Much as the procession of Nuestra Señora de Almolonga had preserved the colonists from an epidemic a century earlier, the application of this new technology happily saved all or almost all of those inoculated from a painful death.<sup>165</sup> The narrative does not represent this change as a shift away from traditional remedies: instead, it seems to match the overall emphasis on practical utility. Just as Hincapié's pursuit of useful measures enlisted the aid of astrology and religious portents alongside his profession of medicine, Juarros' treatment of the inoculations speaks of a colonial Hispanic disaster culture with a strong syncretic aspect. Rather than displacing or marginalising earlier forms of belief and action, new ideas and technologies were added to a diverse repertoire of potentially useful knowledge.

As a whole, what occurred in the eighteenth-century Atlantic world was not a revolution in ideas or sentiments concerning disasters, but rather a series of innovations on a chain of longer epistemic developments. The most important change, the gradual systematisation of disaster knowledge, was the product of a process that had begun a century earlier. Eighteenth-century investigators were aware that something had changed in popular attitudes over that time, even if they could not identify with precision what that change might have been. Even Juarros, ever-ready to believe in the mysterious efficacy of holy images in alleviating calamities, recognised that some of the things his forebears believed were no longer considered credible during his lifetime. He felt it necessary to explain to his readers that the dramatic appearance of a fiery meteor above Guatemala in 1620 was a

---

165 Juarros, 1:236.

frightening portent of woe for people “in those times full of fear and terror”, while “today, when the Physical Sciences are better cultivated in this Metropolis, it would not have occasioned great astonishment”.<sup>166</sup> The movement towards systematisation had involved four key steps: the cultivation of techniques for obtaining information about calamities, the development of written disaster compilations, the conceptual organisation of disastrous phenomena into typologies and their integration into regional and global environmental systems.

Those developments had unintended consequences for older forms of disaster interpretation, making it much more difficult to adduce a single providential cause for a range of phenomena that had been divided among different fields of investigation. Faced with this evolution in the information order, eighteenth-century investigators of calamities responded in several different ways. Some actively participated in the creation of a systematic disaster knowledge based on natural inquiry. Other commentators decried the changes that had occurred in the realm of disaster interpretation and tried to oppose them. Le Franc and Wesley both sought to subordinate the pursuit of dispassionate natural knowledge to the emotive task of spiritual consolation. For them, the contemplation of calamity was a moral pursuit centred upon the personal experience of suffering, fear and retribution and the spiritual meaning of tribulation much more than it was about a natural inquiry into physical facts. A third group of writers attempted to accommodate both advances in the natural investigation of disaster and the evolving conceptual order of calamitous phenomena within a syncretic framework. Both Hincapié and Juarros strove to unite exact observation of physical facts with fervent belief in the power of religious ceremonies and images to combat adversities. Both also set practical utility, rather than pure knowledge, as the goal of disaster

---

<sup>166</sup> “que el día de hoy, en que se halla la Física mas bien cultivada en esta Metropoli, no hubiera ocasionado mayor asombro; pero que en aquellos tiempos llenó de pavor, y espanto á sus moradores”. Juarros, 1:227.

investigation. For the former, a combination of sacral and astral clues held the key to forecasting, while the latter aimed to identify the most effective methods to counter specific kinds of misfortune — whether the carrying of a certain saint's image in procession or the use of medical technology.

## Conclusion

The period between 1605 and 1755 was transformative for the understanding of disasters in the Spanish, British and French Atlantic worlds. This was a long evolutionary process with several key milestones that took on momentum as contemporary actors intensified their investigations into disastrous occurrences. Rather than reflecting a shift in fundamental beliefs about the role of God in the causation of calamities, the key alterations occurred within the epistemology of disaster and the various knowledge practices associated with it. The chief agents of this change were scholars of diverse backgrounds who undertook to produce detailed inquiries into hazardous phenomena. These disaster researchers progressively honed methods for acquiring, vetting and organising information, in an attempt to build robust and useful bodies of knowledge. The cumulative effect of their practices was to change the shape and place of the knowledge of calamity. Over roughly a century of research, profound changes took place in how scholars imagined the causes, nature, effects and interrelationships of earthquakes, storms, epidemics and other hazardous phenomena. In brief, disaster knowledge became more specific, more systematic, better informed, more oriented towards global questions, and more attuned to environmental processes.

Before the middle of the seventeenth century, disasters could be located within the corpus of human knowledge in two main ways: as key constituents of a miscellaneous category of unfortunate or harmful occurrences, or as part of a metaphorical cabinet of curiosities. These arrangements made disasters highly flexible but extremely ambiguous phenomena. Their ambiguity made them capable of fulfilling ancient cultural roles as portents, warnings and moral lessons but it also hampered exact inquiries into their causes and natures. By the last quarter of the century, however, as a result of the intense collecting and classifying activity of investigators, disasters had come to

occupy intricate systems rather than heteroclitic clusters. The development of sophisticated nomenclatures and typologies enabled them to be identified and classified in much more specific ways. At the same time, an emphasis on sourcing reliable information motivated new or improved methods of collection that involved collaboration, quantification and historical comparison. Furnished with a pool of accurate data, investigators were able to assess the veracity of long-held beliefs — such as the association between plague outbreaks and new reigns — which could have important political ramifications. Less scholarly writers reinforced these trends by imitating or plagiarising major projects, but in the process they demonstrated how older religious ideas about calamity could be accommodated to the new techniques. While calamities thus retained some of their traditional spiritual associations they nevertheless shed their old informational order, shifting from the mysterious ambiguity of the world of Biblical plagues and wonders to specific, knowable categories of phenomena.

The interplay between the various intellectual traditions concerned with interpreting calamities — especially natural philosophy, theology, astrology and medicine — enabled the creation of new syntheses as well as new forms of critique. Debates about the significance of eclipses and comets between the 1650s and 1680s called into question the accuracy, veracity and usefulness of astrology as a means of interpreting and predicting disasters. This criticism had several important consequences. Firstly, it highlighted the problems involved in clustering hazardous phenomena together, thus confirming a trend in disaster investigation towards disaggregation and specificity. Secondly, it motivated the collection of historical and contemporary data on catastrophic events to prove or disprove the relationship between celestial affairs and terrestrial disturbances. The discrediting of some aspects of astrology and the acceptance of others (“natural” astrology and, to a lesser degree, medical astrology) inspired new attempts to establish a rational *astrologia sana* that

would create a science informed by recent developments in mechanical philosophy. By the end of the seventeenth century, the reciprocal processes of external critique and internal reinvention had created fusions of astrology with meteorology and with theology, in configurations that differed geographically. In Spanish America in particular, astro-meteorology played a central part in highly syncretic approaches to the study of earthquakes, storms and diseases that united historical data collection with observational practices.

Another major change in the epistemic character of disaster was its reimagining on a global scale. For the inhabitants of the sixteenth and early seventeenth centuries, disasters tended to possess a markedly local character. While most people accepted that universal destruction had occurred in the deep past, particularly in the form of the Biblical Deluge, and perhaps also the earthquake that accompanied the death of Christ, they generally associated the storms, diseases and earthquakes that afflicted them with the affairs of their own communities rather than a wider world. Preachers taught that disasters occurred as divine judgements on those communities for tolerating sinners, or as warnings and lessons. On the authority of Aristotle, Seneca and Pliny, a scholarly consensus maintained that earthquakes could not exceed a relatively circumscribed area. However, between 1680 and 1703 a series of disasters in the Americas, the Caribbean and western Europe generated debates on earthquake transmission that brought to prominence new ideas about the ability of hazardous phenomena not only to affect large areas but to cross oceans. Whether through subterranean chains of chemical reactions, floating gas clouds or the circulation of corrupted exhalations in the air, hazards burst their traditional confines and menaced distant regions, necessitating a set of parallel changes in theological commentary. After the Great Storm of 1703, Daniel Defoe further extended these ideas to the movement of what we would now call weather

systems. Ultimately, the reconsideration of the limits and transmission of earthquakes, storms and disease made a crucial contribution to the revisioning of the planet's geology and atmosphere.

The global reimaging of disaster depended on the trans-Atlantic circulation of information. In the first half of the eighteenth century, new collaborative meteorological projects that drew participants from Canada to Peru aspired to identify predictable patterns in storm occurrence. Although the goal of accurate storm forecasting remained out of reach, the habits of instrumental data collection and collaboration that these projects fostered came to play a central role in disaster research. This is clearly visible in the attempts of medical researchers to link weather observations to disease outbreaks, with the twin goals of improving medical treatment and predicting epidemics. The emphasis on interconnected climatic patterns that emerged from this research also underpinned the work of expeditionaries in South America. At the same time, the interactions of these expeditionaries with creole scholars helped to inspire new disaster ideas. The product of these exchanges was a new vision of American hazards that located them as integral parts of interconnected environmental systems.

The trend of disaster research towards ever greater collaboration found its most impressive expression in the Spanish government's massive bureaucratic survey of the effects of the earthquake of November 1, 1755 that also devastated Portugal and parts of North Africa. By adding a case study of Cádiz to the traditional focus on Lisbon, we can see how Spanish, French and English inquiries were able to draw upon knowledge about the earthquake-tsunamis in Lima and Callao in 1746 and Concepción de Chile in 1751. At the same time, the emphasis on South American geographies also introduced difficulties in explaining the events of 1755. To solve this problem required another massive work of scholarly investigation — the compilation of Philippe Buache at the Académie Royale des Sciences — which drew attention to global marine topography. While the



1755 disasters proved a great stimulus for debates about the physical causes of earthquakes, they did not by any means spell the end for providential disaster interpretation. On the contrary, they invigorated religious commentary on both sides of the Atlantic. However, by this stage both ecclesiastical and lay writers recognised that religious and natural explanations occupied distinct discursive registers, which contemporaries could move between. While some clerical commentators expressed concern that this separation might encourage atheism, they also articulated justifications for religious disaster interpretation that shifted the emphasis away from the war on sin to the consolation of victims. Religious writers increasingly balanced the rhetoric of divine judgement with a more general morality that aimed the weight of condemnation on illegal behaviour (such as looting) rather than collective wickedness, and encouraged charitable giving. The dominant trend toward a quieter, less stern style of religion was not, however, the only possible path for spiritual interpretation. Two Guatemalan texts indicate an alternative trajectory: towards the meticulous recording of portents and miracles alongside meteorology within an environmental knowledge that was both systematic and sacred.

Although this study has focused on the calamities of the early modern era, disasters clearly continue to pose some of the same practical, social and cultural problems, while adding fresh complications. As I worked on this project threats from natural hazards seldom seemed far away. The Christchurch earthquake of 2011 and the Japanese earthquake, tsunami and nuclear meltdown of the same year were often on my mind throughout the research and writing. Different hazards occupied my mind in 2016 when my research in Paris coincided with major floods of the Seine, and in 2017 when my visit to Lima followed a severe inundation there that claimed over 70 lives. It became impossible to avoid thinking about historical comparisons to modern events in late 2016, when I delivered a paper on seventeenth-century earthquakes at the North American Conference on

British Studies on the very morning that news broke of a destructive earthquake at Kaikoura in New Zealand. Similar thoughts recurred during the writing process, for instance in December 2019 when the volcano of White Island erupted not far from my home in New Zealand's Bay of Plenty, killing 22 people. The following year I worked on the full draft of the dissertation during Coronavirus lockdowns in Cambridge, Massachusetts. Back in New Zealand, I made some of the last revisions on a hillside when my town was evacuated with a tsunami warning, following an offshore earthquake that measured 8.1 on the Richter scale. Each of these incidents made me think deeply about the connections and contrasts between the early modern actors of my research and the modern world.

As our own societies confront the mounting threat of disaster — not only in the Coronavirus pandemic but as a result of anthropogenic climate change and environmental degradation — it becomes increasingly important that we recover the means by which past people came to terms with catastrophe. In the first place, examining the changing epistemic topography of disaster in the early modern period sheds light on the structure of our own societies' disaster responses. On the other hand, it may also hint at alternative possibilities to the current reigning epistemic structure.

Unimpeded by the established boundaries of modern academic disciplines, which determine the priorities and shape of disaster research today, early modern investigators tended to approach their work with a willingness to consider many kinds of sources and techniques. It is worth emphasising here that although history currently possesses only a marginal place among the modern disciplines that claim authority in explaining and interpreting disasters, the emergence of a scientific study of hazards as environmental phenomena depended to a great extent upon historical research. Without suggesting a return to early modern theories, there is a strong case to be made for a renewed emphasis on the utility of history to disaster research and indeed for policy-making. The shape of disaster knowledge is never set in stone: as we reflect on current and recent catastrophes it is high

time for us to think carefully about the kinds of knowledge that will help us to prepare for the environmental challenges to come.

## Bibliography:

### Primary sources:

*Acts and Laws of His Majesty's English Colony of Connecticut in New-England in America.* New London: Printed and sold by Timothy Green, printer to the governour and Company of the abovesaid colony, 1750.

*By the Queen, a Proclamation, for a General Fast.* London: printed by Charles Bill, and the executrix of Thomas Newcomb, deceas'd; printers to the Queens most excellent Majesty, 1703.

*Diccionario de Autoridades.* Real Academia Española, 1726-1739.

*Index librorum prohibitorum et expurgatorum [...] de Consilio supremi Senatus generalis Inquisitionis Hispaniarum.*  
Genevae: Sumptibus Jacobi Crispini, 1619.

*Novus index librorum prohibitorum et expurgatorum....* N.p.: ex typographaeo Francisci de Lyra, 1632.

*Proposals by the Corporation of the London-Assurance, Established by His Majesty's Royal Charter, for Assuring Houses and Other Buildings, Goods, Wares, and Merchandizes, from Loss or Damage by Fire,* 1734.

*Seconde Centurie des questions traitées ez conférences du Bureau d'adresse.* Paris: Au Bureau d'Adresse, 1636.

*Several Laws and Orders Made at the General Court, Held at Boston in New-England, October 14. 1668.* Cambridge, MA: Printed by Samuel Green, 1668.

Acosta, José de. *Historia natural y moral de las Indias*. 2 vols. Madrid: R Inglés, impresor, 1894.

Affleck, Captain, and Charles Gray. "An Account of the Agitation of the Sea at Antigua, Nov. 1, 1755. By Capt. Affleck of the Advice Man of War. Communicated by Charles Gray, Esq; F. R. S. in a Letter to William Watson, F. R. S." *Philosophical Transactions of the Royal Society of London* 49 (1755): 668–70.

Agricola, Georg. *De ortu & causis subterraneorum lib. v*. Basileae: Hieronymum Frobenium, 1546.

Aldrete Y Soto, Luis de. *Defensa de la astrologia, y conjeturas por el Apocalypsi de los años en que se extinguió la secta mahometana, y año en que nacera el Ante-Christo ...: y explicación de las profecias que acerca desto predicó San Vicente Ferrer*. Madrid: por Lucas Antonio de Bedmar, 1681.

———. *Discurso del cometa del año de 1680*. n.d.: vendese en la imprenta de Lucas Antonio de Bedmar, 1681.

———. *Discurso del cometa deste año de 1682 ...: en que se explica la significación y aparato que trae en execucion del antecedente del año pasado de 1680*. Madrid: vendese en la imprenta del Reyno de Lucas Antonio de Bedmar, 1682.

Almas Santas, Miguel das. *Relacion: escrita por el Padre Guardian del Real Convento de Mequinèz, y Vice-Prefecto Apostólico de las Santas Misiones, que en las partes de Berberia conserva la Religiosa Provincia de San Diego de RR. PP. Franciscos Descalços, al Padre Procurador de ellas, con motivo del Terremoto acaecido en Ceuta, Tetuàn, Larache, Mámora,*

*Tánger, y Marruecos, en los días 1. y 18. de Noviembre de este año de 1755.* Valencia: en la Imprenta de Agustín Laborda, 1755.

Anderton, William. *Remarks upon the Present Confederacy, and Late Revolution in England, &c.* London: s.p., 1693.

Anghiera, Pietro Martire d'. *The Decades of the Newe Worlde or West India...* Translated by Richard Eden. Londini: Indibus Guilhelmi Powell for Edwarde Sutton, 1555.

d'Anghera, Pietro Martire. *De Orbe Novo: The Eight Decades of Peter Martyr d'Anghera.* Translated by Francis Augustus MacNutt. New York: GP Putnam's Sons, 1912.

Anon. *Anales del Cuzco, 1600 á 1750.* Edited by Ricardo Palma. Lima: Imprenta de "El Estado," 1901.

Anon. *Black Munday Turn'd White: Or, the Astrologers Knavery Epitomized. Being an Answer to the Great Prognosticks, and Gross Predictions of Mr. Lillie, Mr. Culpeper, and the Rest of the Society of Astrologers, Concerning the Eclipse of the Sun, on Munday Last, Which (According to Their Calculation) Should Have Produced an Egyptian Darkness, and the Greatest That Hath Been Seen in This Latter Age...* London: Printed for G. Whiting, 1652.

Anon. *A Dissertation upon Earthquakes, Their Causes and Consequences; Comprehending an Explanation of the Nature and Composition of Subterraneous Vapours, Their Amazing Force, and the Manner in Which They Operate...* London: printed for James Roberts at the Oxford-Arms, in Warwick-Lane, and for the Booksellers in London and Westminster, 1750.

Anon. *L'estonnement populaire, ou Recit veritable du grand tremblement de terre, arrivé aux environs, & dans la ville de Bordeaux, ces iours derniers.* Paris: Chez Iean Brvnet, ruë sainte Anne, proche le palais, 1660.

Anon. *Breve relacion del borroso incendio: que ha padecido la ciudad de Londres, desde Domingo 12 de Septiembre, hasta Iueves 16 del mesmo mes, de este año 1666.* En Sevilla: Por Iuan Gomez de Blas, su impressor mayor, 1666.

Anon. *Copia de una carta escrita por un Cavallero de la Ciudad de Lorca á otro de esta Corte, avisandole del gran terremoto, y Uraçan que huvo en dicha Ciudad, desde el dia de San Lorenzo, hasta el dia de la Degollacion de San Iuan, que es á 29. de Agosto de 1674.* Madrid: Ioseph del Espiritu Santo, n.d.

Anon. *Eniautos Terastios, Mirabilis Annus, or The Year of Prodigies and Wonders: Being a Faithful and Impartial Collection of Several Signs That Have Been Seen in the Heavens, in the Earth, and in the Waters...* n.p.: n.p., 1661.

Anon. *Examen du jugement de l'Argolin sur l'éclipse du mois d'août 1654.* Paris: impr de P Le Petit, 1654.

Anon. *Individual, y verdadera relacion de la extrema ruina que padeció la Ciudad de los Reyes Lima, capital del reyno del Perù, con el horrible temblor de tierra acaecido en ella, la noche del 28. de octubre de 1746. y de la total assolacion del presidio, y puerto del Callao, por la violenta irrupcion del mar, que ocasionò en aquella bahia.* Lima: en la Imprenta que estaba en la Calle de los Mercaderes, 1746.

Anon. *Individual, y verdadera relacion de la extrema ruina que padeció la Ciudad de los Reyes Lima, capital del reyno del Perù, con el horrible temblor de tierra acaecido en ella, la noche del 28. de octubre de 1746. y de la total assolacion del presidio, y puerto del Callao, por la violenta irrupcion del mar, que ocasionò en aquella bahia.* Impreso en Lima, reimpresso en Mexico: Por la viuda de J B de Hogal, 1747.

Anon. *The Late Dreadful Plague at Marseilles Compared with That Terrible Plague in London, in the Year 1665...*

London: printed by H Parker, 1721.

Anon. *London's Dreadful Visitation, or, A Collection of All the Bills of Mortality for This Present Year: Beginning the 20th of December, 1664, and Ending the 19th of December Following: As Also the General or Whole Years Bill: According to the Report Made to the King's Most Excellent Majesty.* London: Printed and are to be sold by E Cotes, 1665.

Anon. *Mirabilis Annus Secundus, or, The Second Year of Prodiges Being a True and Impartial Collection of Many Strange Signes and Apparitions, Which Have This Last Year Been Seen in the Heavens, and in the Earth, and in the Waters...* n.p.: n.p., 1662.

Anon. *Mirabilis Annus Secundus, or, The Second Part of the Second Years Prodiges: Being a True Additional Collection of Many Strange Signs and Apparitions Which Have This Last Year Been Seen in the Heavens, and in the Earth, and in the Waters...* n.p.: n.p., 1662.

Anon. *Noticia Annalica y Estado, Que Tiene El Puerto Del Callao, y La Ciudad de Lima, à El Año Cumplido de Su Desolacion, y Ruyna, Que Lo Hace En Este Mes de Octubre de 1747.* n.p: n.p., n.d.

Anon. *El Pobre del Carreton, contra los Papeles, que han salido a luz con nombre de Don Andres Davila y Heredia, Señor de la Garena, Capitan de Canallos, è Ingeniero Militar - Fondos Digitalizados de la Universidad de Sevilla.* n.p.: n.p., n.d.

Anon. *Reflections on the Weeekly [Sic] Bills of Mortality for the Cities of London and Westminster, and the Places Adjacent: But More Especially, so Far as They Relate to the Plague and Other Mortal Diseases That We English-Men Are Most Subject unto: With an Exact Account of the Greatest Plagues That Have Happened since the Creation ..* London: Printed for Samuel Speed, 1665.



Anon. *Relacion verdadera de la lastimosa destruicion, que padeciò la ciudad de Malaga, por el espantoso terremoto que sucediò el miercoles 9 de octubre deste presente año de 1680.* n.p.: n.p., 1680.

Anon. *Relación verdadera en que se refiere lo sucedido el miércoles nueve de Octubre de este presente año de 1680 con el espantoso Temblor de Tierra que ... se padecio ... en estos Reynos y especialmente en Cordova, Valladolid, Iaen, Antequera y otras partes ...* n.p.: n.p., 1680.

Anon. *Relation des terribles ravages occasionnés en Afrique par le cruel tremblement de terre qui a détruit la plus grande partie du royaume de Maroc : avec un détail de tout ce qui y est arrivé depuis le premier novembre jusqu'à présent.* n.p.: n.p., n.d.

Anon. *Relation du désastre arrivé aux villes de Lima, & du Callao, au Pérou ; le 28 octobre 1746, par un tremblement de terre.* S.l.: De l'Imprimerie de Gonichon, 1747.

Anon. *Tercera relacion en que se da quenta de las vltimas noticias de las tempestades sucedidas en el passado mes de setiembre deste presente año de 1680, y assimismo se refiere el espantoso temblor de tierra que sobrevino à la coronada villa de Madrid, corte augusta de nuestro gran monarca Carlos Segundo (que Dios guarde) el miercoles nueve de octubre de dicho año, en punto de las siete de la mañana.* S.l.: s.n., 1680.

Anon. *Tragica Descripcion Del Lamentable Estrago, Que Ocasionó El Terremoto de El Dia Quatro de Marzo En Este Año de 1751 En Esta Ciudad de Santiago de Goathemala.* Santiago de Guatemala: Impr. de Joachin de Arevalo, 1751.

Anon. *A True and Particular History of Earthquakes. Containing a Relation of That Dreadful Earthquake Which Happen'd at Lima and Callao, in Peru, October 28, 1746; Publish'd at Lima by Command of the Vice-Roy, and Now Translated from the Original Spanish; Also of That Which Happen'd in Jamaica in 1692, and of Others in Different Parts of the World. Accurately Describing The Dreadful Devastations That Have Been Made by Those Horrible Convulsions of the Earth; Whereby Mountains Have Been Thrown Down...* London: printed for the author, and sold by the booksellers in town and country, 1748.

Anon. *A True and Particular Relation of the Dreadful Earthquake Which Happen'd at Lima, The Capital of Peru, and the Neighbouring Port of Callao, on the 28th of October, 1746...* London: printed for T Osborne in Gray's Inn, 1748.

Anon. *A True and Particular Relation of the Dreadful Earthquake, Which Happen'd at Lima, the Capital of Peru, and the Neighbouring Port of Callao, on the 28th of October, 1746: With an Account Likewise of Every Thing Material That Passed There Afterwards to the End of November Following.* Philadelphia: London printed: Philadelphia reprinted, and sold by B Franklin, and D Hall, at the new-printing-office, near the market, 1749.

Anon. *A True and Particular Relation of the Dreadful Earthquake. Which Happen'd at Lima, the Capital of Peru, and the Neighbouring Port of Callao, on the 28th of October, 1746.* Boston, printed; and sold by D Fowle in Ann-Street, and by Z Fowle in Middlestreet, 1755.

Anon. *Verdadera Relación, de La Grande Auenida, y Huracan Tremendo, Que El Día Viernes Seis de Septiembre Acaeciò En La Villa de Ossuna, Este Presente Año de 1680 y Cosas Maravillosas Que Sucedieron, Como Vera El Curioso Lector.* Cordova: n.p., 1680.

Anon. *Relacion breve, en que se da noticia como se sacò en procession, por la peste, la Milagrosissima Imagen de Guadalupe al portico de su Santo Templo, el dia 19. de Iulio de este año de 1682. y los muchos beneficios que los Fieles han recibido de su Santissima Mano.* Madrid: por Iulian de Paredes, 1682.

Anon. *Relacion del exemplar castigo que embió Dios á la Ciudad de Lima Cabeça del Perú, y à su Costa de Barlovento con los espantosos Temblores del dia 20 de Octubre del Año de 1687.* Con licencia en Lima, y por su original en México: por la viuda de Francisco Rodriguez Lupercio, 1688.

Anon. *A Country Dialogue between William and James, on the Monthly Fast-Day: With Reflections on the Earthquake Which Latey Happened at Jamaica, and Here Sept. 8. 1692.* n.p.: n.p., 1692.

Anon. *Les Malheurs des Anglois dans la Jamaïque. A Bord du Vaisseau l'Industrie, devant la Baye des Ruines de Port Royal dans la Iamaïque, le 30. Iuin & 10. Iuillet 1692.* n.p.: n.p., 1692.

Anon. *A True and Faithful Account of All the Earthquakes and the Dreadful Effects Thereof, That Have Happened in England since the Norman Conquest, to This Day: Wherein God's Judgments Are Plainly Described, with Animadversions Thereon.* London: Printed for Richard Baldwin, 1692.

Anon. *The Truest and Largest Account of the Late Earthquake in Jamaica, June the 7th, 1692*. London: Printed for Tho. Parkhurst, 1693.

Anon. *An Account of the Late Terrible Earthquake in Sicily: With Most of Its Particulars*. London: Printed for Richard Baldwin, 1693.

Aquinas, Thomas. *The "Summa Theologica" of St. Thomas Aquinas*. Translated by Fathers of the English Dominican Province. New York: Benziger Brothers, 1918.

Arana, Tomás de, Cristóbal de Hincapié Meléndez, and Agustín Gómez Carrillo. *Terremotos: ruina de San Miguel, 29 de setiembre de 1717, Santa Marta, 29 de julio de 1773*. [Guatemala]: Editorial José de Pineda Ibarra, 1980.

Arbuthnot, John. "An Argument for Divine Providence, Taken from the Constant Regularity Observ'd in the Births of Both Sexes. By Dr. John Arbuthnott, Physitian in Ordinary to Her Majesty, and Fellow of the College of Physitians and the Royal Society." *Philosophical Transactions of the Royal Society of London* 27, no. 328 (1710): 186–90.

———. *Mr. Maitland's Account of Inoculating the Smallpox: Vindicated, from Dr. Wagstaffe's Misrepresentations of That Practice, with Some Remarks on Mr. Massey's Sermon*. London: printed and sold by J Peele, at Lock's Head in Paternoster-Row, 1722.

———. *An Essay Concerning the Effects of Air on Human Bodies*. London: printed for J Tonson in the Strand, 1733.

Ashmole, Elias. *Elias Ashmole (1617-1692): His Autobiographical and Historical Notes, His Correspondence, and Other Contemporary Sources Relating to His Life and Work*. Edited by C. H. Josten. Oxford: Clarendon, 1967.

Augustine of Hippo. “On Genesis: A Refutation of the Manichees.” In *The Works of Saint Augustine: A Translation for the 21st Century*, edited by John E. Rotelle, translated by Edmund Hill. Hyde Park, NY: New City Press, 2002.

Augustine of Hippo. *City of God*. Translated by William M. Green. Cambridge, MA: Harvard University Press, 2014.

Bacon, Francis. “The Advancement of Learning.” In *Works*, vol. 3, edited by James Spedding, Robert Leslie Ellis, and Douglas Denon Heath. London: Longman, 1857.

———. “The New Atlantis.” In *Works*, vol. 3, edited by James Spedding, Robert Leslie Ellis, and Douglas Denon Heath. London: Longman, 1857.

———. “Of the Dignity and Advancement of Learning.” In *Works*, edited by James Spedding, Robert Leslie Ellis, and Douglas Denon Heath, Vol. 4. London: Longman, 1857.

———. “History of the Winds.” In *Works*, vol. 9, edited by James Spedding, Robert Leslie Ellis, and Douglas Denon Heath. London: Longman, 1857.

———. *The New Organon*. Edited by Lisa Jardine. Translated by Michael Silverthorne. Cambridge, UK: Cambridge University Press, 2000.

———. *The Essayes or Counsels, Civill and Morall*. Edited by Michael Kiernan. Oxford; New York: Clarendon; Oxford University Press, 2000.

Barrenechea, Juan de. *Nueva observacion astronomica del periodo tragico de los Temblores grandes de la Tierra. Exactamente arreglada à Europa, y Assia, y de la America, à los Reynos del Perú, Chile, y Guathemala*. Lima: Por Juan Joseph Gonzales de Cossio, 1734.

Barroeta y Angel, Pedro Antonio. *Carta pastoral, que el Illmo. S.D.D. Pedro Antonio de Barroeta y Angel, arzobispo de los Reyes, dirige al venerable clero, y amado pueblo de su diocesis, con ocasion de las noticias, que se han participado de España del gran terremoto, que el dia primero de noviembre de 1755. se experimentó con grandes estragos en la Europa, y otras partes, para que con la prompta penitencia aplaquen la divina justicia, que allá castiga, y acá nos amenaza*. Impresa en Lima: En la Plazuela de San Christoval, 1756.

Barzia y Zambrana, José de. *A Discourse of the Excellency of the Soul, and the Care Every Christian Ought to Have of It: In a Sermon Preach'd in Spanish*. London: Printed for Matthew Turner ..., 1685.

———. *Despertador christiano de sermones doctrinales ...: en dos tomos à que estan reducidos los cinco en que se imprimió antes ... : tomo segundo ...* Septima impression. En Madrid: Por Juan García Infanzon, 1687.

———. *Christ-eyfriger Seelen-Wecker...* Augspurg ; Dillingen: Bencard, 1721.

———. *Christianus animarum excitator...* Augustae Vindel. ; Dilingae: Bencard, 1740.

Bavia, Luis de, and Luis Sánchez. *Tercera parte de la Historia pontifical y catholica. Compuesta y ordenada por el D. Luis de Bavia,... Contiene esta tercera parte de la historia pontifical, las cosas mas notables sucedidas en el mundo, desde el año de mil y quinientos y setenta y dos, hasta el de mil y quinientos y noventa y uno.* En Madrid: por Luis Sanchez... y a su costa, 1608.

Bayle, Pierre. *Pensées diverses sur la comète.* Edited by Hubert Bost and Joyce Bost. Paris: Flammarion, 2007.

———. *Various Thoughts on the Occasion of a Comet.* Translated by Robert C. Bartlett. Albany: State University of New York Press, 2000.

Beard, Thomas. *The Theatre of Gods Judgements: Wherein Is Represented the Admirable Justice of God against All Notorious Sinners....* The fourth Edition, With Additions. London: Printed by SI & MH and are to be sold by Richard Whitaker at the signe of the Kings Armes in St Pauls Churchyard, 1648.

Bede. *Bede's Ecclesiastical History of England; a Revised Translation with Introduction, Life, and Notes by A.M. Sellar.* England: G Bell and sons, 1907.

Bell, John. *London's Remembrancer, or, A True Account of Every Particular Weeks Christnings and Mortality in All the Years of Pestilence within the Cognizance of the Bills of Mortality, Being XVIII Years*. London: Printed and are to be sold by E Cotes...Printer to the Company of Parish Clerks, 1665.

Bertrand, Élie. *Mémoires historiques et physiques sur les tremblemens de terre*. La Haye: Edition de Pierre Gosse, Junior, 1757.

Beverley, Thomas. *Evangelical Repentance unto Salvation Not to Be Repented of: Upon 2 Cor. 7, 10 ; and as Most Seasonable, Short Considerations on That Great Context Hebr. 12, 26, "Yet Once More I Shake Not Only Earth, &c.": Upon the Solemn Occasion of the Late Dreadful Earthquake in Jamaica and the Later Monitory Motion of the Earth in London, and Other Parts of the Nation and beyond the Sea ; Whereunto Is Adjoined a Discourse on Death-Bed Repentance, on Luc. 22, 39*. London: Printed by R Smith for W Miller, 1693.

Birch, Thomas. *The History of the Royal Society of London for Improving of Natural Knowledge, from Its First Rise. In Which the Most Considerable of Those Papers Communicated to the Society, Which Have Hitherto Not Been Published, Are Inserted in Their Proper Order, as a Supplement to the Philosophical Transactions*. London: Printed for A Millar, 1756.

Blackstone, William. *Commentaries on the Laws of England*. 4th ed. Oxford: Printed at the Clarendon Press, 1770.

Boaistuau, Pierre. *Histoires prodigieuses les plus memorables qui ayent esté observées, depuis la nativité de Jesus Christ, jusques à nostres siecle: Extraictes de plusieurs fameux auteurs, Grecz, & Latins, sacrez & profanes: mises en nostre langue*



par P. Boaistuan surnommee Launay, natif de Bretagne, avec les pourtraictz & figures. Paris: Pour Jean Longis & Robert le magnier libraires..., 1560.

Bohun, Ralph. *A Discourse Concerning the Origine and Properties of Wind: With an Historicall Account of Hurricanes, and Other Tempestuous Winds*. Oxford: Printed by W Hall for Tho Bowman, 1671.

Bordelon, Laurent. *Remarques ou reflexions critiques, morales et historiques, sur les plus belles & les plus agreables pensées, qui se trouvent dans les ouvrages des auteurs anciens & modernes*. A Paris,: chez Arnoul Seneuse, ruë de la Harpe, vis-à-vis la ruë des Mathurins, à la Sphere, 1690.

Bouguer, Pierre. *La figure de la terre: déterminée par les observations de messieurs Bouguer, et de la Condamine, de l'Académie Royale des Sciences, envoyés par ordre du roy au Pérou, pour observer aux environs de l'equateur; avec une relation abrégée de ce voyage, qui contient la description du pays dans lequel les opérations ont été faites*. Paris: Charles-Antoine Jombert, 1749.

Bownd, Nicholas. *Medicines for the Plague That Is, Godly and Fruitfull Sermons Vpon Part of the Twentieth Psalme, Full of Instructions and Comfort: Very Fit Generally for All Times of Affliction, but More Particularly Applied to This Late Visitation of the Plague. Preached at the Same Time at Norton in Suffolke, by Nicholas Bownd, Doctor of Diuinitie. And Now Published for the Further Good of All Those That Loue and Feare the Lord. Perused, and Allowed*. London: Printed by Adam Islip [and Felix Kingston] for Cuthbert Burbie, and are to be sold at the Swan in Paules Churchyard, 1604.

Boyle, Robert. "A Confirmation of the Former Account Touching the Late Earth-Quake Near Oxford, and the Concomitants Thereof." *Philosophical Transactions of the Royal Society of London* 1, no. 11 (1665): 179–81.

———. *Tracts Written by the Honourable Robert Boyle: About the Cosmical Suspitions, the Temperature of the Subteraneall Regions, the Temperature of the Submarine Regions, the Bottom of the Sea: To Which Is Præfixt An Introduction to the History of Particular Qualities*. Oxford: Printed by W H for Ric Davis, 1670.

———. *An Essay of the Great Effects of Even Languid and Unbeeded Motion: Whereunto Is Annexed An Experimental Discourse of Some Little Observed Causes of the Insalubrity and Salubrity of the Air and Its Effects*. London: Printed by M Flesher for Richard Davis, 1685.

———. *The General History of the Air*. London: Printed for Awsham and John Churchill, 1692.

———. *The Correspondence of Robert Boyle*. Edited by Michael Hunter, Antonio Clericuzio, and Lawrence Principe. The Boyle Project edition. Charlottesville, VA: InteLex Corporation, 2004.

———. *The work diaries of Robert Boyle*. <http://www.livesandletters.ac.uk/wd/view/view.html>

Bradford, William. *History of Plymouth Plantation*. Edited by Charles Deane. Boston: Privately Printed, 1856.

Brekell, John. *Eurochydon: Or the Dangers of the Sea : Considered, and Improved, in Some Reflections upon St. Paul's Voyage and Shipwreck. Acts Xxvii.* London: printed for J Noon, at the White Hart, in Cheapside; R King, at the Bible and Crown, in Fore-Street; M Waugh, at the Turk's Head, in Grace-Church-Street; R Fleetwood, in Liverpool; M Bryson, in Newcastle; T Cadell, in Bristol; J Eaton, in Yarmouth; and J Munby, in Hull, 1744.

Buendía, José de. *Vida admirable y prodigiosas virtudes del venerable y apostólico padre Francisco del Castillo de la compañía de Jesús.* Madrid: A Roman, 1693.

Burnet, Gilbert. *Burnet's History of My Own Time.* Edited by Osmund Airy. Oxford: Clarendon press, 1897.

Burt, John. *Earthquakes, the Effects of God's Wrath: A Sermon Preached at Bristol, the Lord's Day after a Very Terrible Earthquake, Which Was on Tuesday, November 18, 1755. a Few Minutes after Four o'clock in the Morning.* Newport R.I.: Printed by J Franklin, at the printing-office under the town-school-house, 1755.

Burton, Henry. *A Divine Tragedie Lately Acted, or, A Collection of Sundrie Memorable Examples of Gods Judgements upon Sabbath-Breakers and Other like Libertines in Their Unlawfull Sports Hapning within the Realme of England...* London: n.p., 1642.

Bushel, John. *A True and Perfect Narrative of the Late Dreadful Fire Which Happened at Bridge-Town in the Barbadoes, April 18, 1668...* London: Printed by Peter Lillicrap, 1668.

Byles, Mather. *Divine Power and and Anger Displayed in Earthquakes: A Sermon Occasioned by the Late Earthquake, in New-England, November 18. 1755. And Preached, the next Lord's-Day, at Point-Shirley.* Boston: Printed and sold by S Kneeland, in Queen-Street, 1755.

Cabrera, Vicente. *Segunda relacion y mas lata noticia de todo lo sucedido en el memorable, y lastimoso mes de Setiembre deste presente año de 1680: En que se refieren las grandes, y repetidas Tempestades, Avenidas y Ruinas de Puentes, Edificios, y Heredades de Castilla y Andaluzia ; y en particular del recio Huracan que padeciò la Villa de Ossuna, el dia 6 del referido mes.* En Valencia: Por Vicente Cabrera ... : Vendense en la misma Imprenta, 1680.

Calvin, Jean. *Commentary on the Book of Psalms.* Translated by James Anderson. Edinburgh: Printed for the Calvin Translation Society, 1845.

Camargo y Salgado, Hernando. *La iglesia militante: cronologia sacra y epitome historial de todo quanto ha sucedido en ella prospero y adverso.* Con privilegio en Madrid: Por Francisco Martínez Acosta de Pedro Garcia de Sodruz, mercader de libros, 1642.

Castañega, Martín de. *Tratado de las supersticiones y hechizerias y de la posibilidad y remedio dellas (1529).* Edited by Juan Robert Muro Abad. 3. ed. Logroño: Gobierno de La Rioja; Instituto de Estudios Riojanos, 1994.

Chauncy, Charles. *Earthquakes a Token of the Righteous Anger of God: A Sermon Preached at the Old-Brick-Meeting-House in Boston, the Lord's-Day after the Terrible Earthquake, Which Suddenly Awoke Us out of Our Sleep in the Morning of the 18th of November, 1755.* Boston: Printed and sold by Edes and Gill, at their printing office, next to the prison in Queen-Street, 1755.

Chicoyneau, François. *Observations et reflexions propres a confirmer ce qui est avancé par Mrs Chicoyneau, Verny & Soulier: dans la Relation du 10. decembre 1720 touchant la nature, les événemens & le traitement de la peste de Marseille.* Aix: Joseph David, 1721.

———. *Traité des causes, des accidens, et de la cure de la peste: avec un recueil d'observations et un détail circonstancié des précautions qu'on a prises pour subvenir aux besoins des peuples affligés de cette maladie, ou pour la prévenir dans les lieux qui en sont menacés.* A Paris: Chez Pierre-jean Mariette, Imprimeur-Libraire, rue Saint Jacques, aux Colonnes d'Hercule, 1744.

———. "Notice sur les principales Pestes qui ont ravagé le monde." In *Pièces historiques sur la peste de Marseille et d'une partie de la Provence, en 1720, 1721 et 1722*, edited by Louis François Jauffret. A Marseille: chez les principaux libraires, 1820.

Chicoyneau, François, and François Verny. *Relation de la maladie contagieuse qui a affligé Marseille, envoyée par Messieurs Chicoyneau & Verny, Medecins de Montpellier, qui ont servi pendant cette Contagion à Marseille. Avec une methode pour la traiter.* A Nismes, 1721.

Chrysostom, John. *The Homilies of S. John Chrysostom on the Gospel of St. Matthew.* Edited by Charles Marriott. Translated by George Prevost. Oxford: John Henry Parker; F and J Rivington, 1851-79.

Cleghorn, George. *Observations on the Epidemical Diseases in Minorca. From the Year 1744 to 1749. To Which Is Prefixed, A Short Account of the Climate, Productions, Inhabitants, and Endemial Distempers of That Island.* By George Cleghorn, Surgeon to Brigadier General Offarrell's Regiment. London: printed for D Wilson, at Plato's Head, in the Strand, 1751.

Cogswell, James. *The Danger of Disregarding the Works of God: : A Sermon, Delivered at Canterbury, November 23, 1755. Being the next Sabbath after the Late Surprising Earthquake.* New-Haven: Printed by James Parker, and Company, at the post-office, 1755.

La Condamine, Charles-Marie de. *Journal du voyage fait par ordre du roi, a l'équateur: servant d'introduction historique a la Mesure des trois premiers degrés du méridien.* A Paris: De l'Imprimerie royale, 1751.

Cotton, Jr, John. *The Correspondence of John Cotton Junior.* Edited by Sheila McIntyre and Len Travers. Publications of the Colonial Society of Massachusetts, Vol. LXIX. Boston: The Colonial Society of Massachusetts, 2009.

Córdoba, Luis Cabrera de. *Filipe Segundo, Rey de España.* n.p.: por Luis Sanchez, 1619.

Crespo, Sebastián. *Relacion de la tormenta que padeció la capitana real, en que me hallè, como piloto, al tiempo que passó el mismo infortunio lo restante de las naos de la real armada ...* Cadiz: por Juan Vejarano, 1672.

Crocket, Captain. *A True and Perfect Relation of That Most Sad and Terrible Earthquake, at Port-Royal in Jamaica, Which Happened on Tuesday the 7th. of June, 1692...* London: Printed by R Smith, and are to be sold by G Croom and William Miller, 1692.

Culpeper, Nicholas. *Catastrophe Magnatum, or, The Fall of Monarchie a Caveat to Magistrates, Deduced from the Eclipse of the Sunne, March 29, 1652, with a Probable Conjecture of the Determination of the Effects*. London: Printed for T. Vere and Nath. Brooke, 1652.

Danforth, Samuel. *An Astronomical Description of the Late Comet or Blazing Star as It Appeared in New-England in the 9th, 10th, 11th, and in the Beginning of the 12th Moneth, 1664: Together with a Brief Theological Application Thereof*. Cambridge (Mass.): Printed by Samuel Green, 1665.

———. *An Astronomical Description of the Late Comet or Blazing-Star: As It Appeared in New England in November, December, January, and in the Beginning of February 1664 : Being the First and Greatest of the Three Comets Which Was Seen at London and Elsewhere in Europe : Together with a Brief Theological Application Thereof*. London: Printed at Cambridge in New England, and now re-printed at London for Peter Parker, and are to be sold at his first shop, 1666.

Dávila y Heredia, Andrés. *Respuesta a la piedra de toque, en que se descubren los quilates de los Pareceres sobre el Cometa que se ha visto en el mes de Diciembre pasado de 1680, Escrito por el Abad Don Iuan Brauo de Sobre-Monte*. Madrid: s.n., 1681.

Defoe, Daniel. *The Storm; or, A Collection of the Most Remarkable Casualties and Disasters Which Happen'd in the Late Dreadful Tempest, Both by Sea and Land*. London: Printed for G Sawbridge, and sold by J Nutt, 1704.

———. *A Journal of the Plague Year: Being Observations or Memorials of the Most Remarkable Occurrences, as Well Publick as Private, Which Happened in London during the Last Great Visitation in 1665*. Edited by Louis A. Landa. Revised edition. London, New York: Oxford University Press, 2010.

Dekker, Thomas. "The Wonderful Year (1603)." In *The Plague in Print: Essential Elizabethan Sources, 1558-1603*, edited by Rebecca Carol Noel Totaro. Medieval and Renaissance Literary Studies. Pittsburgh, PA: Duquesne University Press, 2010.

Descartes, René. *Les principes de la philosophie*. Translated by Claude Picot. Paris: Chez Henry Le Gras, 1647.

———. "Les Météores." In *Discours de la méthode pour bien conduire sa raison, et chercher la vérité dans les sciences ; plus, La dioptrique ; Les météores ; et, La géométrie: qui sont des essais de cette méthode*. Paris: Fayard, 1987.

Des Maizeaux, Pierre. *La Vie de Mr Bayle*. Nouvelle édition. Vol. 1. La Haye: Chez P. Gosse & J. Neaulme, 1732.

Desmarest, Nicolas. *Conjectures physico-mechaniques sur la propagation des secousses dans les tremblemens de terre, et sur la disposition des lieux qui en ont ressenti les effets*. n.p.: n.p., 1756.

Diderot, Denis, and Jean Le Rond d'Alembert, eds. *Encyclopédie, ou, Dictionnaire raisonné des sciences, des arts et des métiers*. Paris: Chez Briasson, David, l'ainé Le Breton, Durand, 1751.



Doolittle, Thomas. *Earthquakes Explained and Practically Improved: Occasioned by the Late Earthquake on Sept. 8, 1692 in London, Many Other Parts in England, and beyond Sea*. London: Printed for John Salusbury, 1693.

Du Bartas, Guillaume de Saluste *La Sepmaine, Ou Création Du Monde, de G. de Salluste, Seigneur Du Bartas*. Paris: Chez Jean Feurier, 1578.

———. *Du Bartas His Devine Weekes and Workes Translated*. Translated by Joshua Sylvester. London: Humfrey Lounes, 1611.

Dunton, John. *England's Alarum, Being an Account of God's Most Considerable Dispensations of Mercy and Judgement toward These Kingdoms for Fourteen Years Last Past: And Also of the Several Sorts of Sins and Sinners Therein ... with an Earnest Call to Speedy Humiliation, Supplication, and Reformation ...* London: Printed for Thomas Parkhurst, 1693.

Edwards, John. *A Demonstration of the Existence and Providence of God, from the Contemplation of the Visible Structure of the Greater and the Lesser World: In Two Parts, the First Shewing the Excellent Contrivance of the Heavens, Earth, Sea, &c., the Second the Wonderful Formation of the Body of Man*. London: Printed by J D for Jonathan Robinson and John Wyat, 1696.

Evelyn, John. *The Diary and Correspondence of John Evelyn*. Edited by William Bray. New edition. 4 vols. London: George Bell and Sons, 1908.

Feijoo, Benito Jerónimo. *Teatro Critico Universal: Ó Discursos Varios En Todo Género de Materias, Para Desengaño de Errores Comunes*. Madrid: En la Imprente de Antonio Perez de Soto, 1765.

———. *Teatro crítico universal*. Edited by Agustín Millares Carlo. Madrid: Ediciones de “La Lectura,” 1923.

Fernández de Consuegra, Matías. *Relacion suscinata de la solemne, quanto deuota procesion de rogatiua, que por el estrago de Lima, y Napoles ha celebrado la piedad de los fieles imperiales de la my catholica, y nobilissima ciudad de Toledo, à solitud de su devotissima esclavitud (ò Hermandad) de Nuestra Señora de la Esperanza de San Lucas ... y devota procesion saliò al real monasterio de Santa Fè religion del grande apostol patron de las Españas Santiago, el dia cinco de agosto de 1688*. n.p.: n.p., 1688.

Feuilleé, Louis. *Journal des observations physiques, mathematiques et botaniques, faites par l'ordre du Roy sur les côtes orientales de l'Amerique meridionale, & dans les Indes occidentales, depuis l'année 1707. jusques en 1712*. A Paris: chez Pierre Giffart, 1714.

Figueiredo, Antonio da Silva. *Descripçam antilógica physico-moral do terremoto, e lamentavel estrago de Lisboa : no primeiro de novembro de 1755*. Lisboa: Na Officina Patriarcal de Francisco Luiz Ameno, 1756.

Figueiredo, Antonio Pereira de. *A Narrative of the Earthquake and Fire of Lisbon by Antony Pereria, of the Congregation of the Oratory, an Eye-Witness Thereof. Illustrated with Notes. Translated from the Latin*. London: printed for G Hawkins, 1756.

Figueredo y Victoria, Francisco Joseph de. *Carta Pastoral Exortatoria a Penitencia*. n.p.: en la imprenta de Joachin de Arevalo..., 1756.

Figueroa, Juan de. *Opusculo de astrologia en medicina, y de los terminos, y partes de la astronomia necesarias para el uso della*. Lima: Observatorio de marina de San Fernando, 1660.

Fleming, Robert. *A Discourse of Earthquakes; as They Are Supernatural and Premonitory Signs to a Nation; with a Respect to What Hath Occurred in This Year 1692. And Some Special Reflections Thereon. As Also On That Security and Assurance of Mind, Which Is Attainable in the Light and Power of Religion, under the Greatest Surprizals, and Terrors of Sense. With Some Enquiry upon the Grounds Both of Our Fears and Hopes, as to the Publick State of the Church of Christ in This Day*. London: Printed for Thomas Parkhurst ... and Jonathan Robinson, 1693.

Fortescue, J W. *Calendar of State Papers Colonial, America and West Indies*. Vol. 13. Printed for His Majesty's Stationery Office: London, 1901.

Fournier, Georges. *Hydrographie: contenant la theorie et la pratique de toutes les parties de la navigation*. Seconde edition, Reueüe, Corrigée & Augmentée par l'auteur auant son deceds. A Paris: Chez Iean Du Puis, 1667.

Le Franc de Pompignan, Jean-Jacques. "Ode à M. Racine, sur la mort de son fils." In *Lumières voilées: oeuvres choisies d'un magistrat chrétien du XVIIIe siècle : Le Franc de Pompignan (1709-1784)*, edited by Theodore E. D. Braun and Guillaume Robichez. Saint-Etienne: Publications de l'Université de Saint-Etienne, 2007.

Francklyn, Thomas. *Serious Advice and Fair Warning to All That Live upon the Sea-Coast of England and Wales,; Particularly to Those in the Neighbourhood of Weymouth and Portland; Addressed to Them in a Sermon Preached the 22d of December, 1754, in the Churches of Fleet and Chickerill, on Occasion of Several Shipwrecks at That Time upon the Coast of England. To Which Are Added, Some Extracts from the Several Acts of Parliament Relating to Ships That Are Stranded on the Coast. By Thomas Francklyn, Rector of Langton-Herring, and Vicar of Fleet in the County of Dorset.* London: printed for A Linde, in Catherine Street in the Strand, 1756.

Franklin, Benjamin. *Autobiography and Other Writings.* Edited by Ormond Seavey. Oxford ; New York: Oxford University Press, 1993.

Freke, Thomas. *A Sermon Preach'd on Wednesday, January XIX, 1703/4.: Being the Fast-Day, Appointed by Authority, for the Humbling Our Selves before Almighty God, in a Deep Sense of His Heavy Displeasure, Shew'd Forth in the Late Dreadful Tempest. As Also, For the Imploring of a Blessing on Her Majesty and Allies, Engag'd in the Present War.* By Thomas Freke. London: printed for John Lawrence, at the Angel in the Poultry, 1704.

Frézier, Amédée François. *Relation du voyage de la mer du Sud aux côtes du Chily et du Perou,; fait pendant les années 1712, 1713 & 1714. : Avec une réponse a la preface critique du livre intitulé, Journal des observations physiques,*

*mathematiques & botaniques du R.P. Feuillée, contre la Relation du voyage de la mer du Sud ...* A Paris,; Chez Nyon, Chez Didot, Chez Quillau, 1732.

Froment, Antoine. *Essais d'Antoine Froment advocat au parlement du Dauphiné, sur l'incendie de sa patrie, les singularitez des Alpes en la Principauté du Briançonois; Avec plusieurs autre curieuses remarques sur le passage du Roy aux Italies, ravage des loups, pestes, famines, Avalanches, & embrasemens de plusieurs Villages, y survenus de suite.* Grenoble: Par Pierre Verdier, Imprimeur du Roy, en la sale du Palais, 1639.

Froment, Antoine. *Essais d'Antoine Froment, avocat au parlement de Dauphiné.* Edited by Aristide Albert. Grenoble: Imprimerie Édourd Allier, 1868.

Furetiere, Antoine. *Dictionnaire Universel: Contenant Generalement Tous Les Mots François...* La Haye: Chez Pierre Husson, et al, 1727.

Gadbury, John. *Cardines Cæli, or, An Appeal to the Learned and Experienced Observers of Sublunars and Their Vicissitudes Whether the Cardinal Signes of Heaven Are Not Most Influential upon Men and Things: Proved by X. Remarkable Genitures, &c. in a Reply to the Learned Author of Cometomantia Wherein the Character of Gassendus Is Defended and Sundry Other Starry Truths Are Justified.* London: sn, 1684.

Gassendi, Pierre. *Petri Gassendi ... Opera omnia in sex tomos divisa ..* Edited by Henri Louis Habert de Montmor. Lugduni: sumptibus Lavrentii Anisson & Ioan Bapt, Devenet, 1658.

———. *The Vanity of Judiciary Astrology. Or Divination by the Stars.* London,; Printed for Humphrey Moseley, and are to be sold at his shop at the Prince's Armes in St Pauls Church-yard, 1659.

———. *Abrégé de la philosophie de Gassendi*. Edited by François Bernier; [Modern editors] Sylvia Murr, and Geneviève Stefani. Paris: Fayard, 1992.

Goad, John. *Astro-Meteorologica, or Aphorism's and Discourses of the Bodies Coelestial, Their Natures and Influences: Discovered from the Variety of the Alterations of the Air, Tempeperate [sic], or Intemperate, as to Heat or Cold, Frost, Snow, Hail, Fog, Rain, Wind, Storm, Lightnings, Thunder, Blasting, Hurricane, Tuffon, Whirlwind, Iris, Chasme, Parelj, Comets Their Original and Duration, Earthquakes, Vulcano's, Inundations, Sickness Epidemical, Maculae Solis, and Other Secrets of Nature*. London: Printed by J Rawlins for Obadiah Blagrove, 1686.

Gouraud, P.-L.-A. *Ode sur les désastres arrivés à Saint-Domingue et sur la mort de mon frère causée par le tremblement de terre du 21 novembre 1751*. Angers: A-J Jahyer, 1752.

Grascome, Samuel. *An Appeal of Murther from Certain Unjust Judges, Lately Sitting at the Old Baily: To the Righteous Judge of Heaven and Earth; and to All Sensible English-Men, Containing a Relation of the Tryal, Behaviour, and Death of Mr. William Anderton, Executed June 16. 1693. at Tyburn, for Pretended High Treason*. London: s.n., 1693.

Graunt, John. *Natural and Political Observations Mentioned in a Following Index, and Made upon the Bills of Mortality*. The fifth edition much enlarged. London: Printed by John Martyn, 1676.

Graunt, John. *Natural and Political Observations Made upon the Bills of Mortality*. Edited by Walter F. Willcox. Baltimore: The Johns Hopkins press, 1939.

Gregory of Tours. *The History of the Franks*. Translated by Lewis Thorpe. Harmondsworth, UK; Baltimore: Penguin, 1974.

Gunther, R. T., ed. *Early Science in Oxford*. 14 vols. Oxford: Printed for the Oxford historical society at the Clarendon press, 1923.

Hales, Stephen. *Considerations Sur La Cause Physique Des Tremblemens de Terre: Lues à La Société Royale de Londres. Par M. Hales, ... Avec La Lettre Pastorale de M. l'Evêque de Londres, Sur La Cause Morale Du Même Phénomène*. Londres: chez Jacob Tompsond, 1751.

———. *Some Considerations on the Causes of Earthquakes: Which Were Read before the Royal Society, April 5, 1750*. By Stephen Hales, D.D, F.R.S. London: printed for R. Manby and H. S. Cox, on Ludgate-Hill, 1750.

———. *The Theory and History of Earthquakes...* London: printed for and sold by J Newbery in St Paul's-Churchyard..., 1750.

Hammond, Lawrence. *Diary Kept by Capt. Lawrence Hammond: Of Charlestown, Mass. 1677-1694*. Edited by Samuel A. Green. Cambridge [Mass.]: J Wilson and Son, 1892.

Harrison, Robert. *A Strange Relation of the Suddain and Violent Tempest, Which Happened at Oxford May 31, Anno Domini 1682: Together with an Enquiry into the Probable Cause and Usual Consequents of Such like Tempests and Storms*. n.p.: Printed for Richard Sherlock, 1682.

Harvey, Gideon. *A New Discourse of the Smallpox and Malignant Fevers: With an Exact Discovery of the Scorvey: Comprising the Nature, Manifold Differences, Various Causes, Signs, Prognostics, Chronology, and Several Methods of Curing the Said Disease by Remedies Both Galenical and Chymical: Together with Anatomical Discourses on Convulsions, Palsies, Apoplexies, Rheumatisms, and Gouts, with Their Several Methods of Cure and Remedies: Likewise Particular Observations on Most of the Fore-Mentioned Diseases.* London: Printed by H Hodgskin for James Partridge, 1685.

Heath, Emmanuel. *A Full Account of the Late Dreadful Earthquake at Port Royal in Jamaica: Written in Two Letters from the Minister of That Place: From a Board the Granada in Port Royal Harbour, June 22, 1692.* London: Printed for Jacob Tonson, and sold by R Baldwin, 1692.

Hillary, William. *Observations on the Changes of the Air and the Concomitant Epidemical Diseases, in the Island of Barbados: To Which Is Added a Treatise on the Putrid Bilious Fever, Commonly Called the Yellow Fever; and Such Other Diseases as Are Indigenous or Endemial, in the West India Islands, or in the Torrid Zone.* London: Printed for C Hitch and L Hawes, in Pater-Noster-Row, 1759.

Hippocrates. "Airs, Waters, Places." In *Hippocratic Writings*, translated by J. Chadwick and W.N. Mann. London: Penguin, 1987.



Hooke, Robert. "A Discourse of Earthquakes." In *The Posthumous Works of Robert Hooke...* London: printed by Sam Smith and Benj Walford printers to the Royal Society at the Princes Arms in St Paul's Church-Yard, 1705.

———. *Lectiones Cutlerianae, or, A Collection of Lectures, Physical, Mechanical, Geographical, & Astronomical: Made before the Royal Society on Several Occasions at Gresham Colledge: To Which Are Added Divers Miscellaneous Discourses.* London: Printed for John Martyn, 1679.

Horrox, Rosemary, ed. *The Black Death.* Manchester; New York: Manchester University Press, 1994.

Hubbard, William. *A General History of New England, from the Discovery to MDCLXXX.* Cambridge: Hillard & Metcalf, 1815.

Hull, John. *The Diaries of John Hull, Mint-Master and Treasurer of the Colony of Massachusetts Bay.* Boston: Printed by J Wilson and son, 1857.

Huxham, John. "A Short Account of the Anomalous Epidemic Small-Pox, Beginning at Plymouth in August 1724, and Continuing to the Month of June 1725." *Philosophical Transactions of the Royal Society of London* 33, no. 390 (1724): 379–94.

———. *Observations on the Air and Epidemic Diseases: From the Year MDCCXXVIII. to MDCCXXXVII. Inclusive; Made by Doctor Huxham, at Plymouth: Together with a Short Dissertation on the Devonshire Colic. Translated from the Latin Original, and Now Published with the Doctor's Approbation.* London: printed for J Hinton, at the King's-Arms in Newgates Street, and Henry Whitfeld, in Plymouth, 1759.

———. *Observations on the Air, and Epidemic Diseases;: From the Beginning of the Year 1738, to the End of the Year 1748: Vol. II.* London: printed for J Hinton, at the King's-Arms in Pater-Noster Row, and Henry Whitfeld, at Plymouth, 1767.

Janeway, James, and John Ryther. *Mr. James Janeway's Legacy to His Friends: Containing Twenty Seven Famous Instances of Gods Providences in and about Sea Dangers and Deliverances...* London: printed for Dorman Newman, at the Kings Armes in the Poultry, 1674.

Jessey, Henry. *The Lords Loud Call to England: Being a True Relation of Some Late, Various, and Wonderful Judgments, or Handy-Works of God, by Earthquake, Lightening, Whirlwind, Great Multitudes of Toads and Flies; and Also the Striking of Divers Persons with Sudden Death, in Several Places...* London: printed for L Chapman, in Popes-head Alley, and for Fr Smith at the Elephant and Castle neer Temple-Bar, 1660.

Johnson, Edward. *Wonder-Working Providence, 1628-1651.* Edited by J. Franklin Jameson. New York: Scribner, 1910.

Jonstonus, Joannes. *Iob. Iohnstoni thaumatographia naturalis, in decem classes distincta...* Amsterdami: Apud Guilielmum Blaeu, 1632.

Jonstonus, Joannes. *An History of the Wonderful Things of Nature: Set Forth in Ten Severall Classes...* Translated by John Rowland. London: Printed by John Streater, 1657.

Josselyn, John. *Chronological Observations of America, from the Year of the World to the Year of Christ, 1673*. London: Printed for Giles Widdowes, 1674.

Josselyn, John. *John Josselyn, Colonial Traveler: A Critical Edition of Two Voyages to New-England*. Edited by Paul J. Lindholdt. Hanover: University Press of New England, 1988.

Juarros, Domingo. *Compendio de la historia de la ciudad de Guatemala*. 2 vols. Guatemala: Por D. Ignacio Beteta, 1808.

Mère Juchereau de St-Ignace. *Histoire de l'Hôtel-Dieu de Quebec*. A Montauban [France]: Chez Jerome Legier, et se vend à Paris, chez Claude-Jean-Baptiste Herissant, libraire, 1751.

Jurin, James. "Invitatio Ad Observationes Meteorologicas Communi Consilio Instituendas." *Philosophical Transactions of the Royal Society of London* 32, no. 379 (1723): 422–27.

———. *The Correspondence of James Jurin (1684-1750): Physician and Secretary to the Royal Society*. Edited by Andrea Alice Rusnock. Amsterdam; Atlanta, GA: Rodopi, 1996.

Kallistos Xanthopoulos, Nikephoros. *Abregé de l'histoire byzantine de S. Nicephore, Patriarche de Constantinople.*

Translated by Pierre Moret. A Paris: Chez Jean & R.J.B. de la Caille, 1684.

Keckermann, Bartholomaeus. *Contemplatio gemina: prior, ex generali physica de loco; altera, ex speciali, de terrae motu; potissimum illo stupendo, qui fuit anno 1601, mense septembri.* Hanoviae: Apud Guilielmum Antonium, 1607.

———. *Meditatio de insolito et stupendo illo terræ-motu: quo anno praeterito, VIII. Septembris ... tota penè Europa & Asia ... pars non exigua uno propè momento contremuit.* Haidelbergae: Typis Vœgelinianis, 1602.

Kino, Eusebio Francisco. *Exposicion astronomica de el cometa, que el año de 1680 por los meses de noviembre, y diziembre, y este año de 1681, por los meses de enero y febrero, se ha visto en todo el mundo, y le ha observado en la ciudad de Cadiz.* Mexico: Por F Rodriguez Lupercio, 1681.

Kircher, Athanasius. *Mundus subterraneus, in XII libros digestus...* Amstelodami: apud J Janssonium & E Weyerstraten, 1665.

Kircher, Athanasius. *The Vulcano's, or, Burning and Fire-Vomiting Mountains, Famous in the World, with Their Remarkables...* London: Printed by J Darby, for John Allen, and are to be sold by him, and by Benjamin Billingsly, 1669.

L. D. *A Check to Debauchery, and Other Crying Sins of These Times: With Several Useful Rules for the Attaining the Contrary Virtue: To Which Are Annexed Some Directions and Heads for Meditation and Prayer, Taken out of Holy Scripture...* London: Printed for Richard Butt: and are to be sold by Randal Taylor, 1692.

Lémery, Nicolas. “Explication physique et chimique des feux souterrains, des tremblements de terre, des ouragans, des éclairs et du tonnerre.” *Mémoires de mathématique et de physique de l’Académie royale des sciences*, 1700.

Ligon, Richard. *A True & Exact History of the Island of Barbados...* London: Printed for Humphrey Moseley, 1657.

Lister, Martin. “Three Papers of Dr. Martin Lyster, the First of the Nature of Earth-Quakes; More Particularly of the Origine of the Matter of Them, from the Pyrites Alone.” *Philosophical Transactions of the Royal Society of London* 14, no. 157 (1684): 512–15.

Llano Zapata, José Eusebio de. *Carta, o, Diario Que Escribe D. Joseph Eusebio de Llano y Zapata, a Su Mas Venerado Amigo, y Docto Correspondiente, El Doctor Don Ignacio Chirivoga y Daza, Canonigo de La Santa Iglesia de Quito; En Que Con La Mayor Verdad, y Critica Mas Segura La Dà Cuenta de Todo Lo Acaecido En Esta Capital de El Perù ... Con El Grande Movimiento de Tierra ... Con Una Tabla En Que Se Dà El Calculo Exacto de Todo El Numero de Temblores ... de Este Escrito.* Diario. Madrid: J. de Zuñiga, 1748.

———. *Respuesta Dada al Rey Nuestro Señor D. Fernando El Sexto Sobre La Pregunta Que S. M. Hizo a Un Matemático y Experimentado En Las Tierras de Lima Sobre El Terremoto, Acaecido En El Día Primero de Noviembre de 1755*. Sevilla: Imprenta Real de la Viuda de D. Diego Lo'pez de Haro, 1755.

———. “Observacion diaria critico-historico-meteorologica, contiene todo lo acaecido en Lima desde primero de marzo de 1747 hasta 28 de octubre del mismo...” In *Terremotos: Coleccion de las relaciones de los mas notables que ha sufrido esta capital y que la han arruinado. Va precedida del plano de lo que fue el puerto del Callao antes que el mar lo inundase en 1746 y de un reloj astronómico de temblores*, edited by Manuel de Odrizola. Lima: Tip de A Alfaro, 1863.

Luttrell, Narcissus. *A Brief Historical Relation of State Affairs, from September 1678 to April 1714*. Oxford: Oxford University Press, 1857.

Lilly, William. *Monarchy or No Monarchy in England...* Printed for Humfrey Blunden: London, 1651.

———. *An Easie and Familiar Method Whereby to Iudge the Effects Depending on Eclipses, Either of the Sun or Moon. By William Lilly Student in Astrologie*. London: Printed for the Company of Stationers, and H. Blunden, 1652.

———. *Annus Tenebrosus, or The Dark Year Or Astrologicall Iudgements upon Two Lunar Eclipses, and One Admirable Eclips of the Sun, All Visible in England, 1652. Together with a Short Method How to Judge the Effects of Eclipses*. London: Printed for the Company of Stationers, and H. Blunden, 1652.

———. *William Lilly's History of His Life and Times, from the Year 1602 to 1681. Written by Himself, in the Sixty-Sixth Year of His Age, to His Worthy Friend, Elias Ashmole, Esq.* London: Reprinted for Charles Baldwin, 1822.

Lucretius Carus, Titus. *On the Nature of Things*. Translated by W. H. D. (William Henry Denham) Rouse and Martin Ferguson Smith. Revised ed. Loeb Classical Library ; 181. Cambridge, MA: Harvard University Press, 2014.

Luther, Martin. "Lectures on Genesis Chapters 1-5." In *Luther's Works*, edited by Jaroslav Pelikan, translated by George V. Schick. Saint Louis: Concordia, 1958.

Maggio, Lucio. *Del terremoto: dialogo*. In Bologna: Per Alessandro Benacci, 1571.

Mariana, Juan de. *Historia general de España: compuesta primero en Latin, despues buelta en Castellano*. En Toledo: Por Pedro Rodriguez, 1601.

Martínez, Martín. *Juicio final de la astrologia, en defensa del Theatro critico universal: dividido en tres discursos ...* En Madrid: En la Imprenta Real, 1727.

Martínez Solares, José Manuel. *Los Efectos En España Del Terremoto de Lisboa (1 de Noviembre de 1755)*. Madrid: Dirección General del Instituto Geográfico Nacional, 2001.

Marvell, Andrew. "A Poem upon the Death of His Late Highness the Lord Protector." In *The Poems of Andrew Marvell*, edited by Nigel Smith. London: Pearson Longman, 2003.

Mather, Cotton. *The Wonders of the Invisible World Being an Account of the Tryals of Several Witches Lately Executed [Sic] in New-England, and of Several Remarkable Curiosities Therein Occurring*. 3rd edition. London: Printed first at Bostun [sic] in New-England, and reprinted at London for John Dunton, 1693.

———. *Magnalia Christi Americana: Or, The Ecclesiastical History of New-England, from Its First Planting in the Year 1620. unto the Year of Our Lord, 1698. In Seven Books*. London: T Parkhurst, 1702.

———. *Parentator: Memoirs of Remarkables in the Life and the Death of the Ever-Memorable Dr. Increase Mather, Who Expired August 23, 1723*. Boston: Printed by B Green for Nathaniel Belknap, at the corner of Scarlet's-Wharff, 1724.

———. *Diary of Cotton Mather, 1681-1724*. Collections of the Massachusetts Historical Society ; Ser. 7, v. 7-8. Boston: The Society, 1911.

Mather, Increase. *A Discourse Concerning the Danger of Apostasy...Preached in the Audience of the General Assembly of the Massachusets Colony at Boston in New England, May 23, 1677: Being the Day of Election There*. Boston: n.p., 1679.

———. *[The Necessity] of Reformation with the Expedients Subsर्वient Thereunto Asserted in Answer to Two Questions, I. What Are the Evils That Have Provoked the Lord to Bring His Judgements on New-England?, II. What Is to Be Done That*



*so Those Evils May Be Reformed? / Agreed upon by the Elders and Messengers of the Churches Assembled in the Synod at Boston in New-England, Sept. 10, 1679.* Boston: Printed by John Foster, 1679.

———. *A Confession of Faith, Owned and Consented unto by the Elders and Messengers of the Churches Assembled at Boston in New-England, May 12, 1680.* Boston: John Foster, 1680.

———. *Heavens Alarm to the World, or A Sermon Wherein Is Shewed, That Fearful Sights and Signs in Heaven Are the Presages of Great Calamities at Hand.* Boston: Printed by John Foster, 1681.

———. *Heaven's Alarm to the World, or A Sermon Wherein Is Shewed That Fearful Sights and Signs in Heaven Are the Presages of Great Calamities at Hand.* The second impression. Boston in New-England: Printed for Samuel Sewall and are to be sold by Joseph Browning at the corner of the Prison-Lane next the Town-House, 1682.

———. *The Latter Sign Discoursed of, in a Sermon Preached at the Lecture of Boston in New-England; August, 31. 1682. Wherein Is Shewed, That the Voice of God in Signal Providences, Especially When Repeated and Iterated, Ought to Be Hearkened Unto.* Boston: Printed for Samuel Sewall, 1682.

———. *Kometographia. Or A Discourse Concerning Comets: Wherein the Nature of Blazing Stars Is Enquired into: With an Historical Account of All the Comets Which Have Appeared from the Beginning of the World unto This Present Year, M.DC.LXXXIII. : Expressing the Place in the Heavens, Where They Were Seen, Their Motion, Forms, Duration; and the Remarkable Events Which Have Followed in the World, so Far as They Have Been by Learned Men Observed. : As Also*

*Two Sermons Occasioned by the Late Blazing Stars.* Boston: Printed by S[amuel] G[reen] for S[amuel] S[ewall] And sold by J Browning at the corner of the Prison Lane next the town-house, 1683.

———. *An Essay for the Recording of Illustrious Providences: Wherein an Account Is given of Many Remarkable and Very Memorable Events, Which Have Hapned This Last Age, Especially in New-England.* Boston in New-England: Printed by Samuel Green for Joseph Browning, and are to be sold at his shop, 1684.

———. *A Discourse Concerning Earthquakes: Occasioned by the Earthquakes Which Were in New-England, in the Province of Massachusetts-Bay, June 16. and in Conecticot-Colony, June 22. 1705...* Boston: Printed by Timothy Green, for Benjamin Eliot, at his shop under the west end of the Exchange, 1706.

———. *Diary by Increase Mather, March, 1675-December, 1676: Together with Extracts from Another Diary by Him, 1674-1687.* Edited by Samuel A. Green. Cambridge: J Wilson, 1900.

Mayhew, Jonathan. *The Expected Dissolution of All Things, a Motive to Universal Holiness: Two Sermons Preached in Boston, N.E. on the Lord's-Day, Nov. 23, 1755; Occasioned by the Earthquakes Which Happened on the Tuesday Morning, and Saturday Evening Preceeding.* Boston: Printed by Edes & Gill, and sold at their printing-office, next to the prison in Queen-Street; and by R Draper, in Newbury-Street, 1755.

Mead, Richard. *A Short Discourse Concerning Pestilential Contagion, and the Methods to Be Used to Prevent It.* London: printed for Sam Buckley and Ralph Smith, 1720.

Mexía, Pedro. *Historia imperial, y cesarea: En que sumariamente se contienen las vidas, y hechos de todos los emperadores, desde Iulio Cesar, hasta Maximiliano Primero*. En Madrid: Por Melchor Sanchez, 1655.

Montano, Vicente. *Discurso astronomico que dedica al Excelentissimo señor Duque de Alburquerque ... del Consejo de Estado, y Capitan General de la Armada, y exercito del Mar Oceano*. n.p.: n.p., n.d.

More, Thomas. *A Dialogue of Cumfort against Tribulation, Made by the Right Vertuous, Wise and Learned Man, Sir Thomas More, Sometime L. Chancellor of England, Which He Wrote in the Tower of London, An. 1534...* Now newly set forth, with Many places restored and Corrected by conference of sundrie copies. Antuerpiae: Apud Iohannem Foulherum, Anglum, 1573.

Morin, Jean Baptiste. *Remarques astrologiques sur le Commentaire du Centiloque de Ptolémée, ou la seconde partie de l'Uranie de Messire Nicolas de Bourdin, marquis de Villennes, etc*. Paris: Retz, 1976.

Morton, Nathaniel. *New-Englands Memoriall, or, A Brief Relation of the Most Memorable and Remarkable Passages of the Providence of God Manifested to the Planters of New-England in America with Special Reference to the First Colony Thereof, Called New-Plimouth*. Cambridge: Printed by S.G. and M.J. for John Usher of Boston, 1669.

Mugaburu, Josephe de. *Chronicle of Colonial Lima: The Diary of Josephe and Francisco Mugaburu, 1640-1697*. Translated by Robert Ryal Miller. Norman: University of Oklahoma Press, 1975.

Musanzio, Giovanni Domenico. *Fax chronologica ad omnigenam historiam ...* Romae: s.n., 1701.

Newton, Isaac. *Opticks: Or, A Treatise of the Reflections, Refractions, Inflections and Colours of Light*. 3rd ed. London: printed for William and John Innys at the West End of St Paul's, 1721.

Nieremberg, Juan Eusebio. *Curiosa filosofia y tesoro de maravillas de la naturaleza, examinadas en varias cuestiones naturales...* En Madrid: En la Imprenta del Reyno, 1634.

Nieremberg, Juan Eusebio. *Causa y remedio de los males publicos*. Madrid: Por Maria de Quiñones, 1642.

Noguera, Vicente. *Sermon de rogativas por los terremotos sucedidos en las ciudades de Napoles, y Lima: celebradas de orden del Rey ... la ... Diputacion, y Reyno de Valencia, en 13 de setiembre 1688*. Valencia: en la Imprenta de Iaime de Bordazar, en la Plaça de las Barcas, 1688.

Oviedo y Valdés, Gonzalo Fernández de. *De La Natural Hystoria de Las Indias*. Toledo: n.p., 1526.

Orosius, Paulus. *Seven Books of History against the Pagans: The Apology of Paulus Orosius*. Translated by Irving W. Raymond. New York: Columbia University Press, 1936.

Paine, Thomas. *The Doctrine of Earthquakes : Two Sermons Preached at a Particular Fast in Weymouth, Nov. 3. 1727. The Friday after the Earthquake...* Boston: Printed for D Henchman, over-against the Brick Meeting-House in Cornhill, 1728.

Panthot, Jean-Baptiste. *Dissertation tres instructive, et tres curieuse pour la pratique sur trois operations de la pierre faites en six mois de temps: avec un grand succes, et une parfaite guerison de celuy qui les a souffert*. A Lyon: chez Jacque Guerrier ..., 1702.

———. *Traitté de la baguette, ou La recherche des véritables usages auxquels elle convient pour la découverte des voleurs, des meurtriers, sur la terre & sur les eaux, des bornes, des trésors ... Extrait du Mercure*. 3e édition augmentée. Lyon: T. Amaulri et J. Guerrier, 1693.

Paré, Ambroise. *Des monstres et prodiges*. Edited by Michel Jeanneret. Paris: Gallimard, 2015.

Parets, Miquel. *A Journal of the Plague Year: The Diary of the Barcelona Tanner Miquel Parets, 1651*. Translated by James S. Amelang. New York: Oxford University Press, 1991.

Pascal, Blaise. *Pensées and Other Writings*. Translated by Honor Levi. Oxford; New York: Oxford University Press, 1995.

Peralta Barnuevo, Pedro de. *Historia de España vindicada: en que se haze su mas exacta descripcion la de sus excelencias y antiguas riquezas ...* Lima: En la Oficina de Francisco Sobrino, 1730.

———. *Obras dramáticas*. Edited by Irving A. Leonard. Santiago de Chile: Imprenta universitaria, 1937.

———. *Obras dramáticas cortas*. Edited by Elvira Ampuero. Lima: Biblioteca Universitaria, 1964.

———. *Lima fundada*. Edited by David F. Slade and Jerry M. Williams. Chapel Hill, N.C.: University of North Carolina Press, 2016.

Perkins, John. *An Essay on the Agitations of the Sea, and Some Other Remarkables Attending the Earthquakes of the Year M,DCC,L,V: To Which Are Added, Some Thoughts on the Causes of Earthquakes*. Boston: Printed and sold by B Mecom, at the new printing-office, near the Town-House, 1761.

Phips, Spencer. *By the Honourable Spencer Phips, Esq; Lieutenant-Governour and Commander in Chief, in and over His Majesty's Province of the Massachusetts-Bay in New-England. A Proclamation... Given at the Council-Chamber in Boston, the Twenty-Fourth Day of December 1755 ....* Boston: Printed by John Draper, printer to His Honour the lieutenant-governour and Council, 1755.

Petit, Pierre. *Dissertation sur la nature des comètes ... avec un Discours sur les pronostiques des éclipses & autres matières curieuses, par P. Petit,...*, 1665.

Petty, William. *Observations upon the Dublin-Bills of Mortality, MDCLXXXI, and the State of That City*. London: Printed for Mark Pardoe, 1683.

———. *The Petty Papers; Some Unpublished Writings of Sir William Petty*. Edited by Henry William Edmund Petty-Fitz Maurice Lansdowne. London; Boston and New York: Constable & Co; Houghton Mifflin Co, 1927.

———. *The Economic Writings of Sir William Petty: Together with the Observations upon the Bills of Mortality, More Probably by Captain John Graunt*. Edited by Charles Henry Hull. New York: AM Kelley, 1963.

Petrarca, Francesco. *De los remedios contra prospera y adversa fortuna*. Caragoça: por Georgi Coci, 1523.

———. *Messire Francois petracque des remedes de lune & lautre fortune: prospere & aduerse: nouvellement imprime a Paris*. On le vend a Paris: rue Saint Jacques par honneste homme Pierre Cousin, 1534.

———. *Phisicke against Fortune, Aswell Prosperous, as Adverse: Conteyned in Two Bookees...* Translated by Thomas Twyne. London: Printed by Thomas Dawson for Richard Watkyns, 1579.

———. *Petrarch's Remedies for Fortune Fair and Foul: A Modern English Translation of De Remediis Utriusque Fortune, with a Commentary*. Translated by Conrad H. Rawski. Bloomington: Indiana University Press, 1991.

Pigot, Thomas. "An Account of the Earthquake That Happened at Oxford and the Parts Adjacent Sept. 17. 1683. by a Fellow of a College in That University, and of the Royal Society." *Philosophical Transactions of the Royal Society of London* 13, no. 151 (1683): 311–21.

Pithois, Claude. *A seventeenth-century exposure of superstition: select texts of Claude Pitboys (1587-1676)*. Edited by P. J. S. Whitmore. The Hague: Nijhoff, 1972.

Plot, Robert. *The Natural History of Stafford-Shire*. Oxford: Printed at the Theater, 1686.

Poole, Matthew. *Synopsis criticorum aliorumque S. Scripturæ interpretum*. Londini: Typis J Flesher (usque ad I Sam deinde à II Reg inclusive ad finem voluminis) & T Roycroft: Prostat apud Cornelium Bee, 1669.

———. *Annotations upon the Holy Bible...* London: Printed by John Richardson, for Thomas Parkhurst, Dorman Newman, Jonathan Robinson, Bradbazon Ailmer, Thomas Cockeril, and Benjamin Alsop, 1683.

Portichuelo de Ribadeneira, Diego c 1654. *Relación del viaje y sucessos que tuvo desde que salió de la ciudad de Lima, hasta que llegó a estos Reynos de España el Doctor Don Diego Portichuelo de Rivadeneyra*. En Madrid: por Domingo Garcia y Morras, 1657.

Prince, Thomas. *Earthquakes the Works of God and Tokens of His Just Displeasure....* Boston in New-England: Printed for D Henschman, over against the Brick Meeting House in Cornhill, 1727.

———. *Earthquakes the Works of God, and Tokens of His Just Displeasure...* Boston: printed and sold by D Fowle in Ann-Street, and by Z Fowle in Middle-Street, 1755.

———. *An Improvement of the Doctrine of Earthquakes, Being the Works of God, and Tokens of His Just Displeasure...* Boston, New-England: printed and sold by D Fowle in Ann-Street, and by Z Fowle in Middle-Street, 1755.



Questier, Mathurin. *L'astrologue incogneu ou Le speculateur universel des ephemerides celestes. Prédisant tous les bons-heurs & mal-heurs, qui peuvent arriver pendant le cours de l'année sainte 1650. Particulierement sur les divers climats françois, espagnols... & Liegeois. Où l'on remarquera des choses émerveillables, non veüs ny publiées.* Paris: chez Michel Ballagny, 1649.

R. B. [Nathaniel Crouch]. *The General History of Earthquakes: Being an Account of the Most Remarkable and Tremendous Earthquakes That Have Happened in Divers Parts of the World, from the Creation to This Time, as They Are Recorded by Sacred and Common Authors, and Peticularly Those Lately in Naples, Smyrna, Jamaica and Sicily: With a Description of the Famous Burning Mount, Ætna, in That Island, and Relation of the Several Dreadful Conflagrations and Fiery Irruptions Thereof for Many Ages: Likewise the Natural and Material Causes of Earthquakes, with the Usual Signs and Prognosticks of Their Approach, and the Consequents and Effects That Have Followed Several of Them.* London: Printed for Nath Crouch, 1694.

Raveneau de Lussan, Jacques. *Journal du voyage fait à la mer du Sud avec les flibustiers de l'Amérique en 1684 et années suivantes, par le sieur Raveneau de Lussan.* Paris: J. Le Febvre, 1699.

Ray, John. *Three Physico-Theological Discourses, Concerning I. The Primitive Chaos, and Creation of the World. II. The General Deluge, Its Causes and Effects. III. The Dissolution of the World and Future Conflagration...* 2nd edition. London: Printed for S Smith, 1693.

Ribera, Francisco de. *Francisci Riberae ... Societatis Iesu ... In sacram b. Iohannis Apostoli & Euangelistae Apocalypsin commentarij: cum quinq[ue] indicibus ... ; his adiuncti sunt quinq[ue] libri de Templo & de iis quae ad templum pertinēt, ad multorum intelligentiam cum primis utiles ...* Salmanticae: excudebat Petrus Lassus, 1591.

Rivilla Bonet y Pueyo, José de [Pedro de Peralta Barnuevo]. *Desvios de la naturaleza: O Tratado de el origen de los monstros. A que va anadido un compendio de curaciones chyrurgicas en monstruosos accidentes.* Lima: En la Imprenta Real por Joseph de Contreras, y Alvarado impressor, 1695.

Rocheftort, Charles de. *Histoire naturelle et morale des iles Antilles de l'Amérique. : Enrichie de plusieurs belles figures des raretez les plus considerables qui y sont d'écrites. : Avec vn vocabulaire Caraïbe.* A Rotterdam: Chez Arnould Leers, 1658.

Rosales, Diego de. *Historia general de el reino de Chile, Flandes Indiano.* Edited by Benjamín Vicuña Mackenna. Valparaiso: Impr del Mercurio, 1877.

Rousseau, Jean-Jacques. *Oeuvres de M. Rousseau de Genève.* Nouvelle édition. Amsterdam: Chez Marc-Michel Rey, 1769.

Rubio Salinas, Manuel Joseph. *Carta Pastoral que ... D. M. Rubio Salinas ... dirige al clero y pueblo de su diócesis, con motivo de las noticias, que ... se han recibido de España, del Temblor de Tierra, que en el dia 1 de Noviembre del año ... de 1755 se sintió ... en todo aquel Reyno.* En Mexico: En la Imprenta de la Bibliotheca Mexicana, 1756.

Russiliano, Tiberio. *Apologeticus adversus cucullatos: testo critico, traduzione e note.* Cosenza: Periferia, 1991.

Salinero, Juan. *Pragmática del tiempo en defensa de la buena astrologia contra el juicio final de la astrologia que escribió ... Martin Martínez*. En Madrid: se hallará en casa de Juan de Moya, 1727.

Seneca, Lucius Annaeus. *Natural Questions*. Translated by Harry M. Hine. Chicago; London: The University of Chicago Press, 2010.

Sewall, Samuel. *Phaenomena Quaedam Apocalyptica Ad Aspectum Novi Orbis Configurata. Or, Some Few Lines towards a Description of the New Heaven as It Makes to Those Who Stand upon the New Earth*. Boston: Printed by Bartholomew Green, and John Allen, and are to be sold by Richard Wilkins, 1697.

———. *Diary of Samuel Sewall: 1674-1729*. Collections of the Massachusetts Historical Society ; Ser. 5, v. 5-7. Boston: Massachusetts Historical Society, 1878.

Short, Thomas. *A Rational Discourse of the Inward Uses of Water. Shewing Its Nature, Choice, and Agreeableness to the Blood; Its Operation on the Solids and Fluids; In What Constitutions and Times Proper; How It Promotes Necessary, and Abateth Hurtful Evacuations: In What Diseases Restorative, and Wherein Prejudicial*. London: printed for Samuel Chandler, at the Cross-Keys in the Poultry, 1725.

———. *A General Chronological History of the Air, Weather, Seasons, Meteors, &c. in Sundry Places and Different Times; ... with Some of Their Most Remarkable Effects on Animal (Especially Human) Bodies, and Vegetables*. London: printed for T Longman; and A Millar, 1749.

Simon, Charles. *Recit du prodigieux tremble-terre arrivé en la Nouvelle-France l'an 1663, : tiré d'une lettre écrite de ce pays par vne personne digne de foy, & confirmé par le rapport de tous ceux qui en sont reuenus cette année avec la flotte de Canada*. n.p.: n.p., n.d.

———. "Relatio Terræmotus in Nova Francia, 1663." In *The Jesuit relations and allied documents; travels and explorations of the Jesuit missionaries in North America 1610-1791*, edited by Reuben Gold Thwaites, translated by Finlow Alexander, Percy Favor Bicknell, Crawford Lindsay, and Price William, Vol. 48. Cleveland, OH: The Burrows Brothers Company, 1899.

Sigüenza y Góngora, Carlos de. *Alboroto y motín de México del 8 de junio de 1692. Relación de Don Carlos de Sigüenza y Góngora en una carta dirigida al Almirante Don Andrés de Pez*. Edited by Irving Albert Leonard. México: Talleres gráficos del Museo nacional de arqueología, historia y etnografía, 1932.

———. "Almanaque 1692." In *La Astrología En La Nueva España En El Siglo XVII - de Enrico Martínez a Sigüenza y Góngora*, edited by José Miguel Quintana. Mexico: Bibliófilos mexicanos, 1969.

———. "Almanaque 1693." In *La Astrología En La Nueva España En El Siglo XVII - de Enrico Martínez a Sigüenza y Góngora*, edited by José Miguel Quintana. Mexico: Bibliófilos mexicanos, 1969.

———. *Libra astronómica y filosófica*. Nueva biblioteca mexicana ; 2. México: Centro de Estudios Filosóficos, Universidad Nacional Autónoma de México, 1959.

Sloane, Hans. “A Letter from Hans Sloane, M.D. and S.R.S. with Several Accounts of the Earthquakes in Peru October the 20th 1687. And at Jamaica, February 19th. 1687/8 and June the 7th. 1692.” *Philosophical Transactions of the Royal Society* 18, no. 209 (1694): 78–100.

———. *A Voyage to the Islands Madera, Barbados, Nieves, S. Christophers and Jamaica....* London: printed by B M for the author, 1707.

Smith, Thomas. “Historical Observations Relating to Constantinople, by the Reverend and Learned Tho. Smith, D.D. Fellow. of Magd. College Oxon. and. of the Royal Society.” In John Ray, *Travels through the Low Countries, Germany, Italy and France, with Curious Observations, Natural, Topographical, Moral, Physiological, & c. Also, A Catalogue of Plants, Found Spontaneously Growing in Those Parts, and Their Virtues.*, Second edition. London: Printed for J Walthoe, D Midwinter, A Bettesworth and C Hitch, W Innys, R Robinson, J Wilford, A Ward, J and P Knapton, T Longman, O Payne, W Shropshire, J and R Tonson, T Woodman, R Chandler, and J Wellington, 1738.

Sprat, Thomas. *The History of the Royal-Society of London, for the Improving of Natural Knowledge*. London: Printed by TR for J Martyn , and J Allestry, 1667.

Stafford, Richard. *The Absolute Truth, and Utmost Certainty of the Word of God: And That All Things Which Are Contained in the Scriptures, Yea to Every Tittle and Iota Thereof, Will Be Fulfilled: Demonstrated in a Discourse on Rom IX.* 6. London: Printed, and are to be sold by Ralph Simpson, 1699.

Stukeley, William. *The Philosophy of Earthquakes, Natural and Religious.: Or an Inquiry into Their Cause, and Their Purpose.* By William Stukeley, M. D. Rector of St. George's, Queen-Square; Fellow of the College of Physicians, and of the Royal and Antiquarian Societies. The Third Edition. To Which Is Added, Part III. on the Same Subject. London: printed for A and C Corbett, at their Correct State Lottery-Office over-against St Dunstan's Church, Fleetstreet, 1756.

Sydenham, Thomas. "Medical Observations Concerning the History and Cure of Acute Diseases." In *The Works of Thomas Sydenham, M.D.*, vol. 1, edited by William Alexander Greenhill and R. G. Latham, 3rd ed. Publications of the Sydenham Society. London: Printed for the Sydenham Society, 1848.

———. "Theologia Rationalis." In *The Works of Thomas Sydenham, M.D.*, vol. 2, edited by William Alexander Greenhill and R. G. Latham. Publications of the Sydenham Society. London: Printed for the Sydenham Society, 1848.

Taylor, John. *The Fearefull Summer: Or, Londons Calamitie, the Countries Discourtesie, and Both Their Miserie Printed by Authoritie in Oxford, in the Last Great Infection of the Plague, 1625...* n.p.: n.p., 1636.

Du Tertre, Jean-Baptiste. *Histoire generale des Antilles habitees par les François et enrichy de cartes & de figures.* Seconde édition. A Paris: chez Thomas Jolly, 1667.

Thoum, Louis du. *Le tremble-terre ou sont contenus ses causes, signes, effets & remedes*. Bordeaux: Par Gilbert Vernoy, 1616.

Thurloe, John. *Collection of the State Papers of John Thurloe, Esq; Secretary First to the Council of State and Afterwards to the Two Protectors Oliver and Richard Cromwell*. Edited by Thomas Birch. London: Fletcher Gyles, 1742.

Thwaites, Reuben Gold, ed. *The Jesuit Relations and Allied Documents; Travels and Explorations of the Jesuit Missionaries in North America (1610-1791)*. Translated by Finlow Alexander, Percy Favor Bicknell, Crawford Lindsay, and Price William. Cleveland, OH: The Burrows Brothers Company, 1899.

———. “Epistola ad R.P. Joannem Paulum Olivam, Praepositum Generalem Societatis Jesu, Romae. Hieronymus Lalement; Quebeci in nova francia, August 18, 1663.” In *The Jesuit relations and allied documents; travels and explorations of the Jesuit missionaries in North America 1610-1791*, Vol. 47. Cleveland, OH: The Burrows Brothers Company, 1899.

———. “Relation de ce qui s’est passé de plus remarquable aux missions des peres de la Compagnie de Iesus en la Nouvelle France, és années 1663. & 1664. Envoyée au R.P. André Castillon, Provincial de la Province de France.” In *The Jesuit relations and allied documents; travels and explorations of the Jesuit missionaries in North America 1610-1791*, Vol. 48. Cleveland, OH: The Burrows Brothers Company, 1899.

Torres Villarroel, Diego de. *Entierro del juicio final, y vivificacion de la astrologia, herida con tres llagas, en lo natural, moral, y politico: y curada con tres parches: parche primero, la astrologia es buena, y cierta en lo natural: parche segundo, la*

*astrologia es verdadera, y segura en lo moral: parche tercero, La astrologia es util, y provechosa en lo politico.* En Madrid: En la Imprenta de Antonio Marin : Se hallará en casa de Juan de Moya, frente de San Felipe, 1727.

Tostado Ribera, Alphonsus. *Alphonsi Tostati Hispani, Episcopi Abvlensis, Philosophi, Theologi ... Commentaria in Sextam Partem Matthæi: Mendis nunc sanè quàm plurimis diligenter expurgata ...* Venetiis: Nicolini, 1596.

Ulloa, Antonio de. *Relacion historica del viage a la America Meridional hecho de orden de S. Mag. para medir algunos grados de meridiano terrestre, y venir por ellos en conocimiento de la verdadera figura, y magnitud de la tierra, con otras varias observaciones astronomicas, y phisicas.* En Madrid: Por Antonio Marin, 1748.

Unanue, José Hipólito. *Observaciones sobre el clima de Lima y su influencia en los seres organizados, en especial el hombre.* Edited by Carlos Enrique Paz-Soldán. Lima: Lux, 1940.

Valle, Thomás del. *Don Fr. Thomás Del Valle ... Obispo de Cadiz, y Algeciras ... a Todos Los Fieles de Esta Ciudad ... Despues de La Terrible, Espantosa, y á Nuestros Ojos Jamás Vista Tormenta Del Temblor de Tierra, y Enfurecida Brabeza de El Mar ...* n.p.: n.p., 1755.

Various authors. "An Extraordinary and Surprising Agitation of the Waters..." *Philosophical Transactions of the Royal Society of London* 49 (1755): 351–98.



Vásquez de Herrera, Francisco, and Manuel Lobo. *Vida y virtudes del venerable hermano Pedro de San José de Betancur*. Edited by Lázaro Lamadrid Jimenez. Guatemala: n.p., 1962.

Villarroel, Gaspar de. *Gobierno Eclesiástico pacífico, y union de los dos cuchillos, pontificio y regio*. Madrid: D. Garcia Morràs, 1656.

———. *Gobierno eclesiastico-pacífico y union de los dos cuchillos Pontificio y Regio*. Madrid: en la oficina de Antonio Marin, 1738.

Voltaire. “Candide.” In *Candide and Other Stories*, translated by Roger Pearson, New ed. Oxford; New York: Oxford University Press, 2006.

———. *Poèmes sur la religion naturelle et sur la destruction de Lisbonne , par M. de V\*\*\**. s.i.: s.n., 1756.

Walpole, Horace. *The Yale Edition of Horace Walpole's Correspondence*. Edited by W. S. Lewis. New Haven: Yale University Press, 1937.

Ward, Edward. *A Trip to Jamaica: With a True Character of the People and Island*. The fourth edition. London: n.p., 1699.

Warren, Henry. *A Treatise Concerning the Malignant Fever in Barbados, and the Neighbouring Islands: With an Account of the Seasons There, from the Year 1734 to 1738. In a Letter to Dr. Mead. By Henry Warren, M. D.* London: printed for Fletcher Gyles against Grays-Inn in Holborn, 1740.

Warwick, Mary Rich. *Memoir of Lady Warwick: Also Her Diary, from A.D. 1666 to 1672, Now First Published: To Which Are Added, Extracts from Her Other Writings.* Edited by Anthony Walker. London: Religious Tract Society, 1847.

Wesley, John. *Serious Thoughts Occasioned by the Earthquake at Lisbon. : To Which Is Subjoin'd an Account of All the Late Earthquakes There, and in Other Places.* The sixth edition. London: n.p., 1756.

Winthrop, John. *A Lecture on Earthquakes: Read in the Chapel of Harvard-College in Cambridge, N.E. November 26th 1755. On Occasion of the Great Earthquake Which Shook New-England the Week Before.* Boston; New-England: Printed and sold by Edes & Gill, at their printing-office next to the prison in Queen-Street, 1755.

———. *A Letter to the Publishers of the Boston Gazette, &c.: Containing an Answer to the Rev. Mr. Prince's Letter, Inserted in Said Gazette, on the 26th of January 1756.* Boston: Printed by Edes and Gill, 1756.

Woodward, John. *An Essay toward a Natural History of the Earth: And Terrestrial Bodies, Especially Minerals : As Also of the Sea, Rivers, and Springs : With an Account of the Universal Deluge : And of the Effects That It Had upon the Earth.* London: Printed for Ric Wilkin, 1695.

Woodward, Josiah. *An Account of the Rise and Progress of the Religious Societies in the City of London &c.: And of the Endeavours for Reformation of Manners Which Have Been Made Therein*. Second edition enlarged. London: Printed by J D for the author and sold by Ra Simpson, 1698.

Worthington, John. *The Diary and Correspondence of Dr. John Worthington ... from the Baker Mss. in the British Museum and the Cambridge University Library and Other Sources*. Edited by James Crossley and Richard Copley Christie. Manchester, UK: Printed for the Chetham Society, 1855.

Yepes, Miguel de. *Discurso theologico y filosofico contra la Astrologia, y los que la professan, y juicio de el Cometa que se ha visto en este Horizonte de Madrid, desde 23. de diziembre de el año passado de 1680. hasta el dia de oy 11 de enero de 1681*.

N.p.: n.p., n.d.

Zaragoza, Ioseph. *Esphera en comun Celeste y Terraqueo*. En Madrid: Por Iuan Martin del Barrio, 1675.

Secondary Sources:

“AHR Forum: The General Crisis of the Seventeenth Century Revisited.” *American Historical Review* 113, no. 4 (2008).

Adams, Eleanor Burnham. *Two Colonial New Mexico Libraries, 1704, 1776*. Santa Fe: University of New Mexico, 1944.

Aguilar Piñal, Francisco. “Conmoción espiritual provocada en Sevilla por el terremoto de 1755.” *Archivo Hispalense* 56, no. 171 (1973): 37.

Alberola-Romá, Armando. “Terremotos, memoria y miedo en la Valencia de la Edad Moderna.” *Estudis. Revista d'Història Moderna* 38 (2012).

Alchon, Suzanne Austin. *Native Society and Disease in Colonial Ecuador*. Cambridge: University Press, 1992.

Alfani, Guido. “Plague in Seventeenth-Century Europe and the Decline of Italy: An Epidemiological Hypothesis.” *European Review of Economic History* 17, no. 4 (2013): 408–30.

Álvarez Brun, F. “José Eusebio de Llano Zapata.” *Nueva Corónica* 1 (1963): 33–101.

Amunátegui, Miguel Luis. *El terremoto del 13 de mayo de 1647*. Santiago de Chile: R Jover, 1882.

Anderson, Katharine. *Predicting the Weather: Victorians and the Science of Meteorology*. Chicago: University of Chicago Press, 2005.

Anstey, Peter. "The Creation of the English Hippocrates." *Medical History* 55, no. 4 (2011): 457–78.

Armitage, David. *The Declaration of Independence: A Global History*. Cambridge, MA: Harvard University Press, 2007.

———. *Foundations of Modern International Thought*. Cambridge, UK; New York: Cambridge University Press, 2013.

Arnold, Catherine S. "Affairs of Humanity: Arguments for Humanitarian Intervention in England and Europe, 1698–1715." *The English Historical Review* 133, no. 563 (2018): 835–65.

Ayalon, Yaron. *Natural Disasters in the Ottoman Empire: Plague, Famine, and Other Misfortunes*. New York: Cambridge University Press, 2015.

Azzolini, Monica. *The Duke and the Stars: Astrology and Politics in Renaissance Milan*. Cambridge, MA: Harvard University Press, 2013.

———. “Coping with Catastrophe. St Filippo Neri as Patron Saint of Earthquakes.” *Quaderni Storici* 52, no. 3 (2017): 727–50.

Baldini, Ugo. “The Roman Inquisition’s Condemnation of Astrology: Antecedents, Reasons and Consequences.” In *Church, Censorship, and Culture in Early Modern Italy*, edited by Gigliola Fragnito, translated by Adrian Belton. Cambridge Studies in Italian History and Culture. Cambridge, UK; New York: Cambridge University Press, 2001.

Balteau, J., Michel Prévost, Marius Barroux, Roman d’Amat, Jean-Pierre Lobies, and Yves Chiron, eds. *Dictionnaire de biographie française*. Paris: Letouzey et Ané, 1933-2018.

Bankoff, Greg. *Cultures of Disaster: Society and Natural Hazards in the Philippines*. New York: Routledge, 2002.

———. “Vulnerability as a Measure of Change in Society.” *International Journal of Mass Emergencies and Disasters* 21, no. 2 (2003): 5–30.

———. “‘Regions of Risk’: Western Discourses on Terrorism and the Significance of Islam.” In *Representing the Unimaginable: Narratives of Disaster*, edited by Angela Stock and Cornelia Stott. Frankfurt am Main; New York: Peter Lang, 2007.

Baratta, Mario. *I Terremoti d’Italia: Saggio Di Storia, Geografia e Bibliografia Sismica Italiana*. Torino: Fratelli Bocca, 1901.

Barnard, Toby. “William Petty”, *The Oxford Dictionary of National Biography*.

Barnes, Robin Bruce. *Astrology and Reformation*. Oxford: Oxford University Press, 2016.

———. *Prophecy and Gnosis: Apocalypticism in the Wake of the Lutheran Reformation*. Stanford, Calif.: Stanford University Press, 1988.

Barnett, Lydia. “Between Pleasure and Terror: Enlightenment Science and Maupertuis’ Letter on the Comet.” *Architectural Theory Review* 20, no. 1 (2015): 30–45.

———. *After the Flood: Imagining the Global Environment in Early Modern Europe*. Baltimore, Maryland: Johns Hopkins University Press, 2019.

Bauer Coleman, Lauri. “‘Rain down Righteousness’: Interpretations of Natural Events in Mid-Eighteenth-Century Boston.” In *Remaking Boston: An Environmental History of the City and Its Surroundings*, edited by Anthony N. Penna and Conrad Edick Wright. Pittsburgh, PA: University of Pittsburgh Press, 2009.

Beck, Ulrich. *Risk Society: Towards a New Modernity*. London; Thousand Oaks, CA: Sage Publications, 1992.

Bégrand, Patrick. *Signes et châtements, monstres et merveilles : stratégies discursives dans les “relaciones de milagros” publiées en Espagne au XVIIIe siècle*. Besançon: Presses universitaires franc-comtoises, 2004.

Bégrand, Patrick. *Las relaciones de sucesos, relatos fácticos, oficiales y extraordinarios*. Besançon: Presses Univ. Franche-Comté, 2006.

Bénat Tachot, Louise. "Présentation." *e-Spania. Revue interdisciplinaire d'études hispaniques médiévales et modernes*, no. 12 (2011).

Bennassar, Bartolomé, ed. *Les catastrophes naturelles dans l'Europe médiévale et moderne: actes des XV<sup>e</sup> Journées internationales d'histoire de l'Abbaye de Flaran, 10,11 et 12 septembre 1993*. Toulouse: Presses universitaires du Mirail, 1996.

Benton, Lauren A. *Law and Colonial Cultures: Legal Regimes in World History, 1400-1900*. Cambridge, UK; New York: Cambridge University Press, 2002.

Bergman, Jonathan. "Disaster: A Useful Category of Historical Analysis." *Historical Compass* 6, no. 3 (2008): 934–46.

Berlioz, Jacques. *Catastrophes naturelles et calamités au Moyen Age*. Firenze: Sismel, 1998.

Berlioz, Jacques. "En forme de conclusion." *Hypothèses* 3 (1999): 65–67.

Biraben, Jean Noël. *Les hommes et la peste en France et dans les pays européens et méditerranéens*. Civilisations et sociétés ; 35. Paris: Mouton, 1975.

Bjork, Robert E., ed. *Catastrophes and the Apocalyptic in the Middle Ages and Renaissance*. Turnhout: Brepols, 2019.



Blair, Ann. "Humanist Methods in Natural Philosophy: The Commonplace Book." *Journal of the History of Ideas* 53, no. 4 (1992): 541.

———. *The Theater of Nature: Jean Bodin and Renaissance Science*. Princeton, NJ: Princeton University Press, 1997.

———. "Science and Religion." In *The Cambridge History of Christianity*, edited by R. Po-Chia Hsia, Vol. 6. Cambridge, UK: Cambridge University Press, 2007.

———. *Too Much to Know: Managing Scholarly Information before the Modern Age*. New Haven: Yale University Press, 2010.

Blanc, Paul-Louis. "The Tsunami in Cadiz on 1 November 1755: A Critical Analysis of Reports by Antonio de Ulloa and by Louis Godin." *Comptes Rendus - Géoscience* 340, no. 4 (2008): 251–61.

Bobrowsky, Peter T., ed. *Encyclopedia of Natural Hazards*. Dordrecht: Springer Netherlands, 2013.

Boia, Lucian. *The Weather in the Imagination*. London: Reaktion, 2005.

Bolton Valenčius, Conevery. *The Lost History of the New Madrid Earthquakes*. Chicago; London: The University of Chicago Press, 2013.

Bourke, Joanna. *Fear: A Cultural History*. London: Virago, 2005.

Braun, Theodore E. D. "Voltaire and Le Franc de Pompignan: Poetic Reactions to the Lisbon Earthquake." In *The Lisbon Earthquake of 1755: Representations and Reactions*, edited by Theodore E. D. Braun and John B. Radner. SVEC, 2005:02. Oxford: Voltaire Foundation, 2005.

Bremer, Francis. "Increase Mather's Friends: The Trans-Atlantic Congregational Network of the Seventeenth Century." *Proceedings of the American Antiquarian Society* 94, no. 1 (1984): 59-96.

Bridenbaugh, Carl, and Roberta Bridenbaugh. *No Peace beyond the Line; the English in the Caribbean, 1624-1690*.

Bridenbaugh, Carl. *Beginnings of the American People 2*. New York: Oxford University Press, 1972.

Briese, Olaf, and Timo Günther. "Katastrophe: terminologische Vergangenheit, Gegenwart und Zukunft." *Archiv für Begriffsgeschichte*, 2009, 155–95.

Briffaud, Serge. "Introduction. Vers une nouvelle histoire des catastrophes." *Sources: revue de l'Association "Histoire au présent"* 33 (1993): 3–6.

Brockliss, L. W. B., and Colin Jones. *The Medical World of Early Modern France*. Oxford; New York: Clarendon Press, 1997.

Brosseder, Claudia. "Astrology in Seventeenth-Century Peru." *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences*, Stars, Spirits, Signs: Towards a History of Astrology 1100-1800, 41, no. 2 (2010): 146–57.

———. "Reading the Peruvian Skies." In *A Companion to Astrology in the Renaissance*, edited by Brendan Maurice Dooley, 399–427. Boston: Brill, 2013.

Bulman, William J., ed. *God in the Enlightenment*. New York: Oxford University Press, 2016.

Burns, William E. *An Age of Wonders: Prodigies, Politics, and Providence in England, 1658-1727*. Manchester, UK; New York: Manchester University Press, 2002.

———. "'The Terriblest Eclipse That Hath Been Seen in Our Days': Black Monday and the Debate on Astrology during the Interregnum." In *Rethinking the Scientific Revolution*, edited by Margaret J. Osler. Cambridge ; New York: Cambridge University Press, 2000.

Cameron, Euan. *Enchanted Europe: Superstition, Reason, and Religion, 1250-1750*. Oxford, UK; New York: Oxford University Press, 2010.

Cañizares Esguerra, Jorge. "New World, New Stars: Patriotic Astrology and the Invention of Indian and Creole Bodies in Colonial Spanish America, 1600-1650." *The American Historical Review* 104, no. 1 (1999): 33–68.

Capel, Horacio. "Organicismo, fuego interior y terremotos en la ciencia española del xviii." *Geo Crítica: cuadernos críticos de geografía humana* 12, no. 27–28 (1980): Online edition.

Capp, B. S. *English Almanacs, 1500-1800: Astrology and the Popular Press*. Ithaca, N.Y.: Cornell University Press, 1979.

Caracciolo, Carlos H. "Natural Disasters and the European Printed News Network." In *News Networks in Early Modern Europe*, edited by Joad Raymond and Noah Moxham. Brill, 2016.

Cardim, Pedro, and Tamar Herzog, eds. *Polycentric Monarchies: How Did Early Modern Spain and Portugal Achieve and Maintain a Global Hegemony?* Eastbourne, UK; Portland, OR: Sussex Academic Press, 2012.

Carey, Mark. "Latin American Environmental History: Current Trends, Interdisciplinary Insights, and Future Directions." *Environmental History* 14, no. 2 (2009): 221–52.

Carozzi, Albert V. "Robert Hooke, Rudolf Erich Raspe, and the Concept of 'Earthquakes.'" *Isis* 61, no. 1 (1970): 85–91.

Carozzi, Marguerite. "Reaction of British Colonies in America to the 1755 Lisbon Earthquake a Comparison to the European Response." *Earth Sciences History* 2, no. 1 (1983): 17–27.

Carrière, Charles, Ferréol Rebuffat, and Marcel Courdurié. *Marseille, ville morte. La peste de 1720*. Marseille: M Garçon, 1968.

Cecere, Domenico. “Moralising Pamphlets: Calamities, Information and Propaganda in Seventeenth-Century Naples.” In *Disaster Narratives in Early Modern Naples: Politics, Communication and Culture*, edited by Domenico Cecere, Chiara De Caprio, Lorenzo Gianfrancesco, and Pasquale Palmieri. Roma: Viella, 2018.

———. “Introduzione: Disastri naturali e informazione negli imperi d’età moderna.” *Studi Storici* 4 (2019): 773–79.

———. “‘Subterranea conspiración’. Terremoti, comunicazione e politica nella monarchia di Carlo II.” *Studi Storici* 4 (2019): 811–43.

Céard, Jean. *La nature et les prodiges: l’insolite au XVI<sup>e</sup> siècle*. 2nd éd. rev. et aug. Genève: Droz, 1996.

Chaplin, Joyce E. *Subject Matter: Technology, the Body, and Science on the Anglo- American Frontier, 1500-1676*. Cambridge, MA: Harvard University Press, 2001.

———. *Round about the Earth: Circumnavigation from Magellan to Orbit*. New York: Simon & Schuster, 2012.

Chartier, Roger. *The Cultural Uses of Print in Early Modern France*. Princeton, NJ: Princeton University Press, 2019.

Chester, David K. "Theology and Disaster Studies: The Need for Dialogue." *Journal of Volcanology and Geothermal Research* 146, no. 4 (2005): 319–28.

Cipolla, Carlo M. *Fighting the Plague in Seventeenth-Century Italy*. Merle Curti Lectures ; 1978. Madison, Wis: University of Wisconsin Press, 1981.

Clark, Charles Edwin. "Science, Reason, and an Angry God: The Literature of an Earthquake." *The New England Quarterly* 38, no. 3 (1965): 340–62.

Clark, Geoffrey Wilson. *Betting on Lives: The Culture of Life Insurance in England, 1695-1775*. Manchester; New York: Manchester University Press, 1999.

Cocco, Sean. *Watching Vesuvius: A History of Science and Culture in Early Modern Italy*. Chicago: The University of Chicago Press, 2013.

Coen, Deborah R. *The Earthquake Observers: Disaster Science from Lisbon to Richter*. Chicago; London: The University of Chicago Press, 2013.

Cohn, Norman. *Noah's Flood: The Genesis Story in Western Thought*. New Haven: Yale University Press, 1996.

Condorelli, Stefano. "Le Tremblement de Terre de Sicile de 1693 et l'Europe: Diffusion Des Nouvelles et Retentissement." *Dimensioni e Problemi Della Ricerca Storica*, no. 2 (2013).

Cook, Harold J. "Sydenham, Thomas", *Oxford Dictionary of National Biography*.

Cook, Noble David, and W. George Lovell. "Unraveling the Web of Disease." In *Secret Judgments of God: Old World Disease in Colonial Spanish America*, edited by Noble David Cook and W. George Lovell. Norman: University of Oklahoma Press, 1991.

Cook, Noble David. *Born to Die: Disease and New World Conquest, 1492-1650*. Cambridge, UK; New York: Cambridge University Press, 1998.

Cooper, Donald B. *Epidemic Disease in Mexico City, 1761-1813; an Administrative, Social, and Medical Study*. Austin: Published for the Institute of Latin American Studies by the University of Texas Press, 1965.

Corteguera, Luis. "Loyalty and Revolt in the Spanish Monarchy." In *Early Modern Europe: From Crisis to Stability*, edited by Philip Benedict and Myron P. Gutmann. Newark: University of Delaware Press, 2005.

Crespo Solana, Ana. "Manifestaciones culturales y actitudes sociales y religiosas ante las catastrofes naturales en la España del Antiguo Regimen: el maremoto de 1755 en Cádiz." In *Naturalia, mirabilia & monstrosa en los imperios ibericos: siglos XV-XIX*, edited by Eddy Stols, Werner Thomas, and Johan Verberckmoes, 143–68. Leuven/Louvain: Leuven University Press, 2006.

Croke, Brian. "Two Early Byzantine Earthquakes and Their Liturgical Commemoration." *Byzantion* 51, no. 1 (1981): 122–47.

Crosby, Alfred W. *The Columbian Exchange: Biological and Cultural Consequences of 1492*. Westport, CT: Greenwood, 1972.

Cunningham, Andrew, and Ole Peter Grell. *The Four Horsemen of the Apocalypse: Religion, War, Famine and Death in Reformation Europe*. Cambridge, UK; New York: Cambridge University Press, 2000.

Curry, Patrick. *Prophecy and Power: Astrology in Early Modern England*. Cambridge: Polity, 1989.

Danley, Mark H., and Patrick J. Speelman. *The Seven Years' War: Global Views*. Boston: Brill, 2012.

Daston, Lorraine, and Katharine Park. *Wonders and the Order of Nature, 1150-1750*. New York; Cambridge, MA: Zone Books, 1998.

Daston, Lorraine. "Unruly Weather: Natural Law Confronts Natural Variability." In *Natural Law and Laws of Nature in Early Modern Europe: Jurisprudence, Theology, Moral and Natural Philosophy*, edited by Lorraine Daston and Michael Stolleis, 233–48. Farnham, England ; Burlington, VT: Ashgate, 2008.

———. "The Sciences of the Archive." *Osiris* 27, no. 1 (2012): 156–87.

Davison, Charles. *The Founders of Seismology*. Cambridge, UK: The University Press, 1927.



Delbourgo, James. *Collecting the World: Hans Sloane and the Origins of the British Museum*. Cambridge, MA: The Belknap Press of Harvard University Press, 2017.

Dear, Peter. *Discipline & Experience: The Mathematical Way in the Scientific Revolution*. Chicago: University of Chicago Press, 1995.

———. *Revolutionizing the Sciences: European Knowledge and Its Ambitions, 1500-1700*. Princeton, NJ: Princeton University Press, 2001.

Deconinck-Brossard, Françoise. “Acts of God, Acts of Men: Providence in Seventeenth- and Eighteenth-Century England and France.” In *Signs, Wonders, Miracles: Representations of Divine Power in the Life of the Church: Papers Read at the 2003 Summer Meeting and the 2004 Winter Meeting of the Ecclesiastical History Society*, edited by Kate Cooper and Jeremy Gregory, 356–75. Woodbridge; Rochester, NY: Published for the Ecclesiastical History Society by the Boydell Press, 2005.

Degroot, Dagomar. *The Frigid Golden Age: Climate Change, the Little Ice Age, and the Dutch Republic, 1560–1720*. New York: Cambridge University Press, 2018.

Delumeau, Jean. *La peur en Occident, XIVe-XVIIIe siècles: une cité assiégée*. Paris: Fayard, 1978.

Delumeau, Jean, and Yves Lequin. *Les malheurs des temps: histoire des fléaux et des calamités en France*. Paris: Larousse, 1987.

Dew, Nicholas. "Scientific Travel in the Atlantic World: The French Expedition to Gorée and the Antilles, 1681–1683." *The British Journal for the History of Science* 43, no. 1 (2010): 1–17.

Ditchfield, Simon. "Thinking with Saints: Sanctity and Society in the Early Modern World." *Critical Inquiry* 35, no. 3 (2009): 552–84.

De Vries, Jan. "The Limits of Globalization in the Early Modern World." *Economic History Review* 63, no. 3 (2010): 710–33.

De Zwart, Pim. *The Origins of Globalization: World Trade in the Making of the Global Economy, 1500-1800*. Cambridge, UK; New York: Cambridge University Press, 2018.

Diamond, Jared M. *Collapse: How Societies Choose to Fail or Succeed*. New York: Viking, 2005.

Dobyns, Henry F. *Their Number Become Thinned: Native American Population Dynamics in Eastern North America*. Knoxville, TN: Published by the University of Tennessee Press in cooperation with the Newberry Library Center for the History of the American Indian, 1983.

Dolan, Frances E. *True Relations: Reading, Literature, and Evidence in Seventeenth-Century England*. Philadelphia: University of Pennsylvania Press, 2013.

Domínguez, Francisco Atanasio. *The Missions of New Mexico, 1776; a Description, with Other Contemporary Documents*. Albuquerque: University of New Mexico Press, 1956.

Dombrovsky, Wolf R. "Again and Again: Is a Disaster What We Call 'Disaster'? Some Conceptual Notes on Conceptualizing the Object of Disaster Sociology." *International Journal of Mass Emergencies and Disasters* 13, no. 3 (1995): 241–54.

Dooley, Brendan. "News and Doubt in Early Modern Culture: Or, Are We Having a Public Sphere Yet?" In *The Politics of Information in Early Modern Europe*, edited by Brendan Dooley and Sabrina Alcorn Baron. London; New York: Routledge, 2001.

Dorbath, L., C. Cisternas, and C. Dorbath. "Assessment of the Size of Large and Great Historical Earthquakes in Peru." *Bulletin of the Seismological Society of America* 80, no. 3 (1990): 551–76.

Drake, Ellen T. *Restless Genius: Robert Hooke and His Earthly Thoughts*. New York: Oxford University Press, 1996.

Drévuillon, Hervé. *Lire et écrire l'avenir: l'astrologie dans la France du Grand Siècle, 1610-1715*. Seyssel: Champ Vallon, 1996.

Dunn, Richard S. *Sugar and Slaves: The Rise of the Planter Class in the English West Indies, 1624-1713*. Chapel Hill: Published for the Omohundro Institute of Early American History and Culture by the University of North Carolina Press, 2000.

Dynes, Russell. "The Lisbon Earthquake in 1755: Contested Meanings in the First Modern Disaster," Disaster Research Center Preliminary Paper 255, 1997.

Dynes, Russell. "The Lisbon Earthquake in 1755: The First Modern Disaster," Disaster Research Center Preliminary Paper 333, 2003.

Elliott, J. H. *The Revolt of the Catalans, a Study in the Decline of Spain, 1598-1640*. Cambridge, UK: University Press, 1963.

Elliott, J. H. "Revolts in the Spanish Monarchy." In *Preconditions of Revolution in Early Modern Europe*, edited by Robert Forster and Jack P. Greene. Baltimore: Johns Hopkins Press, 1970.

Elliott, J. H. "The General Crisis in Retrospect: A Debate without End." In *Early Modern Europe: From Crisis to Stability*, edited by Philip Benedict and Myron P. Gutmann. Newark: University of Delaware Press, 2005.

Ermus, Cindy. "The Spanish Plague That Never Was: Crisis and Exploitation in Cádiz during the *Peste* of Provence." *Eighteenth-Century Studies* 49, no. 2 (2016): 167–93.

Espinosa Cortés, Luz María, and Virginia García Acosta, eds. *Estudios históricos sobre desastres naturales en México: balance y perspectivas*. México, DF: Centro de Investigaciones y Estudios Superiores en Antropología Social, 1992.

Esposito, Mario. "On the Pseudo-Augustinian Treatise, 'De Mirabilibus Sanctae Scripturae': Written in Ireland in the Year 655." *Proceedings of the Royal Irish Academy* C35, no. 2 (1919): 189–207.

Eßer, Raingard. "Fear of Water and Floods in the Low Countries." In *Fear in Early Modern Society*, edited by William G. Naphy and Penny Roberts, 62–77. Manchester; New York: Manchester University Press, 1997.

Ettinghausen, Henry. *How the Press Began: The Pre-Periodical Printed News in Early Modern Europe*. A Coruña: SIELAE, Universidade da Coruña, 2015.

Everson, Jane E. "The Melting Pot of Science and Belief: Studying Vesuvius in Seventeenth-century Naples." *Renaissance Studies* 26, no. 5 (2012): 691–727.

Fea, John. "John Adams and Religion." In *A Companion to John Adams and John Quincy Adams*, edited by David Waldstreicher, 184–98. John Wiley & Sons, Ltd, 2013.

Febvre, Lucien. "Pour l'histoire d'un Sentiment: Le Besoin de Sécurité." *Annales. Histoire, Sciences Sociales* 11, no. 2 (1956): 244–47.

Feldman, L. H. "Active Measures in the War against Epidemics in Colonial Guatemala, 1519-1821." *Caduceus* 7, no. 3 (1991).

Feldman, Theodore S. "Late Enlightenment Meteorology." In *The Quantifying Spirit in the Eighteenth Century*, edited by Tore Frängsmyr, H. L. Heilborn, and Robin E. Rider, 143–78. Berkeley: University of California Press, 1990.

Ferreiro, Larrie D. *Measure of the Earth: The Enlightenment Expedition That Reshaped Our World*. New York: Basic Books, 2011.

Figliuolo, Bruno. “Il Terremoto Napoletano Del 1456: Il Mito.” *Quaderni Storici* 20, no. 60 (3) (1985): 771–801.

———. “Il Terremoto Napoletano Del 1456: La Cartografia.” *Quaderni Storici* 20, no. 60 (3) (1985): 803–10.

———. *Il terremoto del 1456*. Storia e scienze della terra 1. Altavilla Silentina: Studi storici meridionali, 1988.

Findlen, Paula. *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy*. Studies on the History of Society and Culture 20. Berkeley: University of California Press, 1994.

Findlen, Paula, ed. *Empires of Knowledge: Scientific Networks in the Early Modern World*. Abingdon, UK; New York: Routledge, 2019.

Forestier-Walker, Robin. “Georgia Priests Bless Tbilisi City in Bid to Contain COVID-19.” *Aljazeera*.

Accessed September 27, 2020. <https://www.aljazeera.com/videos/2020/03/18/georgia-priests-bless-tbilisi-city-in-bid-to-contain-covid-19/>.

Forrest, Ian. *Trustworthy Men: How Inequality and Faith Made the Medieval Church*. Princeton, NJ: Princeton University Press, 2018.

Fox, Adam. "Sir William Petty, Ireland, and the Making of a Political Economist, 1653–87." *The Economic History Review* 62, no. 2 (2009): 388–404.

François René [Binet, Étienne]. *Essay des merveilles de nature et des plus nobles artifices, pièce très-nécessaire à tous ceux qui font profession d'éloquence...* 12th ed. Paris: Chez Jean Poquet, 1657.

Friedman, Jerome. *The Battle of the Frogs and Fairford's Flies: Miracles and the Pulp Press during the English Revolution*. New York: St Martin's Press, 1993.

Fulton, Elaine, and Penny Roberts. "The Wrath of God: Explanations of Crisis and Natural Disaster in Pre-Modern Europe." In *History at the End of the World? History, Climate Change and the Possibility of Closure*. Penrith: HEB Humanities Ebooks, 2010.

Furedi, Frank. "The Changing Meaning of Disaster." *Area* 39, no. 4 (2007): 482–89.

García Acosta, Virginia, ed. *Historia y desastres en América Latina*. 3 vols. Publicaciones de la Casa Chata. Bogotá; México, DF: La RED/CIESAS: Tercer Mundo Editores, 1996.

García Acosta, Virginia, Juan Manuel Pérez Zevallos, and América Molina del Villar, eds. *Desastres agrícolas en México: catálogo histórico*. México D. F.: Centro de Investigaciones y Estudios Superiores en Antropología Social, 2003.

Garrioch, David. "1666 and London's Fire History: A Re-Evaluation." *The Historical Journal* 59, no. 02 (2016): 319–38.

Gaudin, Guillaume. *Penser et gouverner le Nouveau Monde au XVIIe siècle. L'empire de papier de Juan Díez de la Calle, commis du Conseil des Indes*. Paris: L'Harmattan, 2013.

Geneva, Ann. *Astrology and the Seventeenth Century Mind: William Lilly and the Language of the Stars*. Manchester; New York: Manchester University Press, 1995.

Gerdelan, Louis. "The Royal Society, Port Royal and the Great Trans-Atlantic Earthquake of 1692." *Storici* 4 (2019): 845–74.

Gillispie, Charles Coulston, et al. *Complete Dictionary of Scientific Biography*. Detroit, Mich.: Charles Scribner's Sons, 2008.

Ginzburg, Carlo. "Killing a Chinese Mandarin: The Moral Implications of Distance." *Critical Inquiry* 21, no. 1 (1994): 46–60.

Glacken, Clarence J. *Traces on the Rhodian Shore: Nature and Culture in Western Thought from the Ancient Times to the End of the Eighteenth Century*. Berkeley: University of California Press, 1967.

Glick, Thomas F. "On the Influence of Kircher in Spain." *Isis* 62, no. 3 (1971): 379–81.



Goldgar, Anne. *Impolite Learning: Conduct and Community in the Republic of Letters, 1680 - 1750*. New Haven: Yale University Press, 1995.

Golinski, Jan. *British Weather and the Climate of Enlightenment*. Chicago: The University of Chicago Press, 2007.

Grafton, Anthony. *Cardano's Cosmos: The Worlds and Works of a Renaissance Astrologer*. Cambridge, MA: Harvard University Press, 1999.

Gragg, Larry. "The Port Royal Earthquake." *History Today* 50, no. 9 (2000): 28–34.

Graham, Louis. "The Scientific Piety of John Winthrop of Harvard." *The New England Quarterly* 46, no. 1 (1973): 112–18.

Gray, Peter, and Kendrick Oliver, eds. *The Memory of Catastrophe*. Manchester; New York: Manchester University Press, 2004.

Gray, Peter, and Kendrick Oliver. "Introduction." In *The Memory of Catastrophe*, edited by Peter Gray and Kendrick Oliver. Manchester; New York: Manchester University Press, 2004.

Gregory, Stephan. "The Tabulation of England: How the Social World Was Brought in Rows and Columns." *Distinktion (Aarhus)* 14, no. 3 (2013): 305–25.

Greengrass, Mark. *Samuel Hartlib and Universal Reformation: Studies in Intellectual Communication*. Edited by Michael Leslie and Timothy Raylor. Cambridge, UK; New York: Cambridge University Press, 1994.

Guidoboni, Emanuela, and Jean-Paul Poirier. *Storia culturale del terremoto: Dal mondo antico a oggi*. Soveria Mannelli (It.): Rubbettino Editore, 2019.

Guldi, Jo, and David Armitage. *The History Manifesto*. Cambridge, UK: Cambridge University Press, 2014.

Hall, David D. *Worlds of Wonder, Days of Judgment: Popular Religious Belief in Early New England*. New York: Knopf, 1989.

Hall, Marie Boas. *Henry Oldenburg: Shaping the Royal Society*. Oxford; New York: Oxford University Press, 2002.

Halpérin, Jean. “La Notion de Sécurité Dans l’histoire Économique et Sociale.” *Revue d’histoire Économique et Sociale* 30, no. 1 (1952): 7–25.

Hannaway, Caroline C. “The Société Royale de Médecine and Epidemics in the Ancien Régime.” *Bulletin of the History of Medicine* 46, no. 3 (1972): 257–73.

Haraszti, Zoltán. “Young John Adams on Franklin’s Iron Points.” *Isis* 41, no. 1 (1950): 11–14.

Hanska, Jussi. *Strategies of Sanity and Survival: Religious Responses to Natural Disasters in the Middle Ages*. Helsinki: Finnish Literature Society, 2002.

Harris, Steven J. "Networks of Travel, Correspondence, and Exchange." In *The Cambridge History of Science*, edited by Katharine Park and Lorraine Daston, Vol. 3. Cambridge History of Science. New York, New York: Cambridge University Press, 2008.

Hatch, Robert Alan. "Between Astrology and Copernicanism: Morin - Gassendi - Boulliau." *Early Science and Medicine* 22, no. 5–6 (2017): 487–516.

Hazard, Paul. "Esquisse d'une histoire tragique du Portugal devant l'opinion publique du dix-huitième siècle." *Revue de Littérature Comparée* 18 (1938): 59–68.

———. "Le problème du mal dans la conscience européenne du XVIIIe siècle." *Romanic Review* 32, no. 2 (1941): 147.

Herzog, Tamar. *Upholding Justice: Society, State, and the Penal System in Quito (1650-1750)*. Ann Arbor: University of Michigan Press, 2004.

Hewitt, Kenneth. "The Idea of Calamity in a Technocratic Age." In *Interpretations of Calamity from the Viewpoint of Human Ecology*. Winchester, MA: Allen & Unwin, 1983.

Hildesheimer, Françoise. *La terreur et la pitié: l'Ancien Régime à l'épreuve de la peste*. Paris: Publisud, 1990.

Horowitz, Andy. *Katrina: A History, 1915–2015*. Cambridge, MA: Harvard University Press, 2020.

Huet, Marie-Hélène. *The Culture of Disaster*. Chicago: The University of Chicago Press, 2012.

Hughes, Ben. *Apocalypse 1692: Empire, Slavery, and the Great Port Royal Earthquake*. Yardley, PA: Westholme Publishing, 2017.

Hunter, Michael. *Boyle: Between God and Science*. New Haven: Yale University Press, 2009.

Ingram, Robert G. “‘The Trembling Earth Is God’s Herald’: Earthquakes, Religion and Public Life in Britain during the 1750s.” In *The Lisbon Earthquake of 1755 : Representations and Reactions*, edited by Theodore E. D. Braun and John B. Radner. *SVEC*, 2005:02. Oxford: Voltaire Foundation, 2005.

Janković, Vladimir. *Reading the Skies : A Cultural History of English Weather, 1650-1820*. Manchester: Manchester University Press, 2000.

Jardine, Lisa, and Alan Stewart. *Hostage to Fortune: The Troubled Life of Francis Bacon*. New York: Hill and Wang, 1998.

Johns, Alessa. “Introduction.” In *Dreadful Visitations : Confronting Natural Catastrophe in the Age of Enlightenment*, edited by Alessa Johns. New York: Routledge, 1999.

Jouhaud, Christian. *Histoire, littérature, témoignage: écrire les malheurs du temps*. Paris: Gallimard, 2009.

Juneja, Monica, and Franz Mauelshagen. "Disasters and Pre-Industrial Societies: Historiographic Trends and Comparative Perspectives." *The Medieval History Journal* 10, no. 1–2 (2007): 1–31.

Keene, Derek. "Fire in London: destruction and reconstruction, A.D. 982-1676." In *Stadtzerstörung und Wiederaufbau*, edited by Martin Körner, Niklaus Bartlome, and Erika Flückiger. Bern: P Haupt, 1999.

Keevak, Michael. *The Pretended Asian: George Psalmanazar's Eighteenth-Century Formosan Hoax*. Detroit: Wayne State University Press, 2004.

Kempe, Michael. "'Mind the next Flood!' Memories of Natural Disasters in Northern Germany from the Sixteenth Century to the Present." *The Medieval History Journal* 10, no. 1–2 (2007): 327–54.

Kendrick, T. D. *The Lisbon Earthquake*. London: Methuen, 1956.

Keynes, Geoffrey. *A Bibliography of Sir William Petty, F.R.S. and of Observations on the Bills of Mortality by John Graunt, F.R.S.* Oxford: Clarendon Press, 1971.

Kierner, Cynthia A. *Inventing Disaster: The Culture of Calamity from the Jamestown Colony to the Johnstown Flood*. Chapel Hill: University of North Carolina Press, 2019.

Knowles, Scott. *The Disaster Experts: Mastering Risk in Modern America*. Philadelphia: University of Pennsylvania Press, 2011.

Koselleck, Reinhart. *Critique and Crisis: Enlightenment and the Pathogenesis of Modern Society*. Oxford; New York: Berg, 1988.

Koselleck, Reinhart. "Crisis." Translated by Michaela Richter. *Journal of the History of Ideas* 67, no. 2 (2006): 357–400.

Labbé, Thomas. *Les catastrophes naturelles au Moyen Âge: XIIe-XVe siècle*. Paris: CNRS éditions, 2017.

Lanuza Navarro, Tayra M. C. "The Dramatic Culture of Astrological Medicine in Early Modern Spain." In *Medical Cultures of the Early Modern Spanish Empire*, edited by John Slater, María Luz López Terrada, and José Pardo Tomás. Farnham, UK: Ashgate, 2014.

———. "From Intense Teaching to Neglect: The Decline of Astrology at the University of Valencia and the Role of the Spanish Novatores." *Early Science and Medicine* 22, no. 5–6 (2017): 410–37.

Lattuada, Riccardo. "La ricostruzione a Napoli dopo il terremoto del 1688: architetti, committenti e cultura del ripristino." In *Contributi per la storia dei terremoti nel bacino del Mediterraneo: secc. V-XVIII*, edited by Aldo Marturano. Storia e scienze della terra 5. Salerno: Laveglia, 2002.

Laurence, David. "Jonathan Edwards, John Locke, and the Canon of Experience." *Early American Literature* 15, no. 2 (1980): 107–23.

Lavallé, Bernard. "Miedos terrenales, angustias escatológicas y pánicos en tiempos de terremotos a comienzos del siglo XVII en el Perú." In *Una historia de los usos del miedo*, edited by Pilar Gonzalbo, Anne Staples, and Valentina Torres Septién. México, DF: Colegio de México, 2009.

Laza Rojas, José María. "Nuevos Datos Acerca de Luis de Aldrete y Soto." *Boletín de La Sociedad Española de Historia de La Farmacia* 7 (1956): 68–73.

Leonard, Irving A. *Don Carlos de Sigüenza y Góngora: A Mexican Savant of the Seventeenth Century*. Berkeley: University of California Press, 1929.

———. "Pedro de Peralta: Peruvian Polygraph (1664-1743)." *Revista Hispánica Moderna* 34, no. 3/4 (1968): 690–99.

Le Roy Ladurie, Emmanuel. *The Mind and Method of the Historian*. Translated by Siân Reynolds. Brighton, UK: Harvester Press, 1981.

Levy, Jonathan. *Freaks of Fortune: The Emerging World of Capitalism and Risk in America*. Cambridge, MA: Harvard University Press, 2012.

Lewin, C.G. "John Graunt", *The Oxford Dictionary of National Biography*.

López Pérez, Miguel. “Los hijos de Paracelso.” *Studia Hermetica Journal* 6, no. 2 (2016): 69–105.

López Piñero, J. M. “Paracelsus and His Work in 16th and 17th Century Spain.” *Clio Medica* 8, no. 2 (1973): 113-141.

Loupès, Philippe. “Castigo de Dios, Le Tremblement de Terre de 1755 Dans Les Publications Espagnoles de Circonstance.” *Lumières*, no. 2e semestre (2005): 77–94.

Luebken, Uwe, and Christof Mauch. “Uncertain Environments: Natural Hazards, Risk and Insurance in Historical Perspective.” *Environment and History* 17, no. 1 (2011): 1–12.

Lynch, John. *The Hispanic World in Crisis and Change, 1598-1700*. Oxford, UK; Cambridge, MA: Blackwell, 1992.

Lynch, William. *Solomon's Child: Method in the Early Royal Society of London*. Stanford, CA: Stanford University Press, 2001.

Macadam, Joyce. “English Weather: The Seventeenth-Century Diary of Ralph Josselin.” *Journal of Interdisciplinary History* 43, no. 2 (2012): 221–46.

Mackay, Ruth. *The Baker Who Pretended to Be King of Portugal*. Chicago; London: University of Chicago Press, 2012.



Manning, David. "Reformation and the Wickedness of Port Royal, Jamaica." In *Puritans and Catholics in the Trans-Atlantic World, 1600-1850*, edited by Crawford Gribben and Scott Spurlock, 131–63. Christianities in the Trans-Atlantic World, 1500-1800. New York: Palgrave Macmillan, 2016.

Mansilla, Judith. "Providing Temporal and Spiritual Assistance: Responses to the 1687 Earthquake in Lima." *The Latin Americanist* 57, no. 1 (2013): 107–24.

———. "La población de Lima y la administración colonial frente al impacto del terremoto de 1687." *Summa Humanitatis* 8, no. 1 (2015): 52–73.

Mairal, Gaspar. *A Pre-Modern Cultural History of Risk: Imagining the Future*. London; New York: Taylor and Francis, 2020.

Martin, Craig. "The Ends of Weather: Teleology in Renaissance Meteorology." *Journal of the History of Philosophy; Baltimore* 48, no. 3 (2010): 259–82.

———. *Renaissance Meteorology: Pomponazzi to Descartes*. Baltimore: Johns Hopkins University Press, 2011.

Mathias, Julio. *Don Luis de Alderete y Soto, regidor perpetuo de Málaga, alguacil mayor de la Inquisición y curandero; notas para un estudio biográfico*. Edición Angel Caffarena. Málaga: Librería Anticuaria El Guadalhorce, 1965.

McCormick, Ted. *William Petty and the Ambitions of Political Arithmetic*. Oxford: University Press, 2009.

Mauelshagen, Franz. "Natural Disasters and Legal Solutions in the History of State Power." *Solutions* 4, no. 1 (2013).

Mauelshagen, Franz. "Defining Catastrophes." In *Catastrophe and Catharsis : Perspectives on Disaster and Redemption in German Culture and Beyond*, edited by Katharina Gerstenberger and Tanja Nusser, 172–90. Rochester, NY: Camden House, 2015.

McKibben, Bill. *The End of Nature*. New York: Random House, 1989.

McNeill, J.R. *Mosquito Empires: Ecology and War in the Greater Caribbean, 1620-1914*. New York: Cambridge University Press, 2010.

McNeill, William Hardy. *Plagues and Peoples*. Garden City, NY: Anchor Press, 1976.

Mercier-Faivre, Anne-Marie, and Chantal Thomas, eds. *L'invention de la catastrophe au XVIIIe siècle: du châtement divin au désastre naturel*. Genève: Droz, 2008.

Micale, Mark S., and Paul Frederick Lerner, eds. *Traumatic Pasts: History, Psychiatry, and Trauma in the Modern Age, 1870-1930*. Cambridge, UK; New York: Cambridge University Press, 2001.

Millás, José Carlos. *Hurricanes of the Caribbean and Adjacent Regions, 1492-1800*. Miami, FL: Academy of the Arts and Sciences of the Americas, 1968.

Miller, Mary Ashburn. *A Natural History of Revolution: Violence and Nature in the French Revolutionary Imagination, 1789-1794*. Ithaca, NY: Cornell University Press, 2011.

Molesky, Mark. "The Great Fire of Lisbon, 1755." In *Flammable Cities: Urban Conflagration and the Making of the Modern World*, edited by Greg Bankoff, Uwe Lübken, and Jordan Sand. Madison: University of Wisconsin Press, 2012.

———. *This Gulf of Fire: The Destruction of Lisbon, or Apocalypse in the Age of Science and Reason*. New York: Knopf Publishing Group, 2015.

Moote, A. Lloyd, and Dorothy C. Moote. *The Great Plague: The Story of London's Most Deadly Year*. Baltimore: Johns Hopkins University Press, 2004.

More, Anna. "Cosmopolitanism and Scientific Reason in New Spain: Carlos de Sigüenza y Góngora and the Dispute over the 1680 Comet." In *Science in the Spanish and Portuguese Empires, 1500-1800*, edited by Daniela Bleichmar, 115–31. Stanford, Calif: Stanford University Press, 2009.

———. *Baroque Sovereignty: Carlos de Sigüenza y Gongora and the Creole Archive of Colonial Mexico*. Philadelphia: University of Pennsylvania Press, 2012.

———. “Thinking with the Inquisition: Heretical Science and Popular Knowledge in Seventeenth-Century Mexico.” *Romanic Review* 103, no. 1/2 (2012): 111–32.

Moreyra Paz Soldán, Manuel. “Peralta Astronomo, 1966.” *Revista Histórica* 29 (1966): 105–23.

Mulcahy, Matthew. *Hurricanes and Society in the British Greater Caribbean, 1624-1783*. Baltimore: Johns Hopkins University Press, 2006.

———. “The Port Royal Earthquake and the World of Wonders in Seventeenth-Century Jamaica.” *Early American Studies: An Interdisciplinary Journal* 6, no. 2 (2008): 391–421.

Muñoz, D., and A. Udias. “Evaluation of Damage and Source Parameters of the Málaga Earthquake of 9 October 1680.” In *Historical Seismograms and Earthquakes of the World*, edited by William Hung Kan Lee, H. Meyers, and K. Shimazaki. San Diego: Academic Press, 1988.

Musset, Alain. *Villes nomades du nouveau monde*. Paris: Editions de l’Ecole des Hautes Etudes en Sciences Sociales, 2002.

Naphy, William G., and Penny Roberts, eds. *Fear in Early Modern Society*. Studies in Early Modern European History. Manchester; New York: Manchester University Press, 1997.

Navarro Brotóns, Víctor. “La astronomía.” In *Historia de la ciencia y de la técnica en la Corona de Castilla*, edited by Luis García Ballester, Vol. 3. Valladolid: Junta de Castilla y León, Consejería de Educación y Cultura, 2002.

———. *Disciplinas, saberes y prácticas: filosofía natural, matemáticas y astronomía en la sociedad española de la época moderna*. Valencia: Universitat de València, 2014.

Neiman, Susan. *Evil in Modern Thought: An Alternative History of Philosophy*. Princeton, NJ: Princeton University Press, 2002.

Nelson, Louis P. *Architecture and Empire in Jamaica*. New Haven ; London: Yale University Press, 2016.

Newson, Linda A. “The Demographic Collapse of Native Peoples of the Americas, 1492–1650.” In *The Meeting of Two Worlds: Europe and the Americas, 1492-1650*, edited by Warwick Bray and British Academy. Oxford: Published for the British Academy by Oxford University Press, 1993.

Niccoli, Ottavia. *Profeti e popolo nell'Italia del Rinascimento*. Roma: Laterza, 1987.

———. *Prophecy and People in Renaissance Italy*. Princeton, NJ: Princeton University Press, 1990.

Nixon, Rob. *Slow Violence and the Environmentalism of the Poor*. Cambridge, MA: Harvard University Press, 2011.

Nummedal, Tara E. "Kircher's Subterranean World and the Dignity of the Geocosm." In *The Great Art of Knowing: The Baroque Encyclopedia of Athanasius Kircher*, edited by Daniel Stolzenberg. Stanford, CA; Fiesole (Firenze): Stanford University libraries, 2001.

O'Dea, Michael. "Le mot 'catastrophe.'" In *L'invention de la catastrophe au XVIIIe siècle: du bâtiment divin au désastre naturel*, edited by Anne-Marie Mercier-Faivre and Chantal Thomas. Genève: Droz, 2008.

O Grada, C., and J. M. Chevet. "Famine and Market in Ancien Regime France." *The Journal of Economic History* 62, no. 3 (2002): 706–33.

Oldroyd, D. R. "Robert Hooke's Methodology of Science as Exemplified in His 'Discourse of Earthquakes.'" *The British Journal for the History of Science* 6, no. 2 (1972): 109–30.

Oliver-Smith, Anthony. "Anthropological Research on Hazards and Disasters." *Annual Review of Anthropology* 25, no. 1 (1996): 303–28.

Oliver-Smith, Anthony. "Global Changes and the Definition of Disaster." In *What Is a Disaster? Perspectives on the Question*, edited by E. L. Quarantelli. London; New York: Routledge, 1998.

Oliver-Smith, Anthony. "What Is a Disaster? Anthropological Perspectives on a Persistent Question." In *The Angry Earth: Disaster in Anthropological Perspective*, edited by Anthony Oliver-Smith and Susannah M. Hoffman. New York: Routledge, 1999.

Oliver-Smith, Anthony. "Theorizing Disasters: Nature, Power, and Culture." In *Catastrophe & Culture: The Anthropology of Disaster*, edited by Susannah M. Hoffman and Anthony Oliver-Smith. Santa Fe: School of American Research Press; Oxford, 2002.

Osler, Margaret J. "Religion and the Changing Historiography of the Scientific Revolution." In *Science and Religion: New Historical Perspectives*, edited by Thomas Dixon, G. N. Cantor, and Stephen Pumfrey. Cambridge, UK; New York: Cambridge University Press, 2010.

Parcell, William C. "Signs and Symbols in Kircher's *Mundus Subterraneus*." In *The Revolution in Geology from the Renaissance to the Enlightenment*, edited by Gary D. Rosenberg. Boulder, CO: Geological Society of America, 2009.

Parker, Geoffrey. *Global Crisis: War, Climate Change and Catastrophe in the Seventeenth Century*. New Haven: Yale University Press, 2013.

Parrish, Susan Scott. *American Curiosity: Cultures of Natural History in the Colonial British Atlantic World*. Chapel Hill: University of North Carolina Press, 2006.

Patterson, Orlando. *The Sociology of Slavery: An Analysis of the Origins, Development and Structure of Negro Slave Society in Jamaica*. Studies in Society. London: MacGibbon & Kee, 1967.

Pawson, Michael. *Port Royal, Jamaica*. Oxford: Clarendon Press, 1975.

Pearson, Caspar. *Humanism and the Urban World: Leon Battista Alberti and the Renaissance City*. University Park, PA: Pennsylvania State University Press, 2011.

Pearson, Robin. *Insuring the Industrial Revolution: Fire Insurance in Great Britain, 1700-1850*. Aldershot (UK); Burlington (VT): Ashgate, 2004.

Peralta Ruiz, Víctor. “Un patronazgo frustrado. El ilustrado peruano José Eusebio Llano Zapata en Lima y Cádiz a través de su correspondencia (1743-1780).” *Colonial Latin American review* 16, no. 1 (2007): 49–70.

———. “Las tribulaciones de un ilustrado católico. José Eusebio Llano Zapata en Cádiz (1756-1780).” In *Memorias histórico, físicas, crítico, apoloéticas de la América Meridional*, by José Eusebio Llano Zapata, edited by Antonio Garrido Aranda, Luis Millones Figueroa, Víctor Peralta Ruiz, Charles Walker, and Ricardo Ramírez. Fondo Editorial de la Pontificia Universidad Católica del Perú, 2015.

Peraza-rugeley, A. Margarita. *Llámenme “El Mexicano”*: *Los Almanagues y Otras Obras de Carlos de Sigüenza y Góngora*. New York: Peter Lang, 2013.

Pérez Moreda, Vicente. *Las crisis de mortalidad en la España interior (siglos XVI-XIX)*. Historia. Madrid: Siglo Veintiuno de España, 1980.



Pérez Moreda, Vicente. “La peste de 1647–1657 en el Mediterráneo Occidental.” *Revista ADEH* 2 (1987): 14–25.

Pérez-Mallaína Bueno, Pablo Emilio. “Le pouvoir de l’État contre les forces de la Nature: la reconstruction de Lima après le tremblement de terre de 1687.” *Villes en Parallèle* 25, no. 1 (1997): 160–77.

———. “La Fabricación de Un Mito: El Terremoto de 1687 y La Ruina de Los Cultivos de Trigo En El Perú.” *Anuario de Estudios Americanos* 57, no. 1 (2000): 69–88.

———. *Retrato de una ciudad en crisis: la sociedad limeña ante el movimiento sísmico de 1746*. Sevilla; Perú: Consejo Superior de Investigaciones Científicas, Escuela de Estudios Hispano-Americanos ; Pontificia Universidad Católica del Perú, Instituto Riva-Agüero, 2001.

Pestana, Carla Gardina. *The English Conquest of Jamaica - Oliver Cromwell's Bid for Empire*. Cambridge, MA: Harvard University Press, 2017.

Pimentel, Juan. *Testigos del mundo: ciencia, literatura y viajes en la ilustración*. Madrid: Marcial Pons Historia, 2003.

Pocock, J. G. A. *Barbarism and Religion*. Cambridge, UK; New York: Cambridge University Press, 1999.

Poole, William. "The Genesis Narrative in the Circle of Robert Hooke and Francis Lodwick." In *Scripture and Scholarship in Early Modern England*, edited by Ariel Hessayon and Nicholas Keene, 41–57. Aldershot, England ; Burlington, VT: Ashgate, 2006.

———. *The World Makers: Scientists of the Restoration and the Search for the Origins of the Earth*. Oxford: Peter Lang, 2010.

Portuondo, María M. *Secret Science : Spanish Cosmography and the New World*. Chicago: University of Chicago Press, 2009.

Quarantelli, E. L. "What Should We Study? Questions and Suggestions for Researchers about the Concept of Disasters," Disaster Research Center Preliminary Paper 119, 1986.

———. "Disaster Research: Sociohistory of the Field." In *Encyclopedia of Sociology*, edited by Edgar F. Borgatta and Rhonda J. V. Montgomery, 2nd ed. Vol. 1. New York: Macmillan Reference USA, 2000.

———. *What Is a Disaster?: Perspectives on the Question*. Routledge, 2005.

Park, Katharine, and Lorraine J. Daston. "Unnatural Conceptions: The Study of Monsters in Sixteenth- and Seventeenth-Century France and England." *Past & Present* 92, no. 1 (1981): 20–54.

Perry, Ronald W., and E. L. Quarantelli, eds. *What Is a Disaster?: New Answers to Old Questions*. Philadelphia: Xlibris Corp., 2005.

Pettegree, Andrew. *The Invention of News: How the World Came to Know about Itself*. New Haven; London: Yale University Press, 2014.

Pimentel, Juan. "Juan E. Nieremberg, American Wonders, and Preterimperial Natural History." In *Science in the Spanish and Portuguese Empires, 1500-1800*, edited by Daniela Bleichmar. Stanford, CA: Stanford University Press, 2009.

Poëy Y Aguirre, Andrés. *Table chronologique de quatre cents cyclones qui ont sévi dans les Indes occidentales et dans l'océan Atlantique nord: pendant un intervalle de 362 années (depuis 1493 jusqu'en 1855)*. Paris: Impr Administrative de Paul Dupont, 1862.

Quenet, Grégory. *Les tremblements de terre aux XVIIe et XVIIIe siècles: la naissance d'un risque*. Seyssel: Champ Vallon; Paris Diffusion, Presses universitaires de France, 2005.

———. "When Geology Encounters a Real Catastrophe: From Theoretical Earthquakes to the Lisbon Disaster." In *Histoires de La Terre: Earth Sciences and French Culture 1740-1940*, edited by Louise Lyle and David McCallam. Amsterdam ; New York, NY: Rodopi, 2008.

———. "Earthquakes in Early Modern France: From the Old Regime to the Birth of a New Risk." In *Historical Disasters in Context: Science, Religion, and Politics*, edited by Andrea Janku, Gerrit J. Schenk, and Franz Maelshagen. New York: Routledge, 2012.

Quintana, José Miguel. *La Astrología En La Nueva España En El Siglo XVII - de Enrico Martínez a Sigüenza y Góngora*. Mexico: Bibliófilos mexicanos, 1969.

Ramírez, Pedro, and Manuel Chaves. "El terremoto como noticia: relaciones de sucesos y otros textos del temblor de 1680." *Estudios Sobre el Mensaje Periodístico* 14 (2008): 581–604.

Ranalli, Giorgio. "Robert Hooke and the Huttonian Theory." *The Journal of Geology* 90, no. 3 (1982): 319–25.

Ranum, Orest A. *The Fronde: A French Revolution, 1648-1652*. Revolutions in the Modern World. New York: WW Norton, 1993.

Rappaport, Rhoda. "Hooke on Earthquakes: Lectures, Strategy and Audience." *The British Journal for the History of Science* 19, no. 2 (1986): 129–46.

———. *When Geologists Were Historians, 1665-1750*. Ithaca, NY: Cornell University Press, 1997.

Reeves, Eileen Adair. *Evening News : Optics, Astronomy, and Journalism in Early Modern Europe*. Philadelphia: University of Pennsylvania Press, 2014.

Reilly, Conor. "Father Athanasius Kircher, S.J.: Master of an Hundred Arts." *Studies: An Irish Quarterly Review* 44, no. 176 (1955): 457–68.

Rey Fajardo, José del. *Entre el deseo y la esperanza: los jesuitas en la Caracas colonial*. Caracas: Universidad Católica "Andrés Bello", Instituto de Investigaciones Históricas, 2004.

Rigby, Catherine E. *Dancing with Disaster: Environmental Histories, Narratives, and Ethics for Perilous Times*. Charlottesville; London: University of Virginia Press, 2015.

Riquelme, Daniel. *El terremoto del Señor de Mayo*. Santiago de Chile: Imprenta Cervantes, 1905.

Robertson, James. "Rewriting the English Conquest of Jamaica in the Late Seventeenth Century." *The English Historical Review* 117, no. 473 (2002): 813–39.

Robles, Whitney Barlow. "Atlantic Disaster: Boston Responds to the Cape Ann Earthquake of 1755." *The New England Quarterly* 90, no. 1 (2017): 7–35.

Rodríguez de la Torre, Fernando. "Documentos En El Archivo Histórico Nacional (Madrid) Sobre El Terremoto Del 1 de Noviembre de 1755." *Cuadernos Dieciochistas* 6 (2005): 79–116.

Rohland, Eleonora. "Adapting to Hurricanes. A Historical Perspective on New Orleans from Its Foundation to Hurricane Katrina, 1718-2005." *Wiley Interdisciplinary Reviews. Climate Change* 9, no. 1 (2018).

Rohland, Eleonora. *Changes in the Air: Hurricanes in New Orleans from 1718 to the Present*. New York and Oxford: Berghahn Books, 2018.

Rohland, Eleonora, and Virginia García-Acosta. “Disaster.” In *The Routledge Handbook to the Political Economy and Governance of the Americas*, edited by Olaf Kaltmeier, Anne Tittor, Daniel Hawkins, and Eleonora Rohland. New York: Routledge, 2020.

Rojas Lima, Flavio. *Diccionario histórico biográfico de Guatemala*. Ciudad de Guatemala: Asociación de Amigos del País, Fundación para la Cultura y el Desarrollo, 2004.

Roitman, Janet L. *Anti-Crisis*. Durham: Duke University Press, 2014.

Rohr, Christian. “Man and Natural Disaster in the Late Middle Ages: The Earthquake in Carinthia and Northern Italy on 25 January 1348 and Its Perception.” *Environment and History* 9, no. 2 (2003): 127–49.

Rohr, Christian. “Writing a Catastrophe. Describing and Constructing Disaster Perception in Narrative Sources from the Late Middle Ages.” *Historical Social Research / Historische Sozialforschung* 32, no. 3 (121) (2007): 88–102.

Rodríguez, Susy Sánchez M. “Del gran temblor a la monstruosa conspiración: dinámica y repercusiones del miedo limeño en el terremoto de 1746.” In *El miedo en el Perú: siglos XVI al XX*, edited by Claudia Rosas Lauro. Lima: Pontificia Universidad Católica del Perú, Fondo Editorial, 2005.

Roos, Anna Marie. "All That Glitters: Fool's Gold in the Early-Modern Era." *Endeavour* 32, no. 4 (2008): 147–51.

———. *The Salt of the Earth: Natural Philosophy, Medicine, and Chymistry in England, 1650-1750*. Leiden; Boston: Brill, 2007.

Rose, Craig. "Providence, Protestant Union and Godly Reformation in the 1690s: The Alexander Prize Essay, Proxime Accessit." *Transactions of the Royal Historical Society* 3 (1993): 151–69.

Ross, Kathleen. *The Baroque Narrative of Carlos de Sigüenza y Góngora: A New World Paradise*. Cambridge, UK; New York: Cambridge University Press, 1993.

Rossi, Paolo. *The Dark Abyss of Time: The History of the Earth & the History of Nations from Hooke to Vico*. Translated by Lydia G. Cochrane. Chicago: University of Chicago Press, 1984.

Rudwick, M. J. S. *Bursting the Limits of Time: The Reconstruction of Geohistory in the Age of Revolution*. Chicago: University of Chicago Press, 2005.

Rumsey, Peter Lockwood. *Acts of God and the People, 1620-1730*. Ann Arbor, MI: UMI Research Press, 1986.

Rusnock, Andrea Alice. *Vital Accounts: Quantifying Health and Population in Eighteenth-Century England and France*. Cambridge, UK: Cambridge University Press, 2008.

Salivia, Luis A. *Historia de los temporales de Puerto Rico*. San Juan: n.p., 1950.

Sánchez, Luis Alberto. *El doctor Océano; estudios sobre don Pedro de Peralta Barnuevo*. Lima: Universidad Nacional Mayor de San Marcos, 1967.

Schaffer, Simon. "Newton's Comets and the Transformation of Astrology." In *Astrology, Science, and Society: Historical Essays*, edited by Patrick Curry, 219–44. Woodbridge, Suffolk ; Wolfeboro, NH: Boydell Press, 1987.

———. "Newton on the Beach: The Information Order of Principia Mathematica." *History of Science* 47, no. 3 (2009): 243–76.

Schechner Genuth, Sara. *Comets, Popular Culture, and the Birth of Modern Cosmology*. Princeton, NJ: Princeton University Press, 1997.

Schenk, Gerrit Jasper. "Historical Disaster Research. State of Research, Concepts, Methods and Case Studies." *Historical Social Research / Historische Sozialforschung* 32, no. 3 (121) (2007): 9–31.



———. “Dis-astri: modelli interpretativi delle calamità naturali dal Medioevo al Rinascimento.” In *Le calamità ambientali nel tardo Medioevo europeo : realtà, percezioni, reazioni : atti del XII convegno del Centro studi sul la civiltà del tardo Medioevo*. Florence: Firenze University Press, 2010.

———. “‘Human Security’ in the Renaissance? ‘Securitas’, Infrastructure, Collective Goods and Natural Hazards in Tuscany and the Upper Rhine Valley.” *Historical Social Research / Historische Sozialforschung* 35, no. 4 (134) (2010): 209–33.

———. “Disastro, Catastrophe, and Divine Judgement: Words, Concepts and Images for ‘natural’ Threats to Social Order in the Middle Ages and Renaissance.” In *Disaster, Death and the Emotions in the Shadow of the Apocalypse 1400-1700*, edited by Jennifer Spinks and Charles Zika. London: Palgrave Macmillan, 2016.

Schwartz, Stuart B. *Sea of Storms: A History of Hurricanes in the Greater Caribbean from Columbus to Katrina*. Princeton, NJ: Princeton University Press, 2015.

Schwarz-Zanetti, Gabriela, Nicolas Deichmann, and Donat Fäh. “The Earthquake in Unterwalden on September 18, 1601: A Historico-Critical Macroseismic Evaluation.” *Eclogae Geologicae Helvetiae* 96, no. 3 (2003): 441–50.

Scott, Jonathan. *England’s Troubles: Seventeenth-Century English Political Instability in European Context*. Cambridge, UK; New York: Cambridge University Press, 2000.

Seth, Suman. *Difference and Disease: Medicine, Race, and the Eighteenth-Century British Empire*. Cambridge, UK; New York: Cambridge University Press, 2018.

Shapin, Steven, and Simon Schaffer. *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life*. Princeton, NJ: Princeton University Press, 1985.

Shapin, Steven. *A Social History of Truth: Civility and Science in Seventeenth-Century England*. Science and Its Conceptual Foundations. Chicago: University of Chicago Press, 1994.

———. *The Scientific Revolution*. Chicago, IL: University of Chicago Press, 1996.

Shapiro, Barbara J. *Probability and Certainty in Seventeenth-Century England: A Study of the Relationships between Natural Science, Religion, History, Law, and Literature*. Princeton, NJ: Princeton University Press, 1983.

———. *A Culture of Fact: England, 1550-1720*. Ithaca, NY: Cornell University Press, 2000.

Shaw, Caroline. *Britannia's Embrace: Modern Humanitarianism and the Imperial Origins of Refugee Relief*. Oxford: Oxford University Press, 2015.

Sheehan, Jonathan. *The Enlightenment Bible: Translation, Scholarship, Culture*. Princeton, NJ: Princeton University Press, 2005.

Silgado Ferro, Enrique. "Algunos Aspectos de La Ciencia En La Época de Peralta." *San Marcos; Revista de Artes, Ciencias y Humanidades*, 2, 11 (1969): 33–38.

Sigurdsson, Haraldur. *Melting the Earth: The History of Ideas on Volcanic Eruptions*. New York: Oxford University Press, 1999.

Slack, Paul. *The Impact of Plague in Tudor and Stuart England*. London; Boston: Routledge & K. Paul, 1985.

Slonosky, Victoria C. *Climate in the Age of Empire: Weather Observers in Colonial Canada*. Boston, Massachusetts: American Meteorological Society, 2018.

Smith, Pamela H., and Paula Findlen. *Merchants & Marvels: Commerce, Science, and Art in Early Modern Europe*. New York: Routledge, 2002.

Soens, Tim. "Floods and Money: Funding Drainage and Flood Control in Coastal Flanders from the Thirteenth to the Sixteenth Centuries." *Continuity and Change* 26, no. 3 (2011): 333–65.

Solomon, Howard M. *Public Welfare, Science, and Propaganda in Seventeenth Century France; the Innovations of Théophraste Renaudot*. Princeton, NJ: Princeton University Press, 1972.

Sommerville, C. John. *Popular Religion in Restoration England*. Gainesville: University Presses of Florida, 1977.

Soto, Salvador Arana. *Historia de nuestras calamidades*. San Jaun de Puerto Rico: Tipografía Miguza, 1968.

Spinks, Jennifer, and Charles Zika, eds. *Disaster, Death and the Emotions in the Shadow of the Apocalypse 1400-1700*. London: Palgrave Macmillan, 2016.

Spinks, Jennifer, and Charles Zika. "Introduction: Rethinking Disaster and Emotions, 1400-1700." In *Disaster, Death and the Emotions in the Shadow of the Apocalypse 1400-1700*, edited by Jennifer Spinks and Charles Zika. Palgrave Studies in the History of Emotions. London: Palgrave Macmillan, 2016.

Spurr, John. "'Rational Religion' in Restoration England." *Journal of the History of Ideas* 49, no. 4 (1988): 563–85.

Steinberg, Ted. "What Is a Natural Disaster?" *Literature and Medicine* 15, no. 1 (1996): 33–47.

Steinberg, Ted. "The Secret History of Natural Disasters." *Environmental Hazards* 3 (2001): 31–35.

Steinberg, Ted. *Acts of God: The Unnatural History of Natural Disaster in America*. 2nd ed. New York: Oxford University Press, 2006.

Strasser, Gerhard F. "Science and Pseudoscience: Athanasius Kircher's *Mundus Subterraneus* and His Scrvtinivm ... Pestis." In *Knowledge, Science, and Literature in Early Modern Germany*, edited by Gerhild Scholz Williams and Stephan K. Schindler. University of North Carolina Studies in the Germanic Languages and Literatures No. 116. Chapel Hill: University of North Carolina Press, 1996.

Stuber, Martin. "Divine Punishment or Object of Research? The Resonance of Earthquakes, Floods, Epidemics and Famine in the Correspondence Network of Albrecht von Haller." *Environment and History* 9, no. 2 (2003): 173–93.

Taylor, Alan. *American Colonies: The Settling of North America*. New York: Viking, 2001.

Terrall, Mary. "Heroic Narratives of Quest and Discovery." *Configurations (Baltimore, Md.)* 6, no. 2 (1998): 223–42.

Tester, S. J. *A History of Western Astrology*. Woodbridge, UK: Boydell Press, 1987.

Thomas, Keith. *Religion and the Decline of Magic: Studies in Popular Beliefs in Sixteenth and Seventeenth Century England*. London: Weidenfeld and Nicolson, 1971.

———. *Religion and the Decline of Magic: Studies in Popular Beliefs in Sixteenth and Seventeenth-Century England*. New edition. London: Penguin UK, 1991.

Thompson, Edward Maunde, ed. *Correspondence of the Family of Hatton, Being Chiefly Letters Addressed to Christopher, First Viscount Hatton, 1601-1704*. Vol. 2. Camden Society. Publications, n.s., XXII-XXIII. Westminster: Printed for the Camden society, 1878.

Thorndike, Lynn. "The True Place of Astrology in the History of Science." *Isis* 46, no. 3 (1955): 273–78.

Tillyard, E. M. W. *The Elizabethan World Picture*. New York: Vintage Books, 1943.

Tilton, Eleanor M. "Lightning-Rods and the Earthquake of 1755." *The New England Quarterly* 13, no. 1 (1940): 85–97.

Toner, J. P. *Roman Disasters*. Cambridge, UK; Malden, MA: Polity Press, 2013.

Trail, R. R. "Sydenham's Impact on English Medicine." *Medical History* 9, no. 4 (1965): 356–64.

Trigg, Stephanie. "Samuel Pepys and the Great Fire of London: Trauma and Emotion, Private and Public." In *Disaster, Death and the Emotions in the Shadow of the Apocalypse 1400-1700*, edited by Jennifer Spinks and Charles Zika. Palgrave Studies in the History of Emotions. London: Palgrave Macmillan, 2016.

Udías, Agustín. "Earthquakes as God's Punishment in 17th- and 18th-Century Spain." *Geological Society, London, Special Publications* 310, no. 1 (2009): 41–48.

Udías, A., R. Madariaga, E. Buforn, D. Muñoz, and M. Ros. "The Large Chilean Historical Earthquakes of 1647, 1657, 1730, and 1751 from Contemporary Documents." *Bulletin of the Seismological Society of America* 102, no. 4 (2012): 1639–53.

Urrutia de Hazbún, Rosa, and Carlos Lanza Lazcano. *Catástrofes en Chile, 1541-1992*. Santiago de Chile: Editorial La Noria, 1993.

Velasco, Manuel Fernando de. *Relacion de La Ruina de Los Edificios y Casas de La Ciudad de Málaga Que Ocasiónó El Terremoto Del 9 de Octubre de Éste Año. Málaga 1680*. n.p.: n.p., 1680.

Vermij, Rienk. "Subterranean Fire. Changing Theories of the Earth during the Renaissance." *Early Science and Medicine* 3, no. 4 (1998): 323–47.

Vermij, Rienk, and Hiro Hirai. "The Marginalization of Astrology: Introduction." *Early Science and Medicine* 22, no. 5–6 (2017): 405–9.

Vincent, Bernard. "Le Seisme de 1755 à Cadix." *Atlantes. Revue d'études Romanes* 1 (2014): 221–32.

Walker, Charles F. *Shaky Colonialism: The 1746 Earthquake-Tsunami in Lima, Peru, and Its Long Aftermath*. Durham: Duke University Press, 2008.

———. "Natural Disasters in Latin America: Introduction to the Dossier." *Revista de Historia Iberoamericana* 4, no. 1 (2011).

Alexandra Walsham. "Vox Piscis: Or The Book-Fish: Providence and the Uses of the Reformation Past in Caroline Cambridge." *The English Historical Review* 114, no. 457 (1999): 574–606.

———. *Providence in Early Modern England*. Oxford; New York: Oxford University Press, 1999.

———. *The Reformation of the Landscape: Religion, Identity, and Memory in Early Modern Britain and Ireland*. Oxford; New York: Oxford University Press, 2011.

———. “Deciphering Divine Wrath and Displaying Godly Sorrow: Providentialism and Emotion in Early Modern England.” In *Disaster, Death and the Emotions in the Shadow of the Apocalypse 1400-1700*, edited by Jennifer Spinks and Charles Zika. London: Palgrave Macmillan, 2016.

———. “The Happiness of Suffering: Adversity, Providence, and Agency in Early Modern England.” In *Suffering and Happiness in England 1550-1850: Narratives and Representations: A Collection to Honour Paul Slack*, edited by M. J. Braddick and Joanna Innes. Oxford: Oxford University Press, 2017.

Walter, François. *Catastrophes: une histoire culturelle, XVIe-XXIe siècle*. Paris: Seuil, 2008.

Watt, Tessa. *Cheap Print and Popular Piety, 1550-1640*. Cambridge, UK; New York: Cambridge University Press, 1991.

Watts, D. “Cycles of Famine in Islands of Plenty: The Case of the Colonial West Indies in the Pre-Emancipation Period.” In *Famine as a Geographical Phenomenon*, edited by Bruce Currey and Graeme Hugo. Dordrecht; Boston; Hingham, MA: D Reidel; Kluwer Academic Publishers, 1984.

Webb, Gary R. “The Sociology of Disaster.” In *21st Century Sociology: A Reference Handbook*, edited by Clifton D. Bryant and Dennis L. Peck. Thousand Oaks, CA: SAGE Publications, 2007.

White, Richard. *The Organic Machine: The Remaking of the Columbia River*. New York: Hill and Wang, 1995.

White, Sam. *The Climate of Rebellion in the Early Modern Ottoman Empire*. New York: Cambridge University Press, 2011.



White, Sam. *A Cold Welcome: The Little Ice Age and Europe's Encounter with North America*. Cambridge: Harvard University Press, 2017.

Wilkie, Everett C. Jr. "The Authorship and Purpose of the 'Histoire Naturelle et Morale Des Îles Antilles', an Early Huguenot Emigration Guide." *Harvard Library Bulletin* 2, no. 3 (1991): 27–84.

Winship, Michael P. *Seers of God: Puritan Providentialism in the Restoration and Early Enlightenment*. Baltimore, MD: Johns Hopkins University Press, 1996.

Woodward, Alex. "Televangelist 'blows Wind of God' at Coronavirus." *The Independent*, April 6, 2020, sec. News. <https://www.independent.co.uk/news/world/americas/kenneth-copeland-blow-Coronavirus-prayer-sermon-trump-televangelist-a9448561.html>.

Worden, Blair. "The Question of Secularization." In *A Nation Transformed: England after the Restoration*, edited by Alan Craig Houston and Steven C. A. Pincus. Cambridge, U.K. ; New York: Cambridge University Press, 2001.

Worster, Donald. *Dust Bowl: The Southern Plains in the 1930s*. New York: Oxford University Press, 1979.

Wright, Peter. "A Study in the Legitimation of Knowledge: The 'success' of Medicine and the 'Failure' of Astrology." In *On the Margins of Science: The Social Construction of Rejected Knowledge*, edited by Roy Wallis, 85–101. Keele: University of Keele, 1979.

Yale, Elizabeth. *Sociable Knowledge: Natural History and the Nation in Early Modern Britain*. Philadelphia, PA: University of Pennsylvania Press, 2016.

Zahedieh, Nuala. “‘The Wickedest City in the World’: Port Royal, Commercial Hub of the Seventeenth-Century Caribbean.” In *Working Slavery, Pricing Freedom: Perspectives from the Caribbean, Africa and the African Diaspora*, edited by Verene Shepherd. Kingston : Oxford: Ian Randle Pub.; James Currey Pub, 2002.

Zwierlein, Cornel, and Rüdiger Graf. “The Production of ‘Human Security’ in Premodern and Contemporary History.” *Historical Social Research / Historische Sozialforschung* 35, no. 4 (134) (2010): 7–21.

Zwierlein, Cornel. “Sicherheitsgeschichte. Ein neues Feld der Geschichtswissenschaften.” *Geschichte und Gesellschaft* 38, no. 3 (2012): 365–86.

———. “Historicizing Environmental Security.” *European Journal for Security Research* 3, no. 1 (2018): 1–13.

———. *Prometheus Tamed: Fire, Security, and Modernities, 1400 to 1900*. Leiden; Boston: Brill, 2021.