AHR Forum

Crisis and Catastrophe: The Global Crisis of the Seventeenth Century Reconsidered

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THE MID-SEVENTEENTH CENTURY SAW MORE CASES of simultaneous state breakdown around the globe than any previous or subsequent age: something historians have called "The General Crisis." In the 1640s, Ming China, the most populous state in the world, collapsed; the Polish-Lithuanian Commonwealth, the largest state in Europe, disintegrated; much of the Spanish monarchy, the first global empire in history, seceded; and the entire Stuart monarchy rebelled—Scotland, Ireland, England, and its American colonies. In addition, just in the year 1648, a tide of urban rebellions began in Russia (the largest state in the world), and the Fronde Revolt paralyzed France (the most populous state in Europe); meanwhile, in Istanbul (Europe's largest city), irate subjects strangled Sultan Ibrahim, and in London, King Charles I went on trial for war crimes (the first head of state to do so). In the 1650s, Sweden and Denmark came close to revolution; Scotland and Ireland disappeared as autonomous states; the Dutch Republic radically changed its form of government; and the Mughal Empire, then the richest state in the world, experienced two years of civil war following the arrest, deposition, and imprisonment of its ruler.[1]

The frequency of popular revolts around the world also peaked during the mid-seventeenth century. In China, the number of major armed uprisings rose from under ten in the 1610s to more than seventy in the 1620s and more than eighty in the 1630s, affecting 160 counties and involving well over 1 million people.[2] In Japan, some forty

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[1] Other eras have seen a spate of state breakdowns around the world—such as the collapse of many Bronze Age civilizations between 1200 and 800 B.C.E. and the crisis of Late Antiquity between 200 and 600 A.D.—but these took place over centuries, not two decades. Something analogous may have occurred in the mid-fourteenth century, in the wake of the Black Death in Europe and the Near East and the Yuan-Ming transition in East Asia, but the cause remains ambiguous.

[2] See the figures and graphs in James W. Tong, *Disorder under Heaven: Collective Violence in the Ming*

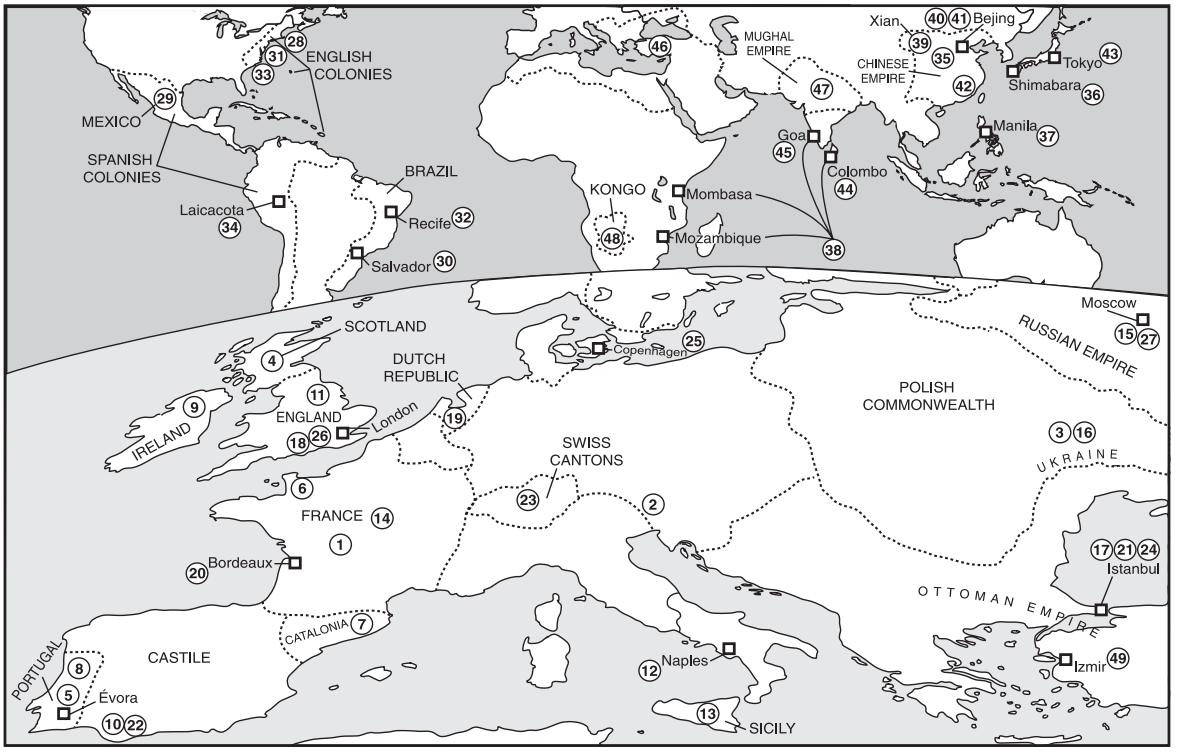

FIGURE 1: The global crisis. A list of the major revolts and revolutions around the world between 1635 and 1666 (see facing page) demonstrates that, although Western Europe and East Asia formed the heartland of the "General Crisis," the Mughal, Russian, and Ottoman empires, like the European colonies in America, also experienced episodes of severe political disruption.

revolts (*hōki*) and two hundred lesser rural uprisings (*hyakushō ikki*) occurred between 1590 and 1642—a total unmatched for two centuries—and the largest uprising, at Shimabara on Kyushu Island in 1637–1638, involved some 25,000 insurgents.[3] In Russia, a wave of rebellions in 1648–1649 shook the central government to its foundations; of the twenty-five major peasant revolts recorded in seventeenth-century Germany and Switzerland, more than half took place between 1626 and 1650; the total number of food riots in England rose from twelve between 1600 and 1620 to thirty-six between 1621 and 1631, with fourteen more in 1647–1649.[4] In France, finally, popular revolts peaked both absolutely and relatively in the mid-seventeenth century. (See Table 1.)

Dynasty (Stanford, Calif., 1991), 47–49. John B. Parsons, *The Peasant Rebellions of the Late Ming Dynasty* (Tucson, Ariz., 1970), provides scatter diagrams of peasant rebellions year by year from 1628 to 1642, with two "cumulative maps" at 86–87.

[3] Figures from Herbert P. Bix, *Peasant Protest in Japan, 1590–1884* (New Haven, Conn., 1986), xxii. On Shimabara, see Matthew E. Keith, "The Logistics of Power: Tokugawa Response to the Shimabara Rebellion and Power Projection in Seventeenth-Century Japan" (Ph.D. diss., Ohio State University, 2006).

[4] Totals from Peter Bierbrauer, "Bäuerliche Revolten im Alten Reich: Ein Forschungsbericht," in Peter Blickle et al., eds., *Aufruhr und Empörung? Studien zum bäuerlichen Widerstand im Alten Reich* (Munich, 1980), 66–67; and John Walter, *Crowds and Popular Politics in Early Modern England* (Manchester, 2006), 69–70.

Major Revolts and Revolutions, 1635–1666

EUROPE

1636 1. Croquants Revolt (Périgord)
2. Revolt in Lower Austria
1637 3. Cossack Revolt [→ 1638]
4. Scottish Revolution [→1651]
5. Évora & S. Portugal Revolt [→ 1638]
1639 6. Nu-pieds Revolt (Normandy)
1640 **7. Catalan Revolt [→ 1659]**
8. Portugal rebels [→1668]
1641 **9. Irish Rebellion [→ 1653]**
10. Andalusia : Medina Sidonia conspiracy
1642 **11. English "Great Rebellion" [→ 1660]**
1647 **12. Revolt of Naples [→ 1648]**
13. Revolt of Sicily [→ 1648]
1648 14. France: Fronde Revolt [→ 1653]
15. Russia: Moscow and other cities rebel [→ 1649]
16. Revolt of Ukraine against Poland [→ 1668]
17. Istanbul: Ottoman regicide
1649 18. London: British regicide
1650 **19. Dutch regime change [→ 1672]**
1651 20. Bordeaux: Ormée Revolt [→ 1653]
21. Istanbul riots
1652 22. "Green Banner" revolts in Andalusia
1653 23. Swiss Revolution
1656 24. Istanbul riots
1660 **25. The "Danish Revolution"**
26. "Restoration" in England, Scotland, and Ireland
1662 27. Moscow Rebellion

AMERICAS

1637 28. Pequot War
1641 29. Mexico Revolt [→ 1642]
30. Portuguese Brazil rebels against Spain
1642 31. English colonies in America take sides in Civil War
1645 **32. Portuguese colonists in Brazil rebel against Dutch [→ 1654]**
1660 33. "Restoration" in English colonies
1666 34. Revolt of Laicacota (Peru)

ASIA AND AFRICA

1635 35. Popular revolts spread from NW China to Yangzi valley [→ 1645]
1637 36. Revolt at Shimabara [→ 1638]
1639 37. Revolt of Chinese (Sangleys) in Manila
1641 **38. Revolt of Portuguese in Mombasa, Mozambique, Goa, and Ceylon against Spain**
1643 **39. Li Zicheng declares Shun Era in Xi'an**
1644 **40. Li Zicheng takes Beijing and ends Ming rule**
41. Qing capture Beijing and occupy Central Plain
1645 **42. Qing invade southern China; "Southern Ming" resistance [→ 1662 in southern China; → 1683 in Taiwan]**
1651 43. Yui conspiracy in Tokyo
1652 44. Colombo rebels against Portugal
1653 45. Goa rebels against Portugal
1657 46. Anatolia: Revolt of Abaza Hasan Pasha [→ 1659]
1658 **47. Mughal Civil War [→ 1662]**
1665 **48. Overthrow of Kongo kingdom**
49. Shabbatai Zvi proclaimed Messiah at Izmir

Events listed in bold are those that produced regime change.

TABLE 1
Popular Revolts in France, 1590–1715

	Aquitaine		*Provence*	
Date	*Number*	*Annual Average*	*Number*	*Annual Average*
1590–1634	47	1	108	2.4
1635–1660	282	11.3	156	6.3
1661–1715	130	2.7	110	2

SOURCES: Table based on Yves-Marie Bercé, *Histoire des Croquants: Étude des soulèvements populaires au XVIIe siècle dans le sud-ouest de la France*, 2 vols. (Geneva, 1974), 2: 682; and René Pillorget, *Les mouvements insurrectionnels de Provence entre 1596 et 1715* (Paris, 1975), 988. William Beik, *Urban Protest in Seventeenth-Century France: The Culture of Retribution* (Cambridge, 1997), 258, estimated that between thirty and forty major uprisings and thousands of lesser ones took place in seventeenth-century France, especially in the 1620s, 1640s, and 1670s—although he also expressed skepticism about the precision of such calculations.

The mid-seventeenth century also saw a third major anomaly: more wars took place around the world than in any other era until the 1940s. In the six decades between 1618 and 1678, Poland was at peace for only twenty-seven years, the Dutch Republic for only fourteen, France for only eleven, and Spain for only three. Jack S. Levy, a political scientist, found the sixteenth and seventeenth centuries in Europe to be "the most warlike in terms of the proportion of years of war under way (95 per cent), the frequency of war (nearly one every three years), and the average yearly duration, extent, and magnitude of war." The historical record reveals at least one war in progress between the states of Europe in every year between 1611 and 1669. Beyond Europe, over the same period, the Chinese and Mughal empires fought wars continuously, while the Ottoman Empire enjoyed only seven years of peace. The global "Conflict Catalogue" compiled by Peter Brecke, another political scientist, shows that, on average, wars around the world lasted longer in the seventeenth century than at any time since 1400 (when his survey begins). (See Figure 2.) War had become the norm for resolving both domestic and international problems.[5]

Finally, throughout the Northern Hemisphere, the mid-seventeenth century witnessed almost unprecedented human mortality. When China's Yongzheng emperor looked back in 1729 on the turbulent transition from Ming to Qing rule two generations before, he claimed that "over half of the population perished" in the violence. In Sichuan (once a densely populated province), "people lamented that they did not have a single offspring. The few who survived had lost hands or feet or had their ears and noses sliced off," he continued. "Older people who had witnessed [the devastation] would weep as they described it."[6] In Germany in 1635, Hans Conrad Lang, a clothier living in Konstanz, believed that war and epidemics had caused "so many deaths that the like of it has never been heard in human history"; while Johann Valentin Andreä, a Lutheran minister in Württemberg, lamented that barely one-

[5] Jack S. Levy, *War in the Modern Great Power System, 1495–1975* (Lexington, Ky., 1983), 139–141; Peter Brecke, "Violent Conflicts 1400 A.D. to the Present in Different Regions of the World" (paper prepared for the 1999 Meeting of the Peace Science Society International Conference, Ann Arbor, Mich.).

[6] *Qing shilu* [Veritable Records of the Ming] 8 (Beijing, 1985), chap. 86, 149, edict of the Yongzheng emperor, November 2, 1729 (translated by Ying Bao).

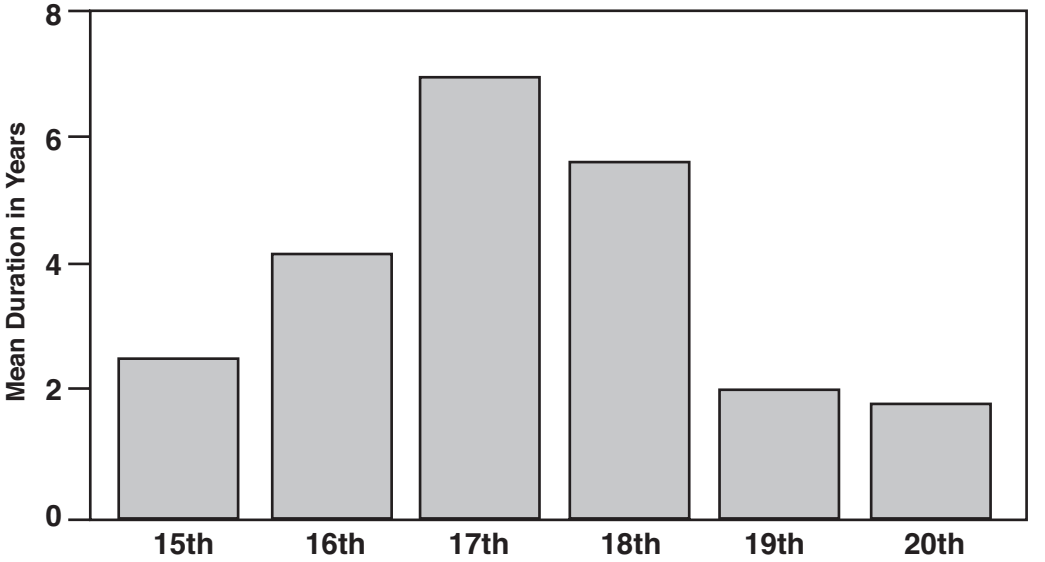

FIGURE 2: Average duration of conflicts by century, showing that more "long wars" occurred in the seventeenth century than at any other time in the past six hundred years. From Brecke, "Violent Conflicts," Figure 11.

third of his parishioners remained alive: "Just in the last five years," he wrote in 1638, "518 of them have been killed by various misfortunes."[7] Many more would die before the Thirty Years' War ended ten years later. In France, a royal minister believed that during the Fronde Revolt (1648–1653) "two-thirds of the inhabitants of the villages around Paris died of illness, want, and misery"; while at neighboring Port-Royal-des-Champs, Abbess Angélique Arnauld lamented that "the miseries of our France are such that there are now only few working men, since almost all those in the countryside, ravaged by the war, are dead, and the rest have enlisted and gone to the wars." In all, she estimated, "a third of the world has died."[8]

Disaster, disorder, and death on this scale demoralized even the most resilient survivors. In *Leviathan*, a treatise on political obedience published in 1651, Thomas Hobbes claimed that "There is [now] no place for industry, because the fruit thereof is uncertain, and consequently no culture of the earth; no navigation, nor use of the commodities that may be imported by sea; no commodious building; . . . no arts; no letters; no society. And, which is worst of all, continual fear and danger of violent death; and the life of man, solitary, poor, nasty, brutish, and short." Many people in France, where Hobbes wrote these words, shared his apocalyptic vision. "If one ever had to believe in the Last Judgment," wrote a Parisian judge in 1652, "I believe it is happening right now"; while in 1655, Abbess Arnauld feared that the general

[7] Geoff Mortimer, *Eye-witness Accounts of the Thirty Years War* (London, 2002), 77–78, quoting Lang; P. Antony and H. Christmann, eds., *Johann Valentin Andreä: Ein schwäbisher Pfarrer im dreissigjährigen Krieg* (Hildesheim, 1970), 128, quoting Andreä.

[8] Jean Jacquart, "La Fronde des Princes dans la région parisienne et ses consequences matérielles," *Revue d'histoire moderne et contemporaine* 7 (1960): 257–290, at 279, quoting André d'Ormesson; *Lettres de la reverende mère Marie Angélique Arnauld, abbesse et réformatrice de Port-Royal*, 2 vols. (Utrecht, 1742), 2: 432–433, to the queen of Poland, January 28, 1654.

TABLE 2
German Demographic Evolution, 1600–1750 (in millions)

	Germany (1871 frontiers)			*Holy Roman Empire*			
Year	*Abel*	*Clark*	*Bosl/Weis*	*Sagarra*	*Kellenbenz*	*Dipper*	*Mitterauer*
1600	16	15	16	18	18–20	18–20	21
1650	10	12	10	10–11	11–13	11–13	16
1700	-	15.5	-	-	-	15–17	21
1750	18	18	18	18	18–20	18–20	23

SOURCES: Christof Dipper, *Deutsche Geschichte, 1648–1789* (Frankfurt, 1991), 44, tabulating the estimates (each one based on extensive research) by Wolfgang Abel (1967), Colin Clark (1969), Karl Bosl and Eberhard Weis (1976), Eda Sagarra (1977), Hermann Kellenbenz (1977), Michael Mitterauer (1971), and Dipper himself.

desolation "must signify the end of the world."[9] That same year, Louis XIV's uncle Gaston of Orléans declared that the French "Monarchy was finished: the kingdom could not survive in its present state. In all the monarchies that had collapsed, decline began with movements similar to the ones he discerned [now]; and he launched into a long list of comparisons to prove his statement from past examples."[10]

Now, of course, the French monarchy was not "finished" by the Fronde—instead, Louis XIV became the most powerful king in its history—just as the world did not end in the 1650s; and history is full of people who sincerely believed that they battled misfortunes the like of which had "never been heard in human history." Nevertheless, subsequent research has corroborated the apparently extravagant claims of those who lived through the mid-seventeenth-century crisis: they did indeed face adversity on a scale unparalleled in modern times. Thus in Württemberg, where Andreä lived, a government survey in 1638 (the year of his lament) revealed that only one-quarter of the prewar population remained in their homes; while another survey in 1655, seven years after the war's end, showed that the duchy's total population remained below one-half of its prewar level.[11] Modern historians of Germany estimate that overall demographic loss during the Thirty Years' War (1618–1648) ranged from 20 to 45 percent and that recovery took at least half a century. (See Table 2.)

In France, the surviving parish registers from the Île-de-France, where Abbess Arnauld lived, also show that the worst crisis of the entire *ancien régime* occurred during the Fronde: "In most of the parishes for which we have a total of burials for 1652," according to Jean Jacquart's demographic research, "almost a quarter of the

[9] Thomas Hobbes, *Leviathan; or, The Matter, Forme, and Power of a Common-wealth, Ecclesiasticall and Civill*, ed. Richard Tuck (1651; repr., Cambridge, 1996), 89; Hubert Carrier, *Le labyrinthe de l'Etat: Essai sur le débat politique en France au temps de la Fronde (1648–1653)* (Paris, 2004), 150, Renaud de Sévigné to Christine de France, July 19, 1652; *Lettres de la reverende mère Marie Angélique Arnauld*, 2: 177, 182–183, to the queen of Poland, September 6 and 20, 1652.

[10] *Mémoires de Mademoiselle de Montpensier*, 2 vols. (Paris, 1728), 2: 276, reporting the pessimistic comments made to her by Gaston, her father, at Easter 1655.

[11] Since seventeenth-century Germany consisted of some 1,000 political units, all aggregations of data are approximate. See the mass of local statistics gathered by Günther Franz, *Der dreissigjährige Krieg und das deutsche Volk*, 4th ed. (Stuttgart, 1978). John C. Theibault, "The Demography of the Thirty Years War Revisited: Günther Franz and His Critics," *German History* 15 (1997): 1–21, questions the value of any book written by a prominent (and unrepentant) Nazi such as Franz, but on p. 4 endorses his overall estimate.

population vanished in a single year." Likewise, the research of Pierre Goubert in the archives of the Beauvaisis, an area north of Paris, revealed "a crisis—economic, social, demographic, physiological and moral—of an intensity and duration hitherto unknown" at precisely this time. The "steep rise and heavy extension of poverty and mortality, and a sharp fall in births" associated with the Fronde reduced the population of the region by about one-fifth.[12]

In China, finally, government records show that the total amount of cultivated land in the empire fell from 191 million acres in 1602 to 67 million in 1645, the year after Qing forces occupied northern China, with a partial recovery to only 90 million in 1661 and 100 million in 1685.[13] No statewide census exists to test the Yongzheng emperor's estimate that "over half of China's population perished," but a wealth of local data supports his claim. Thus a modern demographic reconstruction for Tongcheng County in Anhui Province between 1631 and 1645 shows that some areas—especially those along the routes used by armies—suffered almost 60 percent losses. Farther north, the records of Dancheng County in Shandong Province reveal how a combination of natural and human elements reduced the number of able-bodied males from just over 40,000 in the 1630s to around 34,000 in 1641, to fewer than 10,000 in 1646, and to 9,000 in 1670. During the same period, the number of inhabited settlements in the county declined from 85 to 31. The late Frederic C. Wakeman suggested that the devastation caused by the Ming-Qing transition meant that in Sichuan (the area singled out by the Yongzheng emperor), "well over a million people must have been killed and the local gentry was virtually exterminated."[14]

In part, these catastrophic losses occurred because the General Crisis took place at a time when population densities in the Northern Hemisphere had reached unprecedented and sometimes unsustainable levels. Thus Jiangnan, an area of roughly 17,000 square miles in China's Lower Yangzi Valley, boasted a population of about 20 million by 1620, an average of almost 1,200 persons per square mile. (In comparison, the Netherlands, the most populous part of Europe today, boasts 1,000 persons per square mile.) In some cities, the concentration of people was even higher: population and building densities within the medieval walls of London, for example, had in the 1630s reached levels probably not "witnessed in Britain either before or since." In some parishes, each acre contained almost 400 people.[15]

In such areas, local resources no longer satisfied demand. According to Alvaro

[12] Jacquart, "La Fronde," 283; Pierre Goubert, "The French Peasantry of the Seventeenth Century: A Regional Example," in Trevor S. Aston, ed., *Crisis in Europe, 1560–1660* (London, 1965), 141–165, at 162–163.

[13] Ping-ti Ho, *Studies in the Population History of China*, rev. ed. (Cambridge, Mass., 1967), 102. Note, however, that Ho's 1602 figure of 1,161 million *mou*, at 0.1647 acres per *mou*, is 191.3 million acres, and not 176 million acres as he states.

[14] Ted A. Telford, "Fertility and Population Growth in the Lineages of Tongcheng County, 1520–1661," in Stevan Harrell, ed., *Chinese Historical Microdemography* (Berkeley, Calif., 1995), 48–93, at 70–73; Hilary Beatty, *Land and Lineage in China: A Study of T'ung-ch'eng County, Anhwei, in the Ming and Ch'ing Dynasties* (Cambridge, 1979), 47, 133; Jonathan D. Spence, *The Death of Woman Wang: Rural Life in China in the Seventeenth Century* (London, 1978), 4–9, 42 (quoting from the 1673 *Dancheng County Gazetteer*); Frederic C. Wakeman, *The Great Enterprise: The Manchu Reconstruction of Imperial Order in Seventeenth-Century China* (Berkeley, Calif., 1985), 1109 n. 77.

[15] Xue Yong, "Agrarian Urbanization: Social and Economic Changes in Late Imperial Jiangnan" (Ph.D. diss., Yale University, 2006), 239–240; and Derek Keene, "Growth, Modernization and Control: The Transformation of London's Landscape, c. 1500–c. 1760," in Peter Clark and Raymond Gillespie, eds., *Two Capitals: London and Dublin, 1500–1840* (Oxford, 2001), 20–21.

Semedo, a Portuguese Jesuit writing in 1637, Jiangnan "is so full of all sorts of people that not only the villages but even the cities can now be seen one from another, and in some areas, where the rivers are more common, settlement is almost continuous." Indeed, he mused, China had become "so overpopulated [*eccessivamente popolato*] that after living there for twenty-two years, I remain almost as amazed at the end as I was at the beginning by the multitude of people. Certainly the truth is above any exaggeration: not only in the cities, towns and public places . . . but also on the roads there are normally as many people as would turn out in Europe [only] for some holiday or public festival." Since "the number of people is infinite," he continued, "there can be no capital sufficient for so many, or money sufficient to fill so many purses."[16]

Many of Semedo's contemporaries considered parts of Europe "overpopulated," too. In England, the colonizer Sir Ferdinando Gorges claimed that "this peaceable time affords no means of employment to the multitude of people that daily do increase," and he therefore sent settlers to Maine largely in order to reduce population pressure at home. His rivals in the Virginia Company, fearing "the surcharge of necessitous people, the matter or fuel of dangerous insurrections," likewise sought to remove them from England to their new colony on the Chesapeake. By the mid-1630s, Thomas Bowdler rejoiced that the thousands migrating across the Atlantic each year promoted England's stability because the American colonies "serve for drains to unload their populous state which else would overflow its own banks by continuance of peace and turn head upon itself, or make a body fit for any rebellion."[17]

Nevertheless, only a few years after Semedo and Bowdler wrote, the population of China, the Stuart monarchy, and other states in the Northern Hemisphere did engage in "dangerous insurrections." Why?

MANY CONTEMPORARIES ATTRIBUTED the revolutions, revolts, wars, and mortality that surrounded them to supernatural forces. To the Welsh historian James Howell, writing in 1649, the extent and suddenness of the catastrophe suggested that

> God Almighty has a quarrel lately with all mankind, and given the reins to the ill spirit to compass the whole earth; for within these twelve years there have the strangest revolutions and horridest things happened, not only in Europe but all the world over, that have befallen mankind, I dare boldly say, since Adam fell, in so short a revolution of time . . . [Such] monstrous things have happened [that] it seems the whole world is off the hinges; and (which is the more wonderful) all these prodigious passages have fallen out in less than the compass of twelve years.[18]

[16] Alvaro Semedo, S. J., *Historica relatione del gran regno della Cina* (Rome, 1653), 6–7, 13. Semedo arrived in southern China in 1613 and remained there, with some breaks, until 1637; he wrote his account almost immediately afterward (even though it remained unpublished for many years). He thus described the situation in Jiangnan on the eve of the Qing conquest.

[17] Charles M. Andrews, *The Colonial Period of American History*, vol. 1: *The Settlements* (New Haven, Conn., 1934), 612–613, quoting Gorges (in 1611), the Virginia Company (in 1624), and many others; Nicholas Canny, *The Origins of Empire: British Overseas Enterprise to the Close of the Seventeenth Century* (Oxford, 1998), 20, quoting Thomas Bowdler's "Common Place Book" for 1635–1636.

[18] James Howell, *Epistolae Ho-Elianae*, 3 vols. (London, 1650), 3: 1–3, to Lord Dorset, January 20, 1646. This date is impossible, because Howell mentioned the "tumults" in Moscow and Istanbul in

Others saw the misfortunes that surrounded them as God's punishment for official toleration of activities of which they disapproved, ranging from sodomy to stage plays, and called on governments to persecute and prohibit them before the situation got worse. Such logic dominated the preamble to an act passed in 1642 by the English Parliament:

> Whereas the distressed state of Ireland, steeped in her own blood, and the distracted state of England, threatened with a cloud of blood by a civil war, call for all possible means to appease and avert the wrath of God . . . [and whereas] public sports do not well agree with public calamities, nor public stage-plays with the seasons of humiliation . . . being spectacles of pleasure, too commonly expressing lascivious mirth and levity . . . all public stage plays shall cease.[19]

Others still blamed the devil and his lieutenants on earth: the witches. In Scotland in 1649, after a decade of drought, war, and revolution, when "the prices of victual and corn of all sorts were higher than ever heretofore any[one] living could remember," the Scots Parliament decided "that the sin of witchcraft daily increases in this land" and so, to avert further disasters, issued some five hundred commissions to try suspected witches, resulting in more executions for sorcery during the famine of 1649–1650 than at any other time in Scottish history.[20]

Many contemporaries linked the General Crisis with other extraterrestrial phenomena. A Spanish almanac published in 1640 reminded readers that "Whenever eclipses, comets and earthquakes and other similar prodigies have occurred, great miseries have usually followed" and predicted that the eclipse of the sun observed on June 1, 1639, would produce "great upsets in war, political upheavals, and damage to ordinary people" between March 1640 and March 1642. (The anonymous author also specified further dire consequences that would afflict future generations of readers down to the year 2400 A.D.)[21] The appearance of a particularly brilliant comet during the winter of 1618–1619 likewise led to predictions in China, Russia, India, and the Ottoman Empire, as well as all across Europe, that "discord, irritations,

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summer 1648. In his pamphlet *A Winter Dreame* (London, 1649), 8, Howell used the same conceit: "it seems God Almighty has a quarrel of late years with all earthly potentates, for in so short a time there never happened such strange shocks and revolutions," and named the downfall of Ottoman, Ming, Muscovite, and European rulers. Presumably Howell wrote to Lord Dorset at much the same time, and so "these twelve years" began in 1637 with the Scottish Revolution.

[19] Charles H. Firth and Robert S. Rait, *Acts and Ordinances of the Interregnum, 1642–1660*, 2 vols. (London, 1911), 1: 26–27, "Order for Stage-Plays to Cease" (September 2, 1642, OS). For similar reasons, Parliament also banned public sports and many other "spectacles of pleasure." The Stuart monarchy, like Russia and much of Protestant Europe, used the Julian calendar ("Old Style," or OS), so that all dates fell ten days earlier than in Catholic Europe, which used the Gregorian calendar ("New Style," or NS): thus September 2 in Britain and Sweden was September 12 in Spain and France. All dates in this article given according to the Julian calendar are marked "OS"; all others follow the Gregorian calendar.

[20] Sir James Balfour, *The Historical Works of Sir James Balfour of Denmylne and Kinnaird*, ed. James Haig, 3 vols. (Edinburgh, 1825), 3: 409 (prices), 436–437 (witches); Christina J. Larner, Christopher H. Lee, and Hamish V. McLachlan, *A Source Book of Scottish Witchcraft* (Glasgow, 1977), sub annis 1649–1650; and Larner, *Enemies of God: The Witch-Hunt in Scotland* (London, 1981), 61, 74–75. For the connection drawn by contemporaries in other areas between witchcraft and misfortunes, see Wolfgang Behringer, "Climatic Change and Witch-Hunting: The Impact of the Little Ice Age on Mentalities," *Climatic Change* 43 (1999): 335–351.

[21] Biblioteca Nacional, Madrid [hereafter BNM], Ms. 2371/634, *Prognosticon* (an anonymous broadsheet of 1640).

deaths, upheavals, robberies, rape, tyranny, and the change of kingdoms" would follow.[22] As late as 1649, a London newspaper still linked the comet of 1618 with the Thirty Years' War because "the Blazing Star, in the year the war began, appeared over Europe for thirty days and no more."[23] In China, a popular encyclopedia likewise noted that "when comets have dominated Heaven, there have been conflicts over the succession to the throne"; but it also blamed the stars. "Venus is a star associated with war. If one examines the patterns of Heaven through successive dynasties, [one finds that] when Venus has dominated Heaven, wars have arisen on a great scale."[24] Many Europeans agreed. Thus in 1648, Johann Adler Salvius, a Swedish diplomat, considered it "a great miracle that we hear of revolts by the people against their rulers everywhere in the world, for example in France, England, Germany, Poland, Muscovy, and the Ottoman Empire," and wondered "whether this can be explained by some general configuration of the stars in the sky."[25] Three years later, Landgrave Hermann of Hesse suggested that the stars might influence human affairs through the weather in his *Meteorological History: That is, twenty-four years of original and truthful observations and daily descriptions of the weather, chiefly to show if and how the weather each day is linked with the stars, and why this would happen (or not)*.[26]

Only a few of those who lived through the seventeenth-century crisis linked the

[22] Mendo Pacheco de Britto, *Discurso em os dous phaenominos aereos do anno de 1618* (Lisbon, 1619), fols. A11–11v. Tabitta van Nouhuys, *The Age of Two-Faced Janus: The Comets of 1577 and 1618 and the Decline of the Aristotelian World View in the Netherlands* (Leiden, 1998), 487–555, surveys the "significance" attached to the comet of 1618 in ten books and pamphlets published in the Low Countries. On the fears occasioned by the 1618 comet in China and its neighbors, see Wakeman, *The Great Enterprise*, 57; Gertraude Roth, "The Manchu-Chinese Relationship, 1618–1636," in Jonathan D. Spence and Jack E. Wills, eds., *From Ming to Ch'ing: Conquest, Region, and Continuity in Seventeenth-Century China* (New Haven, Conn., 1979), 7–8; and Timothy Brook, *The Confusions of Pleasure: Commerce and Culture in Ming China* (Berkeley, Calif., 1998), 163–167. For India, see Shireen Moosvi, "Science and Superstition under Akbar and Jahangir: The Observation of Astronomical Phenomena," in Irfan Habib, ed., *Akbar and His India* (Delhi, 1997), 115.

[23] *The Moderate Intelligencer* [London], no. 202 (January 25–February 1, 1649). Naturally such untenable beliefs persisted even longer in Massachusetts. A brilliant comet in 1683 prompted Increase Mather, preacher at the North Church in Boston and president of Harvard College, to write a comprehensive treatise that noted that the Thirty Years' War and the depopulation of the natives of New England had followed the comet of 1618, while the plague and fire that devastated London had followed that of 1664. He warned his readers that it was only because "we that live in America know but little of the great motions of Europe, much less in Africa and Asia, until a long time afterwards" that news of yet more catastrophes caused by comets had not reached Harvard: Mather, *Kometographia; or, A Discourse concerning Comets, wherein the Nature of Blazing Stars is Enquired into, with an Historical Account of all Comets which have Appeared since the Beginning of the World* (Boston, 1683), 118, 124, 107.

[24] Xie Zhaozhe, *Wu za zu* (1608), quoted in Mark Elvin, "The Man Who Saw Dragons: Science and Styles of Thinking in Xie Zhaozhe's *Fivefold Miscellany*," *Journal of the Oriental Society of Australia* 25–26 (1993–1994): 34.

[25] Boris F. Porshnev, "Les Rapports politiques de l'Europe occidentale et de l'Europe orientale à l'époque de la Guerre de Trente Ans," in *Rapports du XIe Congrès des sciences historiques*, 4 vols. (Stockholm, 1960), 4: 158, quoting Salvius. A few years later, the influential history of Majolino Bisaccione, *Historia delle guerre civili di questi ultimi tempi, cioê di Inghilterra, Catalogna, Portogallo, Palermo, Napoli, Fermo, Moldavia, Polonia, Svizzera, Francia, Turco*, 4th ed., "ricorretta et in molte parti accresciuta" (Venice, 1655), 510, argued that only "the influence of the stars" could explain the apparently universal "wrath among the people against governments."

[26] Landgrave Hermann IV of Hesse, *Historia meteorologica, das ist, vier und zwantzig jährige eigentliche und trewfleissige Observation und tägliche Verzeichnüss des Gewitters, erstlich demonstriret wird, ob und wie des tägliche Gewitter mit dem Gestirn uberein troffen, und warumb solches Geschehen sey oder nicht?* (Kassel, 1651).

catastrophes that surrounded them with climate change. In an essay titled "Of Seditions and Troubles," the English statesman and philosopher Francis Bacon warned that "when any of the four pillars of government are mainly shaken or weakened (which are religion, justice, council and treasure), men had need to pray for fair weather."[27] As the century advanced and the "pillars of government" shook in state after state, prayers for "fair weather" multiplied. Thus in February 1647, Don Juan Chumacero (president of the Council of Castile, charged with maintaining domestic law and order) patiently explained the link between climate and catastrophe to his master, King Philip IV. "Torrential and persistent rain has made traffic impossible on the roads to Madrid," he warned, and so, "since the bakers of the Court have never had the capacity, or the resources, to bake more than their normal annual quota, we have consumed almost all the flour in the city's granary." As he wrote these words in the royal palace, in the neighboring parishes of Madrid births plunged and deaths soared.[28] (See Figure 3.) A few months later, even in Andalusia, "it began to rain a lot, and the weather turned very cold, even worse than the coldest January day." Freak frosts killed the ears of grain and produced the worst harvest of the century.[29] Chumacero despaired: "God has chosen to wear out these realms with every calamity—war, famine and plague—each one of which normally suffices to raise great anguish and a sense of panic," he told the king in October 1647. "The population [of Madrid] is very volatile and every day it becomes more insolent, which leads to fears of some violence . . . because hunger respects no one [*la ambre a ninguno respecta*] and so it is necessary to do all we can to help, and to avoid any decision which the people might regard as a burden, even if they have no cause . . . The people are so licentious that no day is safe [from the threat of violence]." He concluded wearily: "There is no shortage of people who blame Your Majesty, saying that he does nothing, and that the council is at fault—as if we had any control over the climate!"[30]

Before long, repeated examples of extreme weather, especially prolonged cold spells, led some to suspect global cooling. In July 1675, the learned Parisian Madame de Sévigné complained that, instead of the normal summer heat wave, "We suffer horribly from the cold and have the fires lit" and speculated that "the behavior of the sun and of the seasons has completely changed." That same decade, according to an Ottoman traveler in Egypt, "No one here used to know about wearing furs. There was no winter. But now we have severe winters and we have started wearing furs because of the cold."[31] In China, the frequency of extreme climatic events led the Kangxi emperor, who studied regional weather reports closely, to conclude in

[27] Francis Bacon, *The Essayes or Counsels, Ciuill and Morall, of Francis Lo: Verulam* (London, 1625), 79–80.

[28] Archivo del Ministerio de Asuntos Exteriores, Madrid [hereafter AMAE], Ms. 42/7, Chumacero to Philip IV, February 6, 1647; Charles Larquié, "Popular Uprisings in Mid-Seventeenth Century Spain," *Renaissance and Medieval Studies* 26 (1982): 90–107.

[29] Francisco Morales Padrón, ed., *Memorias de Sevilla (1600–78)* (Córdoba, 1981), 123–124. The graph of tithe yields for the archdiocese of Seville in Gonzalo Anes Álvarez, *Las crisis agrarias en la España moderna*, 2nd ed. (Madrid, 1974), graph 9, shows a dramatic fall in 1647.

[30] AMAE, Ms. 42/15–16v, Chumacero to Philip IV, October 22, 1647.

[31] Emmanuel Le Roy Ladurie, *Histoire humaine et comparée du climat, I: Canicules et glaciers (XIIIe–XVIIIe siècle)* (Paris, 2004), 462–463, quoting a letter from Mme. de Sévigné to her daughter, July 24, 1675 (a year noted by climatologists as one of the coldest on record); Evliyā Çelebi, *Seyahatname* [Book of Travels], 15 vols. (Istanbul, 1969–1971), 10: 508 (reference and translation kindly provided by Jane Hathaway).

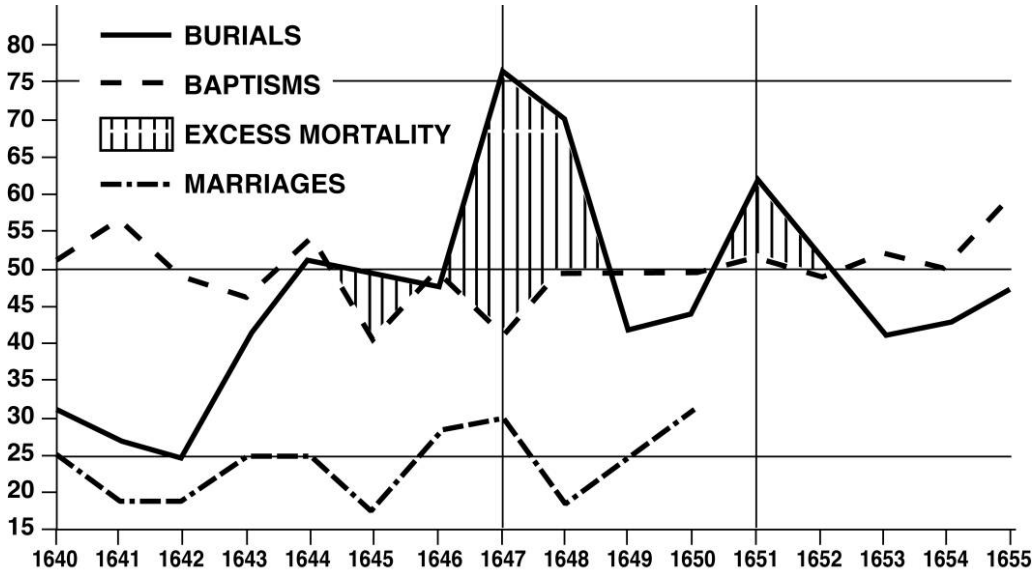

FIGURE 3: The consequences of a subsistence crisis in the Madrid parish of Santa María de la Almudena. The registers of births, burials, and marriages in 1640–1655 reveal a major mortality crisis that peaked in January and February 1647, just as the granaries of the capital ran out of flour. Based on Larquié, "Popular Uprisings," 97.

1717 that "The climate has changed." His Majesty recalled that in the mid-seventeenth century, "when I was touring in Jiangnan, by the 18th day of the third month new wheat [from the winter wheat crop] was available to eat. Now, even by the middle of the fourth month, wheat has not been harvested . . . I have also heard that in Fujian, where it never used to snow, since the beginning of our dynasty [1636], it has."[32]

A generation later, the French intellectual Voltaire made the first systematic attempt to see the rebellions, wars, and natural catastrophes of the preceding century as a global phenomenon arising in part from climate change. In the 1740s, he composed a lengthy *Essay on the Customs and Character of Nations* for his friend Madame du Châtelet, who was bored stiff by the past. Because the mid-seventeenth century presented his reluctant reader with special problems of ennui, Voltaire decided to render the apparent anarchy intelligible by setting individual episodes within a global framework: "a period of usurpations almost from one end of the world to the other" that included Oliver Cromwell in Europe, Aurangzeb in India, and Li Zicheng in China.[33] No doubt fearing that his 800-page metanarrative might exhaust Mme. du Châtelet, Voltaire ended his *Essay* in telegraphic style: "Three things exercise a constant influence over the minds of men: climate, government, and religion." Only this trinity, he asserted, could "explain the enigma of this world."[34]

[32] Robert B. Marks, *Tigers, Rice, Silk and Silt: Environment and Economy in Late Imperial South China* (Cambridge, 1998), 195, quoting the *Da Qing sheng zu (Kangxi) shi lu* for 1717. Ironically, at the precise moment when the emperor reached this conclusion, the climate began to warm again.

[33] François-Marie Arouet de Voltaire, *Essai sur les moeurs et l'esprit des nations*, 2 vols. (1756; repr., 2 vols., Paris, 1963), 2: 794 (see further examples at 2: 756–757).

[34] Ibid., 2: 806: "le climat, le gouvernement, et la religion."

So far, all historians of the General Crisis have included "government and religion" in their analysis, but few have considered the impact of the climate. Even the pioneering 1967 study *Times of Feast, Times of Famine: A History of Climate since the Year 1000*, by Emmanuel Le Roy Ladurie, a historian of early modern Europe, concluded that "In the present state of our knowledge it still seems as if the long 'crisis,' hypothetical or real, of the seventeenth century had some other explanation" than climate change. For example, Le Roy Ladurie continued, "it would be quite absurd" to try and "'explain' the Fronde by the adverse meteorological conditions of the 1640s." Accordingly, instead of writing a study of the impact of climatic fluctuations on European history, as he had intended, Le Roy Ladurie made "a modest attempt to establish an accurate chronology of those fluctuations."[35]

In 1967, such pessimism was justified; but over the past forty years, an avalanche of new data has transformed our knowledge of early modern weather and thus the links between climate and catastrophe. The data fall into two distinct categories: a "human archive" and a "natural archive." The former consists of four main types of records:

- *Narrative* information contained in written texts (chronicles and histories, letters and diaries, judicial and government records, newspapers and broadsheets) and oral traditions.
- *Numerical* information compiled from documentary proxy data (such as the changing date on which the harvesting of certain crops began each year, or the annual volume harvested) or, occasionally, from narrative reports ("Rain fell for the first time in 42 days").
- *Pictorial* information contained in dated visual representations of natural phenomena (paintings that show the position of a glacier's tongue in a given year or that depict ice floes in a harbor during a winter of unusual severity).
- *Epigraphic* or *archaeological* information, such as inscriptions on structures that date flood levels, or excavations of settlements abandoned because of climate change.

The size of this "human archive" for the mid-seventeenth century is overwhelming. In Sicily, more than a dozen contemporaries recorded in detail the progress of the drought and famine that sparked revolt in most of the island's towns in 1647; while in Ireland, judges took sworn "depositions" from some 2,600 Protestant men and 600 women, filling almost 20,000 pages with the things seen, heard, and suffered in 1641 when, following three failed harvests, large numbers of Catholics raped, robbed, killed, and humiliated their Protestant neighbors. In China, a scholar who set out in the 1660s to reconstruct the misery of the recent transition from Ming to Qing in Jiangnan found almost seventy local histories to consult.[36] No previous period boasts such a wealth of eyewitness evidence for historical investigation. But

[35] Emmanuel Le Roy Ladurie, *Times of Feast, Times of Famine: A History of Climate since the Year 1000*, rev. ed. (New York, 1988; orig. French ed. 1967), 293, 289, 5. With remarkable prescience, on p. 303 the author foresaw that computers would transform the historical study of climate.

[36] Peter Burke, "Some Seventeenth-Century Anatomists of Revolution," *Storia della storiografia* 22 (1992): 23–35; Aidan Clarke, "The 1641 Depositions," in Peter Fox, ed., *Treasures of the Library, Trinity College Dublin* (Dublin, 1986), 111–122; Lynn A. Struve, *The Ming-Qing Conflict, 1619–1683: A Historiography and Source Guide* (Ann Arbor, Mich., 1998), 7–9, 33–34 (citing the histories of Ji Liuqi).

there is more: a "natural archive" provides abundant complementary material on long-term trends. Here, too, four types of record possess special relevance for the period before scientific instruments became available to track climate change:

- *Ice cores*: the annual deposits on ice caps and glaciers around the world, captured in deep boreholes, provide evidence of changing levels of volcanic emissions, precipitation, air temperature, and atmospheric composition.
- *Glaciology*: the alternating advance and retreat of glaciers, together with an analysis of the debris left behind, sheds light on both precipitation and ablation.
- *Palynology*: changes in pollen and spores deposited in lakes, bogs, and estuaries reflect the natural vegetation at the time of pollen deposit.
- *Dendrochronology*: the varying size of growth rings laid down by trees during each growing season reflects local conditions in spring and summer. A thick ring corresponds with a year favorable to growth, while a narrow ring indicates a year of adversity.[37]

Combining the two "archives" has enabled climatologists to re-create detailed weather maps for western Europe back to 1659 by month, and back to 1500 by season.[38] In 1999, the journal *Climatic Change* devoted an entire issue to European weather during the sixteenth century, which was later published in book form.[39] Since then, articles in the *International Journal of Climatology* and elsewhere have offered a detailed reconstruction of both the European climate between 1675 and 1715 and the entire global climate for certain decades of the early modern period.[40]

Unfortunately, no similar survey has yet appeared for the 1640s, the decade at

[37] See the detailed discussion of these categories in Raymond S. Bradley, *Paleoclimatology: Reconstructing Climates of the Quaternary*, 2nd ed. (San Diego, Calif., 1999), 441–470; Christian Pfister, Rudolf Brázdil, and Mariano Barriendos, "Reconstructing Past Climate and Natural Disasters in Europe Using Documentary Evidence," *Pages News* 10, no. 3 (2002): 6–8; Christian Pfister, "Weeping in the Snow: The Second Period of Little Ice Age-Type Impacts, 1570–1630," in Wolfgang Behringer, Hartman Lehmann, and Christian Pfister, eds., *Kulturelle Konsequenzer der "Kleinen Eiszeit"* (Göttingen, 2005), 31–86; and Rudolf Brázdil, Christian Pfister, Heinz Wanner, Hans Von Storch, and Jürg Luterbacher, "Historical Climatology in Europe—the State of the Art," *Climatic Change* 70 (2005): 363–430.

[38] Jürg Luterbacher, Daniel Dietrich, Elena Xoplaki, Martin Grosjean, and Heinz Wanner, "European Seasonal and Annual Temperature Variability, Trends, and Extremes since 1500," *Science* 303, no. 5663 (March 5, 2004): 1499–1503. The study of floods provides another excellent example of how historians of climate now combine surviving human and natural archives: see *Historical Hydrology*, special issue, *Hydrological Sciences Journal* 51, no. 5 (2006), edited by Rudolf Brázdil. Several of the fourteen papers present data concerning early modern Europe.

[39] Christian Pfister, Rudolf Brázdil, and Rüdiger Glaser, eds., *Climatic Variability in Sixteenth-Century Europe and Its Social Dimension* (Dordrecht, 1999).

[40] Jürg Luterbacher et al., "Monthly Mean Pressure Reconstruction for the Late Maunder Minimum Period (AD 1675–1715)," *International Journal of Climatology* 20 (2000): 1049–1066; and Keith R. Briffa and Timothy J. Osborn, "Blowing Hot and Cold," *Science* 295, no. 5563 (March 22, 2002): 2227–2228. Briffa and Osborn reconstructed "annual mean temperatures from all land regions north of 20N," and although the 1640s do not stand out in the "50 year smoothed filter" diagram shown in the article, they feature prominently in the "unsmoothed time series" provided in the attached data file. The National Center of Competence in Research on Climate (NCCR) at the University of Bern, Switzerland, is assembling a database of serial records; see EuroClimHist: A Data-Base on Past Weather and Climate in Europe and Its Human Dimension, created by Christian Pfister and Urs Dietrich-Felber, http://www.euroclimhist.com (accessed July 9, 2008), and Urs Dietrich-Felber, "Using Java and XML in Interdisciplinary Research: A New Data-Gathering Tool for Historians Working with EuroClimHist," *Historical Methods* 37, no. 4 (2004): 174–185. As ECH's projects reach completion, they become available on the website of the United States National Oceanic and Atmospheric Administration (NOAA) Paleoclimatology Project.

the center of the General Crisis, but the natural and human "archives" are both abundant, and they reveal both extreme cold and prolonged drought around the globe. In America, New England's colonists experienced the second-coldest winter in a century in 1641–1642. John Winthrop, governor of the Massachusetts Bay Colony, noted in his journal that "The frost was so great and continual this winter that all the Bay was frozen over, so much and so long, as the like, by the Indians' relation, had not been so these forty years . . . To the southward also the frost was as great and the snow as deep, and at Virginia itself the great [Chesapeake] bay was much of it frozen over, and all of their great rivers." Sir Ferdinando Gorges's settlers on the coast of Maine likewise complained of the "most intolerable piercing winter," adding, "it is incredible to relate the extremity of the weather."[41] East Asia also experienced abnormal cold. In Japan, when Enomoto Yazaemon (a merchant and minor official living just north of Tokyo) wrote his memoirs, he remembered the unique conditions on New Year's Day 1641, when "ice lay in the fields one foot deep. From that time, I observed seven snowfalls until the spring." The following November, Tokyo was once again covered with snow: only two other years since then have seen snowfalls so early.[42] A reconstruction of annual temperatures in China since 1370 likewise shows the lowest point ever in the mid-seventeenth century. (See Figure 4.) A chronicler in Shanghai, writing in April 1642, recorded that "since the New Year [January 31], it has been cold and it has rained frequently. The spring has almost come to an end, but the cold still persists."[43]

Europe, too, experienced winters of extreme severity—from Scandinavia (which suffered the coldest winter ever recorded in 1641–1642) to Macedonia (where that same year "there was so much rain and snow that many workers died through the great cold").[44] In the Alps, fields, farmsteads, and even whole villages disappeared as glaciers advanced to their maximum extent between 1640 and 1644. Summers as well as winters were unusually cold in those years. In eastern France, cool summers delayed every grape harvest between 1640 and 1643 by a full month and reduced harvest yields.[45] Hungary experienced a run of unusually wet and cold summers in the 1640s; while in Bohemia, frosts in late May and early September, and occasionally

[41] John Winthrop, *The Journal of John Winthrop, 1630–1649*, ed. Richard S. Dunn, James Savage, and Laetitia Yeandle (Cambridge, Mass., 1996), 368, 384, 387; Karen O. Kupperman, "The Puzzle of the American Climate in the Early Colonial Period," *American Historical Review* 87, no. 5 (December 1982): 1262–1289, at 1274, quoting Thomas Gorges, the nephew of Sir Ferdinando Gorges. The intensity of the "intolerable piercing winter" of 1641–1642 appears in Harold C. Fritts, *Reconstructing Large-Scale Climatic Patterns by Tree-Ring Data* (Tucson, Ariz., 1991), 125–126, 139–149, and the "natural archive" data published in Raymond S. Bradley and Philip D. Jones, eds., *Climate since A. D. 1500* (London, 1992), 83 and Fig. 14.4.

[42] Enomoto Yazaemon, *Enomoto Yazaemon Oboegaki* [Memoranda Written by Enomoto Yazaemon], ed. Ono Mizuo (Tokyo, 2001), 35; H. Arakawa, "Dates of the First or Earliest Snow Covering for Tokyo since 1632," *Quarterly Journal of the Royal Meteorological Society* 82 (1956): 222–226 (a snow covering in November occurred only in 1641, 1699, and 1802).

[43] Ye Shaoyuan's memoir quoted in William S. Atwell, "Volcanism and Short-Term Climatic Change in East Asian and World History, c. 1200–1699," *Journal of World History* 12 (2001): 29–98, at 67–68.

[44] Takehiko Mikami, ed., *Proceedings of the International Symposium on the Little Ice Age Climate* (Tokyo, 1992), 6–9; Paolo Oderico, ed., *Conseils et mémoires de Synadinos, prêtre de Serrès en Macédoine (XVIIe siècle)* (Paris, 1996), 163, 169.

[45] Le Roy Ladurie, *Histoire humaine, I*, 298–303 (Alpine glaciers), 356–366 (the adverse French climate between 1640 and 1643).

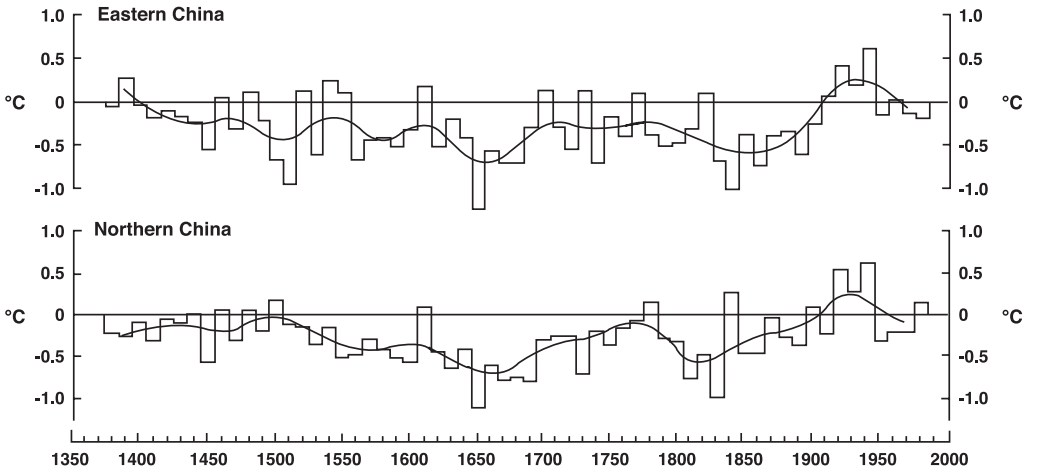

FIGURE 4: Annual temperature anomalies in China, 1370–1800. In both eastern China (above: Shanghai, Jiangsu, Jiangxi, Anhui, and Zhejiang provinces) and northern China (below: Beijing, Hebei, Henan, Shandong, and Shanxi provinces), ten-year mean annual temperature departures from 1880–1979 levels show the 1640s and 1650s as by far the coldest during the entire period. The same decades also saw the highest frequency of unusually cold events. Based on Bradley, *Paleoclimatology*, 461.

also in summer, ruined several harvests.[46] Perhaps most striking of all, a soldier serving in central Germany recorded in his diary in *August* 1640 that "at this time there was such a great cold that we almost froze to death in our quarters. On the road, three people did freeze to death: a cavalryman, a woman, and a boy."[47] In the Northern Hemisphere as a whole, 1641 was the third-coldest summer recorded over the past six centuries, 1643 was the tenth-coldest, and 1642 was the twenty-eighth-coldest—three landmark winters in a row. These extremes have led historians and climatologists alike to speak of the period as "the Little Ice Age."[48]

The 1640s also saw prolonged drought in many areas. The western United States lacked rain in 1640–1644, which, combined with unusually low temperatures, sig-

[46] Lájos Rácz, "Variations of Climate in Hungary (1540–1779)," in Burkhart Frenzel, ed., *European Climate Reconstructed from Documentary Data: Methods and Results* (Stuttgart, 1992), 125–135; Rudolf Brázdil, Hubert Valášek, and Oldřich Kotyza, "Meteorological Records of Michel Stüeler of Krupka and Their Contribution to the Knowledge of the Climate of the Czech Lands in 1629–1649," in Dušan Drbohlav, Jan Kalvoda, and Vít Voženílek, eds., *Czech Geography at the Dawn of the Millennium* (Olomouc, 2004), 95–112.

[47] Jan Peters, ed., *Ein Söldnerleben im Dreissigjährigen Krieg: Eine Quelle zur Sozialgeschichte* (Berlin, 1993), 166. (The diarist Peter Hagendorf made this entry in Neustadt-an-der-Saale on August 7, 1640. I thank David Parrott for this reference.) Data concerning the extreme weather of 1640–1641 abound in Christian Pfister, *Klimageschichte der Schweiz 1525–1860 und seiner Bedeutung in der Geschichte von Bevolkung und Landwirtschaft*, 2 vols. (Bern, 1988), 1: 70–71; Walter Lenke, *Klimadaten von 1621–1650 nach Beobachtungen des Landgrafen Herman IV. von Hessen* (Offenbach, 1960), 37–38 (annual tables for frost/snow 1640–1641); Rüdiger Glaser, *Klimarekonstruktion für Mainfranken, Bauland und Odenwald* (Stuttgart, 1991), 111–112; and Glaser, *Klimageschichte Mitteleuropas: 1000 Jahre Wetter, Klima, Katastrophen* (Darmstadt, 2001), 147–148.

[48] Atwell, "Volcanism," 63. For estimated temperatures, see Anders Moberg et al., "Highly Variable Northern Hemisphere Temperature Reconstructed from Low- and High-Resolution Proxy Data," *Nature* 333, no. 7026 (2005): 613–617, and the accompanying database. For a recent discussion, see Brázdil et al., "Historical Climatology in Europe," and John A. Matthews and Keith R. Briffa, "The 'Little Ice Age': Re-evaluation of an Evolving Concept," *Geografiska Annaler* 87 A (2005): 17–36. Although the mid-seventeenth century experienced several notable climatic anomalies—1619–1620, 1627, 1630–1631, 1640–1642, 1647–1649, 1657–1658, 1660–1661, 1664–1665, and 1675, many of them coinciding with episodes of major political upheaval—for reasons of space this article concentrates on just 1640–1642.

nificantly stunted the growth of plants. No rain fell in the Valley of Mexico between spring and mid-October 1641, and a shortage of rain the following summer raised the price of maize, the staple crop, to famine levels: in both years the clergy of Mexico City took the "Virgen de los Remedios" on procession to solicit God's intervention before everyone died.[49] Across the Pacific, according to a 1642 pamphlet, the entire Philippines suffered from a "great drought that prevails—for there has been no rain for eight months, which occasions excessive heat; and the rice, the usual food in this country, cannot be sown, and a great famine is feared." Between 1643 and 1671, the Indonesian archipelago experienced the longest drought recorded during the past four centuries.[50] In 1640, northern China experienced the single-driest year recorded during the last five centuries; while in 1641, central China experienced its second-driest year in two centuries, with a drought so severe in Shandong Province that the Grand Canal dried up for the only time on record.[51] In Egypt, the Nile fell to some of its lowest recorded levels between 1640 and 1643; much of West Africa suffered droughts of great intensity in 1639–1643; and prolonged drought reduced Lake Chad to the lowest level ever recorded.[52] In Europe, finally, Catalonia experienced a drought in spring 1640 so intense that the authorities declared a special holiday so that the entire population could make a pilgrimage to a local shrine to pray for water—one of only four such occasions recorded in five centuries. One day in May 1641, in Madrid, the entire central government received an order to stop work and join the royal family in a procession that followed the body of the capital's patron saint, St. Isidro, around the streets to pray for rain.[53]

[49] Southern and Midwestern USA Climate Reconstructions, dataset created by D. W. Stahle and M. K. Cleaveland, http://gcmd.nasa.gov/records/GCMD_NOAA_NCDC_PALEO_94-024.html (accessed July 9, 2008); International Tree-Ring Data Bank, maintained by the NOAA Paleoclimatology Program and World Data Center for Paleoclimatology, http://www.ncdc.noaa.gov/paleo/treering.html (accessed July 9, 2008); Enrique Florescano, *Analisis histórico de las sequías en México* (Mexico, 1972), 23; Charles Gibson, *The Aztecs under Spanish Rule* (Stanford, Calif., 1964), 313–315.

[50] Emma H. Blair and James A. Robertson, eds., *The Philippine Islands, 1493–1898*, 55 vols. (Cleveland, 1905–1910), 35: 123, from reports on events in 1640–1642 compiled by Franciscan friars; Anthony R. Reid, "The Crisis of the Seventeenth Century in Southeast Asia," in Geoffrey Parker and Lesley M. Smith, eds., *The General Crisis of the Seventeenth Century*, 2nd ed. (London, 1997), 211–217.

[51] Wang Shaowu, "Climate of the Little Ice Age in China," in Mikami, *Proceedings*, 120; Sato Taketoshi, *Chukogu saigaishi nenpyo* [Chronology of Natural Disasters in China] (Tokyo, 1993), 243–244 (listing natural disasters recorded in the *Mingshi*, compiled from gazetteers, one of which recorded the drying up of the Grand Canal in Shandong in 1641); and Song Zhenghai, *Zhongguo gudai zhong da ziran zaihai he yichang nianbiao* [A Comprehensive Chronology of Significant Natural Disasters and Unusual Occurrences in Ancient China] (Guangzhou, 1992), data for 1641 in categories 4–7/9.

[52] Nasir Ahmad Ibrahim, *Al-Azmat al-ijtima ʿiyya fi misr fi al-qarn al-sabiʿ ʿashar* [Social Crises in Egypt in the Seventeenth Century] (Cairo, 1998), 1 (drought), Appendixes 11 and 12 (the Nile reached only fifteen cubits in 1641, the lowest recorded); Sharon E. Nicholson, "Saharan Climates in Historic Times," in Martin A. J. Williams and Hugues Faure, eds., *The Sahara and the Nile: Quaternary Environments and Prehistoric Occupation in Northern Africa* (Rotterdam, 1980), 177, 180 (graph); Roderick J. McIntosh et al., eds., *The Way the Wind Blows: Climate, History, and Human Action* (New York, 2000), 131, 156; and Joseph C. Miller, "The Significance of Drought, Disease and Famine in the Agriculturally Marginal Zones of West-Central Africa," *Journal of African History* 23 (1982): 17–61, especially the tabulated data at 43–46. On Lake Chad, see Sharon E. Nicholson, "The Methodology of Historical Climate Reconstruction and Its Application to Africa," *Journal of African History* 20 (1979): 31–49; and Climate Research Committee, National Research Council, *Natural Climate Variability on Decade-to-Century Time Scales* (Washington, D.C., 1995), 32–35.

[53] Javier Martín-Vide and Mariano Barriendos Vallvé, "The Use of Rogation Ceremony Records in Climatic Reconstruction: A Case Study from Catalonia (Spain)," *Climatic Change* 30 (1995): 201–221, at 212 (the other years were 1529, 1566, and 1628); BNM, Ms. 8177/141–145, "Relación" of May 16, 1641.

So we now know that the General Crisis coincided with a major anomaly in the world's climatic history; but what caused that anomaly? Responsibility rests with two natural phenomena that began in the mid-seventeenth century and persisted until the early eighteenth century, when the global climate changed again and became more benign. First, solar activity reached the lowest level in two millennia. Fewer sunspots—those dark, cooler patches on the solar surface surrounded by "flares" that make the sun shine with greater intensity—appeared between 1645 and 1715 than in a single year of the twentieth century. Whereas more than 100,000 sunspots now come and go in a sixty-year period, the last six decades of the seventeenth century saw scarcely 100.[54] Other observations by astronomers of the time confirm a striking reduction in solar energy. The aurora borealis (the "northern lights," caused when charged particles from the sun interact with the earth's magnetic field) became rare for two generations after 1640—so rare that when Edmond Halley, England's Astronomer Royal, saw an aurora in 1716, he wrote a learned paper describing the phenomenon because it was the first time he had seen one in almost fifty years of observation. Likewise, the brilliant corona nowadays visible during every total solar eclipse also disappeared: descriptions by astronomers between the 1640s and the 1700s mention only a pale ring of dull light, reddish and narrow, around the moon. The energy of the sun appears to have diminished, a condition normally associated with reduced surface temperatures and extreme climatic events on earth.[55]

Simultaneously, contemporaries regularly reported "dust veils" in the skies above the Northern Hemisphere that made the sun seem paler or redder than usual. During the first six months of 1651, a Barcelona shopkeeper lamented that "among our misfortunes, I think the greatest was that the sun did not shine once . . . and if it came out it was pale and yellow, or else much too red, which caused great fear."[56] Thousands of miles to the east, Korea's royal astronomers reported on numerous occasions in the seventeenth century that "the skies all around are darkened and grey as if some kind of dust had fallen."[57] Both the dust and the reddened skies stemmed from a spate of major volcanic eruptions, each hurling sulfur dioxide into the stratosphere, where it deflected some of the sun's radiation back into space and thus significantly reduced temperatures in all areas of the earth beneath the dust clouds. In particular, twelve major volcanic eruptions occurred around the Pacific between 1638 and 1644—apparently an all-time record—and all of them occurred near the

[54] F. W. G. Spörer, "Über die Periodicität der Sonnenflecken seit dem Jahre 1618," *Vierteljahrschrift der astronomischen Gesellschaft* 22, pt. 4 (1887): 323–329; E. W. Maunder, "The Prolonged Sunspot Minimum, 1645–1715," *Journal of the British Astronomical Association* 32 (1922): 140–145. The reconstructions of Luterbacher, "Monthly Mean Pressure Reconstruction," 1050, show an exceptional decrease in solar activity in the second half of the seventeenth century.

[55] John A. Eddy, "The 'Maunder Minimum': Sunspots and Climate in the Reign of Louis XIV," in Parker and Smith, *The General Crisis of the Seventeenth Century*, 268. R. K. Mukerjee, "Agricultural Cycles and Sunspots," *Indian Journal of Sunspots* 10, no. 2 (1939): 259–299, demonstrated that "when the relative sunspot numbers were below 15, a drought period occur[red]" in central India because the monsoon weakened by between 25 and 40 percent.

[56] Miquel Parets, *A Journal of the Plague Year: The Diary of the Barcelona Tanner Miquel Parets, 1651*, trans. and ed. James S. Amelang (Oxford, 1991), 100, from the chronicle of Andrés de la Vega.

[57] Atwell, "Volcanism," 41; Yi Tae-Jin, "Meteor Fallings and Other Natural Phenomena between 1500–1750, as Recorded in the Annals of the Choson Dynasty (Korea)," *Celestial Mechanics and Dynamical Astronomy* 69 (1998): 205–206, 217.

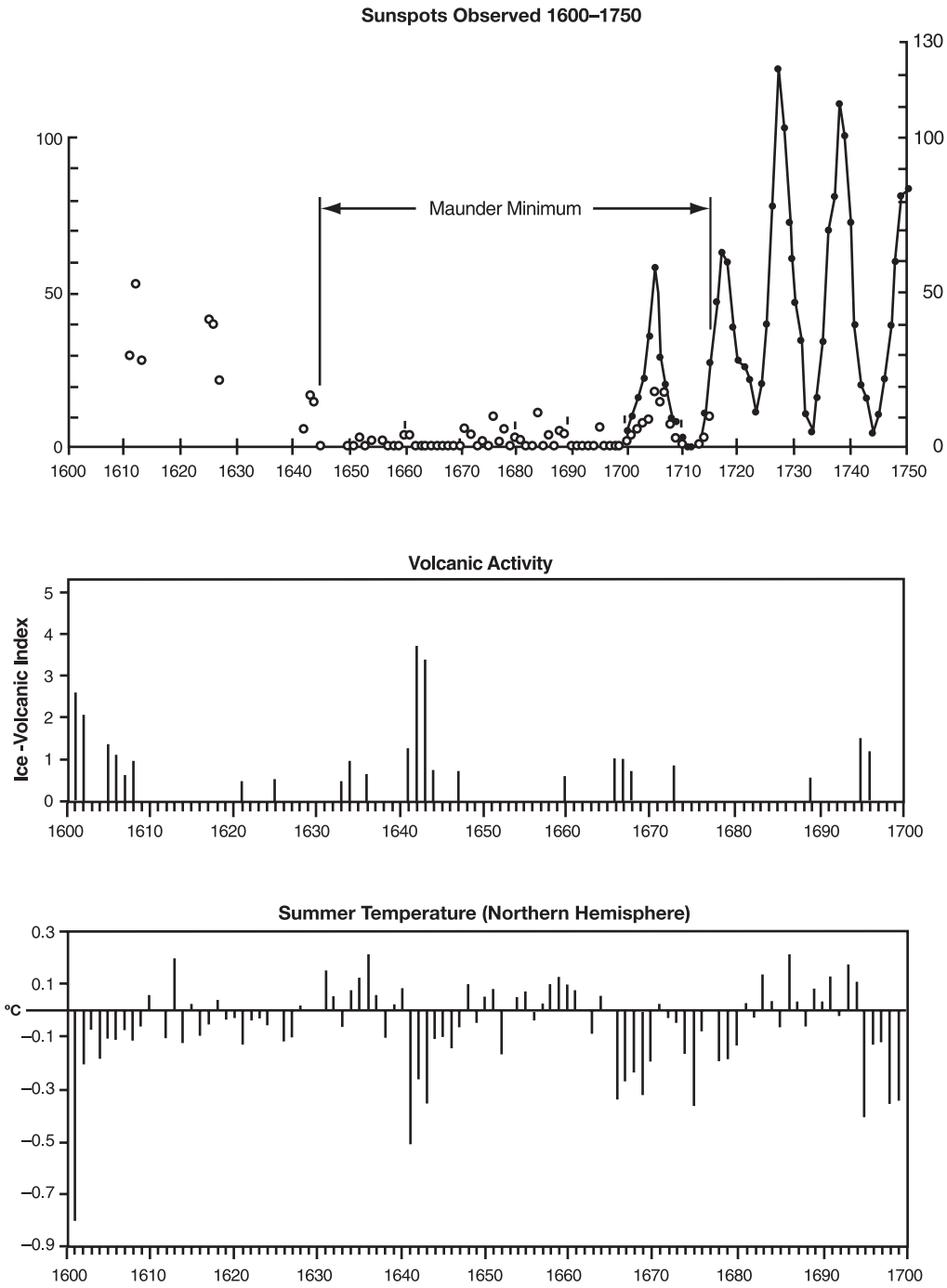

FIGURE 5: Sunspot cycles, volcanic anomalies, and summer temperature variations, 1600–1700. The number of sunspots observed and recorded by European astronomers (top) shows the Maunder Minimum (1645–1715), in which fewer sunspots appeared in sixty years than appear in a single year now. Measurements of volcanic deposits in the polar ice cap (the "Ice-Volcanic Index") reveal a peak in the 1640s. Both phenomena show a striking correlation with lower summer temperatures in the Northern Hemisphere. Based on Eddy, "The 'Maunder Minimum,'" 290, Figure 11-6, and Atwell, "Volcanism," Figures C5 and E3.

equator, so that their dust veils reduced the solar energy received by the most densely populated areas of the planet.[58]

Reduced solar energy received on earth—whether due to fewer sunspots, more volcanic activity, or both—not only lowers the global temperature; it also changes the climate. In normal summers, a column of rising heat over Central Asia attracts the monsoon system, which means that easterly winds blowing from equatorial America bring heavy rains to East and Southeast Asia. By contrast, reduced solar energy means that the snow lingers in Central Asia, reflecting the sun's heat instead of absorbing and radiating it as dark land surfaces do; without the column of rising heat, westerly winds blowing from equatorial Asia to America take the monsoon rains eastward, a phenomenon called El Niño (or, properly, ENSO: El Niño/Southern Oscillation). This shift dramatically affects the world's climate: whereas in normal years heavy rains nurture the harvests of South and East Asia, in El Niño years they bring floods to Central and South America instead and create drought in Asia and Australasia. The "global footprint" left by El Niño also includes three other regions: the Caribbean almost always suffers floods; Ethiopia and northwest India usually experience droughts; and Europe frequently experiences harsh winters.[59] On average, these disruptive El Niño episodes occur only once every five years, but in the mid-seventeenth century they happened twice as often: in 1640, 1641, 1647, 1650, 1652, 1655, and 1661. Each time, the regions normally affected all experienced abnormal weather.[60]

Besides increasing the frequency of El Niño episodes, reduced solar energy affects the global climate in two other significant ways. First, mean temperatures decline far more in the Northern Hemisphere (home to the majority of humankind and the site of most mid-seventeenth-century revolts, wars, and mortality) than at the equator, in part because increased snow cover and sea ice reflect more of the sun's rays back into space. Thus any significant extension of the polar ice caps and glaciers (both of which occurred in the mid-seventeenth century) further reduces temperatures in northerly latitudes.[61] Second, any fall in overall temperature triggers extreme climatic events. To pluck three notable mid-seventeenth-century examples: In

[58] Recent analysis has demonstrated that at least three of the 1640–1641 eruptions were rich in sulfur. See the data and discussion in Atwell, "Volcanism," 32–36, 63–65.

[59] The "global footprint" is admirably discussed in Richard H. Grove and John Chappell, eds., *El Niño: History and Crisis* (London, 2000), chap. 1, and César Caviedes, *El Niño in History: Storming across the Centuries* (Gainesville, Fla., 2001), 198. Two popular works by Brian Fagan—*Floods, Famines, and Emperors: El Niño and the Fate of Civilizations* (New York, 1999) and *The Little Ice Age* (New York, 2001)—attempt to relate the rise and fall of states to climatic conditions but largely ignore the mid-seventeenth-century crisis.

[60] Henry F. Diaz and Vera Markgraf, eds., *El Niño: Historical and Paleoclimatic Aspects of the Southern Oscillation* (Cambridge, 1993), 122–123, gives William H. Quinn's chronology of mid-seventeenth-century ENSO events (including 1618, 1619, 1621, 1624, 1630, 1635, 1640, 1641, 1647, 1650, 1652, 1655, 1661, 1671, and 1681). McIntosh, *The Way the Wind Blows*, 58 table (c), displays proxy data for Pacific Ocean temperatures around the Galápagos Islands that show the 1640s as the greatest anomaly in the entire series 1600–2000. Philip D. Jones, Raymond S. Bradley, and Jean Jouzel, eds., *Climatic Variations and Forcing Mechanisms of the Last 2000 Years* (Berlin, 1996), 388–389, shows a spectacular absence of coral formation in 1641 at Urvina Bay, in the Galápagos, which correlates with the unique double El Niño.

[61] D. T. Shindell et al., "Solar Forcing of Regional Climate Change during the Maunder Minimum," *Science* 294 (December 7, 2001): 2149–2152, argue that solar cooling reduces temperatures at northerly latitudes by five to ten times more than at the equator. (I thank Martha Peach for bringing this reference to my attention.) William F. Ruddiman, "The Anthropogenic Greenhouse Era Began Thousands of

the winter of 1620–1621, the Bosporus froze over so hard that people could cross on foot between Europe and Asia. In 1630, torrential rains in Arabia and western Asia (which an Ottoman chronicler compared with "the times of Noah") caused floods so severe that they destroyed two walls of the Kaaba in Mecca (a place that normally sees little rain) and caused "the Tigris and Euphrates to overflow, and floods to cover the whole Baghdad plateau." Finally, in the Baltic, where Sweden and Denmark were at war, an "extraordinary violent frost" early in 1658 "increased to such a degree, that the Little Belt which divides Jutland from the isle of Funen was so intensely frozen, as suggested to the Swedish king an enterprise (full of hazard, but not disagreeable to a fearless mind edged with ambition) of marching over the ice into Funen with horse, foot and cannon." The astonished Danish defenders "made large cuts in the ice, which were soon congealed again" because of the extreme cold.[62] Each of these extreme climatic events remains unparalleled; each occurred in the Little Ice Age.

How, precisely, can historians link the harsh winters, cool summers, droughts, and floods of the 1640s—to say nothing of the sunspot minimum, the volcanic maximum, and the more frequent El Niños—with individual cases of state breakdown such as the revolts of Scotland, Ireland, and England against Charles I, or the collapse of Ming rule in China? We must not paint bull's-eyes around bullet holes and argue that since climatic aberrations seem to be the only factor capable of causing simultaneous upheavals around the globe, therefore those aberrations "must" have caused the upheavals. In several cases, however, the human and natural climatic archives show exactly how extreme weather anomalies triggered or fatally exacerbated major political upheavals. Thus much of southern Portugal rebelled in 1637 when drought forced the price of bread to unprecedented heights; popular revolts spread throughout Catalonia in spring 1640 as prolonged drought threatened catastrophic harvest failure; and the first urban riots of the Tokugawa era occurred in 1642 when rice ran short in Osaka, the "kitchen of Japan."[63] Three disastrous harvests preceded the Irish Rebellion in 1641; the catastrophic harvests of 1647 and 1648 helped to precipitate

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Years Ago," *Climatic Change* 61 (2003): 261–293, argues that snow cover and sea ice "amplify global mean temperature changes by a factor of two to three" (285).

[62] On the frozen Bosporus, see B. S. Baykal, ed., *Peçevi Tarihi*, 2 vols. (Ankara, 1982), 1: 385; and Z. Yılmazer, ed., *Topçular Kâtibi ʿAbdülkādir (Kadrî) Efendi Tarihi* (Ankara, 2003), 944–946, 985. (I thank Günhan Börekçi for locating and translating these references.) Jane Hathaway drew my attention to the floods that partially destroyed the Kaaba in 1630 (a year in which Italy, India, Britain, and Spain also experienced a climatic catastrophe; see Parker, *The Global Crisis*, pt. 2, for details). On the frozen Baltic, see Philip Meadows (an eyewitness), *A Narrative of the Principal Actions Occurring in the Wars betwixt Sueden and Denmark Before and After the Roschild Treaty* (London, 1677), 33–35; and Arne Stade, *Carl X Gustaf och Danmark* (Stockholm, 1965).

[63] On the two Iberian revolts, see the striking maps in (respectively) Jean-Frédéric Schaub, *Le Portugal au temps du comte-duc d'Olivares (1621–1640): Le conflit de juridictions comme exercice de la politique* (Madrid, 2002), 491, and Antonio Simón i Tarrés, "Catalunya en el siglo XVII: La revuelta campesina y popular de 1640," *Estudi general* / Col·legi Universitari de Girona 1, no. 1 (1981): 145 and the source at 146 n. 87. On the Osaka riots, see *Dagregisters gehouden bij de Opperhoofden van het Nederlandsche Factorij in Japan*, 9 vols. (Tokyo, 1974–1999), 6: 87, entry for July 15, 1642, reporting information received from the Japanese translators ("door de tolcken") attached to the Dutch factory at Nagasaki.

major revolts in Sicily, central Italy, Poland, and Russia; while the harvest of 1650 was the worst of the century in Sweden, creating the backdrop for near-revolution when the Estates of the kingdom met in Stockholm.[64]

Scotland offers an excellent example of the role of climate in producing catastrophe. King Charles I made no secret of his desire to create "one uniform course of government in, and through, our whole monarchy" and to impose a single "form of public worship," so that "as it has but one Lord and one faith, so it has but one heart and one mouth . . . in the churches that are under the protection of one sovereign prince."[65] In Scotland, this process gathered momentum in 1634, when Charles ordered the bishops to prepare a new Prayer Book based on the one used in England. Haggling over minor details between the king, his Archbishop of Canterbury William Laud, and the Scottish bishops delayed production for three years, so that when in June 1637 the Scottish Privy Council decreed the compulsory and exclusive use of the new Prayer Book on pain of outlawry, the kingdom faced not only a "scarcity of victuals" and a "scarcity and want of monies" but also a plague epidemic.[66] In addition, it faced a severe if not unprecedented drought. According to the Earl of Lothian, one of Scotland's worried landowners, "The earth has been iron in this land . . . and the heavens brass this summer, till now in the harvest there have been such inundations and floods and winds, as no man living remembers the like. This has shaken and rotted and carried away the little corn [that] came up."[67]

His Lordship did not exaggerate. Scotland's "natural archive" reveals that 1637 was the driest year in two decades. Indeed, the kingdom experienced the worst recorded drought in a millennium from 1636 until 1649, when food of all sorts became so scarce that "the like had never been seen in the kingdom before heretofore, since it was a nation."[68] Small wonder, then, that Charles I's innovations, coming at a time of acute climate-induced adversity, should produce popular riots and lead landowners such as the Earl of Lothian to join the Covenanting Revolt and raise an army to secure guarantees that the king would respect their political and religious autonomy. Likewise, a decade of cold, wet summers, ruining one harvest after another, explains the eagerness of the Scots to appropriate England's resources throughout

[64] See details on all these examples in Parker, *The Global Crisis*, pt. 2.

[65] Clarence S. Brigham, ed., *British Royal Proclamations Relating to America, 1603–1783* (1911; repr., New York, 1964), 53, "A proclamation for settling the plantation of Virginia," May 13, 1625, OS; "Charles R" [King Charles I], *A Large Declaration Concerning the Late Tumults in Scotland* (London, 1639), 16.

[66] *Register of the Privy Council of Scotland*, 2nd ser., ed. David Masson and P. Hume Brown, 6 vols. (Edinburgh, 1899–1908), 6: 431–432, 438–439, 442–445, 454–456 (plague and scarcity of food) and 465 (coinage), acts dated June 3, 10, 8, 17, and 26, 1637. Ibid., 6: 448, act of June 13, 1637, which placed those who refused to use the new Prayer Book "under pain of rebellion." On the tortuous negotiations over *The Book of Common Prayer and Administration of the Sacraments and Other Parts of Divine Service for the Use of the Church of Scotland* (Edinburgh, 1637), see Gordon Donaldson, *The Making of the Scottish Prayer Book of 1637* (Edinburgh, 1954).

[67] *Correspondence of Sir Robert Kerr, First Earl of Ancram, and His Son William, Third Earl of Lothian*, ed. David Laing, 2 vols. (Edinburgh, 1875), 1: 93–98, Lothian to Ancram, October 19, 1637, OS, a letter full of complaints about the economic disasters caused by bad weather that summer.

[68] Balfour, *The Historical Works of Sir James Balfour*, 3: 432–433; NOAA Paleoclimatology Program and World Data Center for Paleoclimatology, Northwest Scotland Stalagmite and Climate Reconstruction Data, contributors: Andy Baker, Chris Proctor, and Bill Barnes, ftp://ftp.ncdc.noaa.gov/pub/data/paleo/speleothem/scotland/scotland_data.txt (accessed July 9, 2008) (calculations from the width of the annual luminescent band formed by precipitation each year on stalagmites in northwest Scotland, normally the wettest part of the country).

the 1640s—billeting as many of their troops as possible south of the border and extracting a huge ransom before they agreed to withdraw—despite the knowledge that their perceived rapacity discredited and alienated their English supporters. Many Covenanters felt that unless they exploited their assets in England to the hilt, Scotland would starve.[69]

The Scottish Revolution thus offers a perfect vindication of Voltaire's thesis that rebellions arose during the mid-seventeenth century through a fatal synergy between government, religion, and climate. Charles's insistence on creating "one uniform course of government in, and through, our whole monarchy," especially in matters of religion, coupled with the Little Ice Age, led to state collapse. But climate cannot explain everything; we must not become "climatic determinists." Three other factors, all of them related to human agency, also shaped the General Crisis in Scotland (and elsewhere): contingency, imitation, and intransigence.

The crucial role played by *contingency* is best illustrated by the rioting that attended the first use of Charles I's new Prayer Book in Edinburgh's St. Giles's Cathedral on July 23, 1637, thereby starting the Scottish Revolution. Despite the presence of the king's judges and the city magistrates, as soon as the dean began to read the new set prayers, a group of maidservants sitting at the front, "with clapping of their hands, cursings and outcries, raised such a barbarous hubbub in that sacred place that not any one could either hear or be heard."[70] One of them also hurled her small folding stool. None of this was coincidence. Rumors that Charles planned major religious innovations had circulated for several months, but the defenders of the traditional ways lacked irrefutable evidence until, in a classic case of Scottish parsimony, the government printer decided to sell the corrected proofs of the new liturgy as scrap paper, and individual sheets of it appeared in "the shops of Edinburgh to cover spice and tobacco."[71] Only this convinced a group of godly aristocrats that Charles did indeed plan to change the established form of worship, and they now laid plans for their maidservants to start a riot whenever the new Prayer Book was first used. These were the women who raised the "barbarous hubbub" in St. Giles's Cathedral on July 23, 1637, despite the presence of judges and magistrates.

The Scottish Revolution also exemplifies the important role of *imitation* in sparking rebellion. As early as 1638, an Anglican bishop in Ireland complained about the "desperate example the contumacious Nonconformists [sc. the Scottish Covenanters] have given both to England and to Ireland," and lamented that "this contagion" had already begun to spread to Ulster. Shortly afterward, the Scots distributed thousands of copies of pamphlets that justified their actions to the English in what David Como has hailed as "among the most systematic and concerted campaigns hitherto attempted by a foreign power to bombard a separate kingdom with propaganda, thereby using the printed word to manipulate political opinion and fundamentally

[69] Parker, *The Global Crisis*, provides more details on these events and makes a similar argument for the Qing at the same time: global cooling and drought-reduced crop yields in their homeland convinced the Manchu leaders that unless they invaded China and exploited its superior resources, they would starve.

[70] Charles I, *A Large Declaration*, 23.

[71] John Leslie, Earl of Rothes, *A Relation of Proceedings concerning the Affairs of the Kirk of Scotland*, ed. J. Nairne (Edinburgh, 1830), 197, reported the careless use of proofs as wrapping paper. See the perceptive reconstructions of these events in Walter Makey, *The Church of the Covenant, 1637–1651* (Edinburgh, 1979), 18–19.

to alter the political process of another nation."[72] In 1645, as James Howell wondered "upon whom to lay the blame" for the outbreak of civil war in England, he singled out the rebellion of the Irish Catholics as "the womb of our miseries." But, he added (wallowing in mixed metaphors), "They have administered fuel enough, and too much, to this fire, but it was first kindled in Scotland. The Puritans there were the womb of it; though I must tell you withall, the loins that begot this centaur were the Puritans here in England. If the flint and steel had not struck fire in England, the tinder had never took fire in Scotland, nor had the flame ever gone over into Ireland to increase the fire."[73]

Many contemporaries less addicted to metaphor agreed that "the example of Scotland" had played a crucial role in the genesis of the Irish Rebellion. The Earl of Castlehaven recalled in his *Memoirs* how his Irish Catholic colleagues "saw the Scots, by pretending grievances and taking up arms to get them redressed, had not only gained divers privileges and immunities, but got £300,000 for their visit, beside £850 a day for several months together." According to one of the leading conspirators, the Covenanters' success convinced the Irish malcontents that only military strength could end "the tyrannical government that was over them," and they therefore resolved "to imitate Scotland, who got a privilege by that course."[74] "The Scots had their wills by force of arms," another conspirator observed, and "so would they here in this kingdom." "Why," another of the insurgents asked his Protestant prisoner rhetorically, "may not we as well and better fight for religion, which is the substance, than the Scots did for ceremonies (which are but shadows)?" Most revealing of all, when another Protestant prisoner asked his Irish captor "What? [Have you] made a Covenant among you as the Scots did?" he received the crushing reply: "The Scots have taught us our A. B. C."[75]

Finally, *intransigence* often provoked and prolonged the tension between rulers and ruled during the General Crisis. Thus in 1638, Charles I determined to use force against his critics in Scotland because "not only now my crown but my reputation for ever lies at stake"; and so he vowed that "I would rather die than yield to those impertinent and damnable demands."[76] Three weeks later, he exclaimed that "by the heavenly God, so long as this Covenant is in force . . . I have no more power in

[72] *Calendar of State Papers Relating to Ireland of the Reign of Charles I*, ed. R. P. Mahaffy, 4 vols. (London: H.M.S.O., 1900–1904), 3: 182, Bishop Bramhall of Derry to Laud, February 23, 1638; David R. Como, "Secret Printing, the Crisis of 1640, and the Origins of Civil War Radicalism," *Past & Present* 196 (2007): 37–82, quotation at 57. Como also presented evidence of spirited anti-government pamphlets written and printed in England.

[73] [James Howell,] *A Discourse Discovering Some Mysteries of Our New State . . . Shewing the Rise and Progresse of England's Unhappinesse, ab anno illo infortunato 1641* (Oxford, 1645), 15.

[74] James Tuchet, Earl of Castlehaven, *Memoirs of the Irish Wars* (London, 1684), 13 (with corroborating statements on 14–16); John T. Gilbert, ed., *A Contemporary History of Affairs in Ireland from 1641 to 1652*, 6 vols. (Dublin, 1879–1880), 1: 353, examination of Owen Connolly, October 22, 1641, OS.

[75] Nicholas Canny, *Making Ireland British, 1580–1650* (Oxford, 2001), 536 (with more contemporary Scottish parallels quoted at 471, 489, 526, and 529); Mary Hickson, *Ireland in the Seventeenth Century; or, The Irish Massacres of 1641–2, Their Causes and Results*, 2 vols. (London, 1884), 1: 329, deposition of Dr. Robert Maxwell, August 22, 1642, OS; Gilbert, *A Contemporary History*, 1: 527, Richard Plunkett's claim according to Rev. George Creighton's Deposition, April 15, 1643, OS. Even some Protestants agreed: Sir James Turner observed the irony of sending an army of Scottish Covenanters led by the Earl of Leven "against the rebells in Ireland who (had they not shed so much blood) did no more against His Majestie than Leven himselfe had done"; ibid., 1: 573.

[76] Gilbert Burnet, *The Memoires of the Lives and Actions of James and William, Dukes of Hamilton* (1677; repr., Oxford, 1852), 70–71, Charles to Hamilton, June 11, 1638, OS.

Scotland than as a Duke of Venice, which I will rather dye than suffer."[77] Charles adopted the same uncompromising attitude toward all groups of subjects whom he suspected of wanting to demote him to "Duke of Venice." In 1642, he swore "that no extremity or misfortune shall make me yield" to rebels, "for I will either be a glorious king or a patient martyr." Repeated military defeats failed to shake the king's conviction that "God will not suffer rebels and traitors to prosper, or [my] cause to be overthrown . . . A composition with them at this time is nothing else but a submission, which, by the grace of God, I am resolved against, whatever it cost me; for I know my obligation to be, both in conscience and honour, neither to abandon God's cause, injure my successors, or forsake my friends"—an intransigent attitude that would in 1649 turn him into a "patient martyr."[78]

DESPITE THE IMPORTANCE OF THESE AND OTHER contingent factors, no convincing account of the General Crisis can now ignore the impact of the unique climatic conditions that prevailed. Indeed, the wealth of data in both the human and natural "archives" encouraged Le Roy Ladurie to write the *Comparative Human History of Climate* that he had abandoned in 1967 for lack of evidence. The first volume, which appeared in 2005, proclaimed that

> The history of climate, which has made considerable progress since the publication of our *History of the climate since the year 1000*, has now won full legitimacy . . . The days are gone when modish historians disparaged this new discipline with taunts such as "bogus science." The time for such irreverent barbs is past, and this book seeks to provide a *human* history of climate, dealing with the impact of climatic and meteorological fluctuations on societies, above all through the prism of famines and, in some cases, of epidemics.

In addition, the author boasted that he had produced "a *comparative* history: following in the footsteps of Marc Bloch, who wanted to compare what is comparable, we shall focus *inter alia* on the temperate zones of France: the north and centre. That will be at the foreground of our research," accompanied by "constant—or, depending on the evidence, frequent—comparisons with England, Scotland, sometimes Ireland, Belgium, the Netherlands, Switzerland, Germany (not only western); and when possible Bohemia and Poland, sometimes the three Scandinavian countries, Finland or even Iceland."[79] "Le *PAG*" ["petit âge glaciaire": Little Ice Age] forms the backbone of Le Roy Ladurie's new book, with special attention devoted to what he calls "le Hyper-*PAG*" of the mid-seventeenth century. He even included a whole chapter

[77] Conrad Russell, *The Fall of the British Monarchies, 1637–1642* (Oxford, 1991), 56, Charles to Hamilton, June 25, 1638. John Adamson, *The Noble Revolt: The Overthrow of Charles I* (London, 2007), 194, observed that "Venice figures recurrently in Charles's thoughts" at this time.

[78] Burnet, *Memoires*, 203, Charles to Hamilton, December 1642; James O. Halliwell, *Letters of the Kings of England*, 2 vols. (London, 1846), 2: 383–384, Charles to Prince Rupert, July 31, 1645, OS. Steve Hindle, "Dearth and the English Revolution: The Harvest Crisis of 1647–1650," *Economic History Review*, Special Issue, 61 (2008): 64–98, underlines the link between climate and catastrophe during these traumatic years that saw the trial and execution of Charles I.

[79] Le Roy Ladurie, *Histoire humaine, I*, 7–8. Volume 1, *Canicules et glaciers (XIIIe–XVIIIe siècle)*, appeared in 2004 (740 pages); volume 2, *Disettes et révolutions (1740–1860)*, appeared in 2006 (611 pages). *Histoire humaine* seldom strays beyond France and its neighbors, however: despite the copious evidence available, its author seldom refers to southern Europe and largely omits Asia, America, and Africa.

on "L'énigme de la Fronde" that connected climatic anomalies with political upheavals in France and England between 1648 and 1650—precisely the link he dismissed in 1967 as "quite absurd."

Despite the cachet conferred on climatic history by Le Roy Ladurie, one of the world's foremost living historians, his epiphany has as yet made little impression in North America. In July 2008, although fifty libraries in North America boasted a copy of volume 1, only one had a copy of volume 2 (published in September 2006 and containing the tables and graphs that underpin volume 1); neither amazon.com nor barnesandnoble.com offered copies for sale (although the former advertised more than one hundred of his works and the latter almost thirty); and no North American journal has yet published a review.

Does this indifference simply reflect the unwillingness of Anglophone American academics to tackle large books written in foreign languages? Or does it also reveal a residual resistance to admitting that climate can exercise a decisive influence on human history? After all, "denial" is currently the commonest human reaction to environmental catastrophe: we know with absolute certainty that natural disasters have happened in the past, and that they will continue to happen in the future, but we convince ourselves that they will not happen just yet—or, at least, not to us. The worsening droughts, desiccation, and desertification in equatorial Africa over the past forty years have caused massive migrations, famines, and wars that resemble those of the mid-seventeenth century; yet the rest of the world does virtually nothing. In the West, even isolated extreme climatic events such as the European heat wave of 2003 (which claimed the lives of at least 35,000 people) and Hurricane Katrina (which ruined or rendered uninhabitable 300,000 homes in the southeastern United States) found the richest and most powerful governments in human history completely unprepared and incapable of taking appropriate action in time.[80] Yet even these tragedies remained local: how would those same governments—how would we—cope with a *global* catastrophe like that of the 1640s?

We have only two ways to anticipate the impact of a future catastrophic climate change, neither of them particularly precise or entirely reliable. Either we "fast-forward" the tape of history and predict what might happen on the basis of current trends; or we "rewind the tape" and learn from what happened during global catastrophes in the past. Although many experts (mainly climatologists, sociologists, and political scientists) have tried the former, few have systematically attempted the latter—perhaps because only one previous global cataclysm, the one in the mid-seventeenth century, has left sufficient records for detailed historical study.[81] Taking

[80] See the elegant arguments of Richard A. Fortey, *Earth: An Intimate History* (New York, 2004). Jared Diamond, *Collapse: How Societies Choose to Fail or Succeed* (New York, 2005), 434–436, stresses the role of "denial" in several past environmental catastrophes that have wiped out individual human communities, but he does not examine its role in a single catastrophe (such as the Little Ice Age) that affected the entire world.

[81] Ragnhild Nordås and Nils Petter Gleditsch, "Climate Change and Conflict," *Political Geography* 26 (2007): 627–638, criticize the failure of the Intergovernmental Panel on Climate Change (IPCC) to undertake systematic analysis of historical evidence to show how climate change acts as a "threat multiplier for instability in some of the most volatile regions of the world" (628, quoting *National Security and the Threat of Climate Change: Report from a Panel of Retired Senior US Military Officers*, published in 2007). Their article introduces a special issue of the journal that contains five articles on the subject. I thank Andreas Daum and Sharmistha Bachi-Sen of the University of Buffalo for this reference.

advantage of the human and natural archives on climate to reopen the General Crisis debate not only sheds new light on an old problem but also offers a rare opportunity for historians to engage with scholars in other disciplines who are concerned with the fate of our planet. Studying causal mechanisms and coping strategies 350 years ago will not, of course, prevent the onset of further climatic catastrophes in the twenty-first century; but if historians can identify the structural, political, economic, and ideological characteristics in each afflicted society around the world that prevented (or facilitated) an appropriate response during the General Crisis, and consider how the outcomes could have been different, we may learn some valuable lessons for dealing with the climate challenges that undoubtedly await us and our children.

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