

to secure a copy of all known books for the imperial library – but ‘If the books contain language that is anti-dynastic, the emperor commanded, ‘then the woodblocks and printed sheets must both be put to the flames. Heterodox opinions must be quashed, [so] that later generations may not be influenced.’ The literary inquisition, which lasted for fifteen years, destroyed 70,000 printing blocks and incinerated almost 4,000 works, while authors and printers purged many other works themselves, re-carving some individual blocks and removing censored names and statements from others.<sup>54</sup>

The Qing continued to see intellectual innovation and learned discussion as potential threats, not potential assets. For them, ‘new truths about the physical world’ continued to seem (in Rabb’s words) ‘both a symptom of, and a stimulus to the fires of doubt’. Unlike rulers in northwest Europe, China’s new masters denied their leading scholars both freedom of expression and freedom to exchange ideas. In the intellectual as in the economic sphere, reactions to the Global Crisis stimulated the Great Divergence.

## Conclusion: The Crisis Anatomized

### Winners and Losers

Crane Brinton’s classic study *Anatomy of Revolution*, first published in 1938, sought ‘uniformities’ between the political upheavals in seventeenth-century England, eighteenth-century North America and France, and twentieth-century Russia. In the last chapter, Brinton asked ‘What did these revolutions really change?’, and he answered:

Some institutions, some laws, even some human habits, they clearly changed in very important ways; other institutions, laws and habits they changed in the long run but slightly if at all. It may be that what they changed is more – or less – significant than what they did not change. But we cannot begin to decide the last matter until we have got the actual changes straight.

The preceding pages have attempted to get straight what changed and what stayed the same in the seventeenth-century world; it now remains to assess their relative significance and to ascertain the uniformities among the fifty or more revolutions and rebellions that occurred around the world between 1618 and 1688.<sup>1</sup>

At the individual level, the most significant change for most contemporaries was a sharp deterioration in the overall quality of life. During the Indian famine of 1631, English merchants living in Gujarat considered that ‘The times here are so miserable that never in the memory of man [has] the like famine and mortality happened.’ Ten years later, in China, according to the diary kept by a young scholar, ‘Jiangnan has never experienced this kind of disaster’. In 1647 a Welsh historian opined: ‘’Tis tru we have had many such black days in England in former ages, but those parallel’d to the present are to the shadow of a mountain compar’d to the eclipse of the moon.’ During the famine of 1649, a Scot lamented that ‘The pryces of victuall and cornes of all sortes wer heigher than ever heirtofore aney[one] living could remember.’<sup>2</sup>

In a diary entry during the winter of 1660–61, the Essex clergyman Ralph Josselin cast doubt on such extreme verdicts, observing ‘how apt wee are to account a harsh time the hardest wee ever felt and a mild the best.’<sup>3</sup>

Pessimists who claim that the hardships they face are the 'worst in living memory' can indeed be found in all times and places, but the surviving evidence from the mid-seventeenth century suggests that the lamentations of those alive then were justified: decreased solar energy, increased volcanic and El Niño activity, frequent wars and state breakdowns created several decades of unparalleled adversity.

Some groups suffered disproportionately. Slaves led the way. In China, in parts of Europe (notably Britain and Ireland), and above all in Africa, millions of men and women lost their liberty and often their lives when they became slaves; millions more in Russia and Eastern Europe lost their liberty when they became serfs. Women, whether free or unfree, also suffered disproportionately in most parts of the world. Many killed themselves after they had been raped and otherwise humiliated, or because they were destitute, or because they did not wish to survive the death or disappearance of their loved ones. Many survivors faced (in the memorable words of 'a poor woman with only a small field or so to her name' in Germany) a 'bitter living' (Chapter 4): she and her sisters had to work harder and longer just to stay alive.

Admittedly, some European women used the 'weapons of the weak' to retaliate against their oppressors. Female workers and servants abused by their employers could seek revenge not only through foot-dragging, pilfering and slander but also (in extreme cases) through arson and murder. Wives could plead with their abusive husbands in private, and also complain to their neighbours and to the courts; they could seek (or threaten) divorce; and they could threaten (or *in extremis* inflict) grievous bodily harm. In London, Elizabeth Pepys used all of these strategies in 1668 after she discovered her philandering husband Samuel making love to their sixteen-year-old servant. After tears and reproaches, she threatened to tell their neighbours, to leave him, even to join the Catholic Church. She also attacked Samuel with a pair of red-hot tongs and threatened to slit the servant's nose (a popular punishment for adultery); but Elizabeth's most effective weapon lay 'in matters of pleasure'. After three weeks of enforced celibacy, Pepys felt 'troubled to see how my wife is by this means likely for ever to have her hand over me, that I shall be for ever a slave to her'. Only English and Dutch women seem to have enjoyed this limited ability to retaliate, however. Their sisters in other areas of Europe might well ask, like Queen Christina of Sweden in the 1680s, 'What crime has the female sex committed to be condemned to the harsh necessity of being shut up all their days either as prisoners or slaves? I call nuns "prisoners" and wives "slaves".'<sup>4</sup>

Wars and revolutions killed and maimed women and men both directly through violence and brutality and indirectly through forced migration and destruction of property, especially in Western and Central Europe during the Thirty Years' War, in Eastern Europe and Russia during the Thirteen

Years' War, and in China during the Ming-Qing transition. For many people, the Global Crisis proved a terminal event, and it claimed the lives of so many millions that they amounted to a lost generation.

In some areas, a whole way of life disappeared. The Ming-Qing transition permanently destroyed sericulture in the province of Shaanxi, and the Gujarat famine and floods of 1628-31 did the same to one of India's premier cotton- and indigo-producing areas (Chapters 5 and 13). The plague epidemic that spread through Southern Europe in the decade after 1649, killing one-half of the inhabitants of Seville, Barcelona, Naples and other port-cities, set the seal on the decline of the Mediterranean as the heart of the European economy for ever. In many other areas, if the observations of Alex de Waal and Scott Cane concerning the effect of a prolonged 'hungry time' on farmers of marginal lands and on hunter-gatherers in the twentieth century (Chapters 3 and 15) also prevailed in the seventeenth century, then countless families and many communities must have crossed 'a threshold of awfulness' and perished, leaving no trace.

Of course, the turmoil did not only produce losers. In East Asia, both Nurhaci and Tokugawa Ieyasu were revered as gods soon after their deaths. Even today, about 130 Tōshōgū shrines in Japan still honour the divinity of the first shogun, issuing their own newsletter, making him by far the most successful denizen of the seventeenth-century world. The descendants of Alexei Romanov also prospered from the political, economic and social balance created by the crisis of 1648-49, cementing their control over an empire that expanded at the rate of 55 square miles a day - more than 20,000 square miles a year - for the next two centuries.

Many followers of these rulers also profited from the upheaval. Nurhaci and Ieyasu bequeathed to their numerous descendants a luxurious lifestyle that would endure for more than two centuries, and tens of thousands of Manchu bannermen and their families exchanged a precarious existence on the steppe for a life of plenty south of the Great Wall. Most of the military and civilian officials who swiftly transferred their allegiance from Ming to Qing also prospered: of 125 senior officials who received the ambiguous title *Er chen* ('ministers who served both dynasties'), 49 later became president or vice-president of a department of state. In Japan, the Tokugawa clansmen and most of their *daimyō* allies enjoyed more than two centuries of peace and plenty following the proclamation of the Genna Armistice in 1615. In Russia, the descendants of the nobles who in 1649 won control over their serfs through the *Ulozhenie* likewise maintained their gains for over two centuries. In India, the leaders who supported Aurangzeb when he challenged his father and brothers during the Mughal Civil War of 1657-59 became stakeholders in the richest state on Earth.

In Europe, among civilians, government office allowed Samuel Pepys to increase his personal fortune from £25, when he began to serve in 1660, to

£10,000 ten years later; Jean-Baptiste Colbert, who at school 'was so dull that he was always bottom of the class', died a millionaire and (thanks to Louis XIV) bequeathed a hereditary peerage to his son. Among soldiers, Sweden's commanders in Germany who survived the Thirty Years' War returned home with immense wealth: the castle of Skökloster near Stockholm testifies even today to the booty acquired by General Carl Gustav Wrangel; his colleague Hans Christoff Königsmarck, who began as a common soldier, died a nobleman with assets worth 2 million thalers. In England luck and good judgement during the Civil War allowed George Monck, the younger son of a squire (and lucky as a young man to escape hanging after he murdered a deputy sheriff), to become duke of Albemarle and commander-in-chief of England's armed forces in 1660, and to die with assets worth £60,000. Monck's followers also prospered. In return for facilitating the Restoration, the general insisted on full payment of the wage arrears of his men, and over the next two years the king's treasurers-at-war paid them £800,000.<sup>5</sup>

The balance sheet of many other states showed both losses and gains. Although Qing China and Romanov Russia topped the list of successful states, millions of their subjects lost either their lives or their freedom. In Ukraine, although Ruthenian culture flourished (and even spread to Russia), while serfdom disappeared, the name *Ruina* given by its historians testifies to the costs of the struggle to shake off Polish rule. Portugal exploited Spain's weakness to gain independence – the only entirely successful rebellion of the seventeenth century – but once again this success reflected immense material and personal sacrifices and led to the temporary loss of its colonies in Africa and Brazil. The Dutch Republic gained formal recognition as an independent state, and carved out a lucrative trading empire in south and southeast Asia at the expense of Portugal and independent rulers like the sultan of Mataram; but it lost its colonies in North and South America. Britain's brief republican experiment secured the Caribbean island of Jamaica, and commercial dominance in the North Atlantic, but the civil wars caused the premature death of perhaps 500,000 people in Britain and Ireland. Scotland and Ireland temporarily lost their independence. The weakness of the Ottoman empire allowed the Austrian Habsburgs to conquer most of Hungary, and the weakness of the Spanish Habsburgs allowed Louis XIV to advance the frontiers of France, but in both cases expansion cost hundreds of thousands of lives.

Other states suffered grave political losses in the mid-seventeenth century and gained little or nothing. The kingdom of Kongo in Africa, the Pequot of New England and the Wendat of New France all perished. The Polish-Lithuanian Commonwealth lost half its population, temporarily ceased to exist as an independent state and lost for ever its status as a great power. The Spanish monarchy, too, never recovered its political pre-eminence after the secession of Portugal and its overseas empire; and

although Philip IV eventually overcame his rebels elsewhere, he did so only after making major concessions (in Catalonia, for example, he left the Constitutions intact and pardoned virtually all those who had defied him). In East Asia, the Shun dynasty founded by Li Zicheng in China disappeared without trace; and the fall of the Ming forced a reconstruction of Korean identity because it 'shattered the premise concerning the world order of which the Koreans felt they were a part' (just as it required Han Chinese intellectuals to refashion themselves).<sup>6</sup>

With the exception of Japan, New England and New France, the demographic balance of the seventeenth century was negative. Apart from the cases of drastic population loss already cited – China; Russia and Ukraine; the Polish-Lithuanian Commonwealth; most of Germany – Philip IV ruled far fewer subjects at his death in 1665 than at his accession four decades before. Famines, epidemics and civil war meant that Philip's son-in-law, Louis XIV, also ruled far fewer subjects when he began his personal rule in 1661 than at his accession eighteen years before, and the Little Ice Age combined with his repeated wars meant that he probably ruled fewer subjects at his death than when he began his personal rule.

#### In Search of Common Denominators

According to political scientist Mark Hagopian's book, *The phenomenon of revolution*, 'those seeking simplicity should study something else than the causes of revolution' because 'there is good reason to doubt the "completeness" that any explanation of revolution could possibly attain'. Francis Bacon agreed. In an essay entitled 'Of seditions and troubles', first published in 1612, he listed eleven 'causes and motives of sedition', namely:

innovation in religion; taxes; alteration of lawes and customs; breaking of priviledges; general oppression; advancement of unworthy persons; strangers; dearths; disbanded soldiers; factions growne desperate; and whatsoever, in offending people, joyneth and knitteth them in a common cause.<sup>7</sup>

In his lectures to the Statistical Society of London in 1878 on 'The famines of the world: past and present', Cornelius Walford analysed just one of Bacon's categories: dearths. Walford discerned thirteen distinct precipitants of harvest failure, some natural (excessive rain, frosts, droughts, 'plagues of insects and vermin' and sunspot cycles), others human (war, 'defective agriculture', insufficient transport, legislative interference, currency manipulation, hoarding, and diverting grain from making bread to other purposes such as brewing or distilling). Walford also noted an 'enigma': that 'the very remedies which have been adopted to prevent, or to mitigate the severity of,

these periodical visitations [of famine], have by some reflex action, apparently, either aided in producing them, or at least added very much to the severity of the results flowing from them' – results that might include rebellion and sometimes revolution. Nevertheless, after analysing nineteenth-century evidence from England and British India, Walford concluded that extreme climatic events normally played a greater role than human action in creating catastrophe.<sup>8</sup>

Does the seventeenth-century evidence support this analysis? Certainly, the major revolts almost all broke out in a period of unparalleled climatic adversity, notably when a 'blocked climate' produced either prolonged precipitation and cool weather or prolonged drought (1618–23, 1629–32, 1639–43, 1647–50, 1657–58 and 1694–96). Some areas suffered for longer: both Scotland (1637–49) and Java (1643–71) suffered the longest droughts in their recorded history. The century also saw a run of landmark winters, including some of the coldest months on record; two 'years without a summer' (1628 and 1675); and an unequalled series of extreme climatic events (the freezing over of both the Bosphorus in 1620 and the Baltic in 1658); and the maximum advance of both the Alpine and Andean glaciers in the 1640s; Scandinavia experienced its coldest winter ever in 1641. These various climatic aberrations accompanied a major episode of global cooling in both northern and southern hemispheres that lasted at least two generations: something without parallel in the past 12,000 years. The famines caused by these climate changes caused what would today be called a humanitarian crisis in which millions of people died.

These same years of dearth also saw rebellions and revolutions, with two distinct peaks: Normandy, Catalonia, Portugal and its overseas empire, Mexico, Andalusia, Ireland, Scotland and England in 1639–42; Naples, Sicily, France, England (again), Russia, the Ottoman empire and Ukraine in 1647–48. Sometimes a link between rebellion and climate change is manifest. In Scotland, the summer of 1637 (when Charles I sought to impose his new liturgy) was the driest in two decades; the summer of 1638 (when he refused to make concessions to his Scottish opponents) was the driest in a century; the summer of 1639 (when he attempted to invade) was the coldest in more than a century. Government innovation and inflexibility at a time of such climatic adversity drove many Scots reluctantly into rebellion. The earl of Lothian, a prominent landowner, spoke for many when (having described how, in October 1637, 'the Earth has been iron in this land', ruining the harvest) he wrote 'I think I shall be forced this term to run away and let the creditors of the estate catch that catch may, for I cannot do impossibilities'. In the event, instead of running away his lordship signed the National Covenant and in 1640 led a regiment in the invasion of England, declaring that 'necessitie made us come from home' and 'in our lauffull defence WE DARE DIE'.<sup>9</sup> In Ireland, too, the failed harvests of 1638–41 caused

widespread hardship among the Catholic population, disposing many to support the rebellion that began in October 1641, when ice and snow covered many parts of the island. Then followed 'a more bitter winter than was of some years before or since seen in Ireland', which turned the brutal mistreatment of Protestant settlers by their Catholic neighbours into a massacre that would in turn provoke massive retaliation.<sup>10</sup> Likewise, in East Asia, repeated harvest failures caused by adverse weather in the early 1640s had two dramatic political effects. Famines and popular rebellions in Jiangnan fatally weakened the Ming as they struggled against the inroads of bandits from the northwest; drought and cold in Manchuria so reduced harvest yields that the Qing leaders concluded that invading China offered the only way to avoid starvation.

Climate-induced dearth contributed to many other rebellions. Perhaps, as Leon Trotsky wrote of the Russian Revolution of 1917, 'the mere existence of privations is not enough to cause an insurrection; if it were, the masses would always be in revolt' – but privations in the mid-seventeenth century apparently formed an exception. The revolts in Évora in 1637, Palermo in 1647, Fermo in 1648 and Andalusia in 1652 began in the same way as the greatest rebellion of the twentieth century in Petrograd in 1917: when adverse weather ruined a harvest and created a food shortage that brought hungry people onto the streets shouting 'bread!'<sup>11</sup>

In such a tense situation, even a small increase in government pressure could produce a disproportionate popular reaction. The revolt of Sicily in 1647 began when the government ended subsidies that had kept down the price of bread; the Naples revolution a month later began when the viceroy re-imposed an unpopular excise on fruit. In both cases, Philip IV overrode the misgivings of his ministers because he needed funds to pay for his wars – despite the fact that domestic rebellion opened a 'second front'. The same perverse logic prevailed in the French monarchy, where Louis XIII repeatedly raised taxes in times of high food prices so that his subjects had no money left to buy bread. 'Long live the king; death to taxes!' became the cry of rebellious subjects throughout Europe.

Governments could stimulate or spread insurrections by other means. Charles I's insistence on imposing a new liturgy on Scotland in 1637 inflamed and united his opponents as nothing else could have done. The desecration by royal troops of churches in villages that defied them had the same effect in Catalonia in 1640, and so did the decision of the Qing regent Dorgon to enforce the head-shaving edict on all males in China in 1645. The Scottish Revolution lasted a decade; the revolt of the Catalans lasted eighteen years; the resistance of Ming loyalists lasted thirty-eight years.

Government ineptitude could also encourage resistance. In Naples the inability of the *eletto del popolo* to settle a squabble over who should pay the fruit excise on the morning of 7 July 1647 allowed Masaniello and his

*ragazzi* to galvanize irate bystanders into action. During the summer of 1648, revolts broke out in Moscow when the tsar refused to receive a supplication from his subjects that condemned corruption among his ministers, and in Paris when the queen regent botched an attempt to arrest her leading opponents as they left a service in Notre Dame Cathedral. In Barcelona in 1640, in Naples in 1647 and in Messina in 1674, rebellions began just after galley squadrons based in each port-city departed to fight elsewhere.

Violent opposition to governments in the mid-seventeenth century often began in a capital city – a circumstance that reflected the greater vulnerability of all urban areas to both climate change and government pressure. The major revolts against Charles I began in Edinburgh, Dublin and London; those against Philip IV in Barcelona, Lisbon, Palermo and Naples. Other insurrections that rocked and sometimes toppled seventeenth-century regimes also began in capital cities: Prague in 1618; Istanbul in 1622, 1648 and 1651; Manila in 1639; Paris in 1648; Moscow in 1648 and 1662; Tokyo in 1651.

Popular protests alone rarely toppled governments, however, and all the major rebellions of the mid-seventeenth century included members of the secular and, in most Christian and Muslim societies, also the clerical elite. Churchmen headed four rebel governments, at least for a time (Henderson in Scotland, Claris in Catalonia, Rinuccini in Ireland and Genoino in Naples); while throughout the French, Stuart and Spanish monarchies, clerics preached sermons and published propaganda in support of the rebel cause. In the Polish Commonwealth, the Ukrainian clergy threw its weight behind Khmelnytsky, and in the Ottoman empire the chief mufti played a pivotal role in legitimizing the deposition (and subsequent murder) of the sultan in 1622 and again in 1648.

Noblemen, too, took the lead in several European revolts – Condé and Longueville in France; Argyle and Hamilton in Scotland; Antrim and Maguire in Ireland; Essex and Manchester in England – and in all four countries virtually the entire nobility participated in the resulting civil war. In Portugal, Duke John of Bragança founded a new royal dynasty in 1640; in Castile, the duke of Medina Sidonia sought to become the head of an independent Andalusia in 1641; seven years later the duke of Guise established the short-lived Royal Republic of Naples.

Most of the remaining leaders of the major mid-seventeenth-century rebellions belonged to the intellectual elite. At least 80 per cent of the members of the English House of Commons between 1640 and 1642, and many English peers, had either studied law at the Inns of Court, or gone to university, or both. The Fronde in France began with the revolt of its senior judges. Those who had mastered China's national curriculum and started to climb its administrative ladder of success by passing state examinations took the lead both in paralyzing the Ming with factionalism and in opposing the Qing with suicidal energy.

Most insurgents in Europe claimed that they desired only the restoration of some past Golden Age. Rebels in Palermo and Naples demanded a return to the charters granted a century before; Catalans called for respect for their ancient Constitutions; the Portuguese wanted a return to the relationship with the king created at the Union of the Crowns in 1580 (and when they could not get it, a restoration of the constitutional situation that had prevailed *before* 1580). Initially, Charles I's enemies also called for a return to the past. In England, they demanded government by the crown-in-Parliament, as created by his predecessors; in Ireland, Catholics sought implementation of the Graces, which would end the recent trend in Protestant expansion at Catholic expense; in Scotland, Covenanters insisted on retaining their traditional liturgy. In France, judges wanted a return to the constitutional balance of power that they believed had prevailed in the Middle Ages; and nobles saw the liberties and franchises won by the blood of their ancestors in the service of the crown as their birthright, and to defend it they felt a duty to rebel. In Russia, the crowd wanted the tsar to accept their petitions as he and his predecessors had done before.

Rebels in other parts of the world also drew strength from precedents. In China, Li Zicheng, Zhang Xianzhong and the Qing, all of whom strove to replace the Ming dynasty, cited earlier examples (some of them two millennia earlier) of dynasties that had lost the Mandate of Heaven; and Wu Sangui would do the same in 1673 when he initiated the Revolt of the Three Feudatories against the Qing. In the Ottoman empire, Kadizade Mehmed and his followers called for a return to the political and religious conventions that had prevailed at the time of the Prophet Mohammed a millennium before. Many others, such as the Nu-Pieds of Normandy, demanded a return to a Golden Age when justice had prevailed. To quote Crain Brinton: 'Revolutions cannot do without the word "justice" and the sentiments it arouses.'<sup>12</sup>

Attempts to gain justice, at least in Europe, often attracted support from legal institutions of unquestioned legitimacy, such as the law courts or Parliament. To this end, rebel leaders in Scotland, Catalonia and Portugal immediately summoned representative assemblies to legitimize their challenge to established authority, as well as to enact appropriate policies and vote funds – thus creating an alternative government capable of winning widespread support both at home and abroad. In Ireland, since the Protestant-dominated Dublin government condemned the rebellion of 1641, Catholic leaders created their own General Assembly and Supreme Council at Kilkenny, which served for a decade as the government of an independent Ireland. In England, Parliament was already in lawful session when the king declared its members rebels, but both Houses continued to sit until, in January 1649, the surviving members of the Commons (the Rump) tried and executed him and then proclaimed England to be a republic with themselves as its sole sovereign body. The following year, in the Dutch Republic, the

States-General exploited the death of William II of Orange to gain control over the executive functions that he had exercised. In Ukraine, Hetman Bohdan Khmelnytsky from the first sought the approval of the assembly of Cossack freemen for his various actions, including a declaration of independence from the Polish Commonwealth and, later, a treaty of union with Russia that preserved most of the gains won by the initial revolt.

The unifying appeal of these aims helps to explain why so many seventeenth-century insurgencies lasted so long. The revolt of Bohemia against Habsburg authority in 1618 initiated a war that lasted thirty years. The revolt of Portugal against Habsburg authority in 1640 began a war that lasted twenty-eight years. The Cossacks' rejection of the authority of the Polish crown in Ukraine led to eighteen years of war.

Longevity changed the character of most rebellions. As John Wallis later observed about England: 'As is usual in such cases, the power of the sword frequently [passed] from hand to hand, because 'those who begin a war [are unable] to foresee where it will end'.<sup>13</sup> None of the five MPs whom Charles I tried to arrest early in 1642 possessed military experience, and few had held executive office, so they gave way to those, like Oliver Cromwell, who could demonstrate an ability to win wars. In Naples, the lawyer-turned-priest Genoino replaced the illiterate demagogue Masaniello, only to lose his place to Gennaro Annese who possessed military experience. The rise of a second generation of more militant leaders, like Cromwell and Annese, helps to explain why revolutions became more violent the longer they lasted. At the same time, the experience of resistance habituated leaders to actions that previously would have seemed intolerable.

Rebellious regimes might also appeal for foreign aid, and in so doing fragment their domestic support. In Ireland, the Catholic Confederacy turned to their co-religionists in Europe, and although the papacy, France and Spain all provided valuable material assistance, each foreign power had its own agenda and did not scruple to create and exploit damaging domestic divisions in order to achieve them. In the Iberian Peninsula, Catalan opponents of Philip IV appealed for French assistance; and although French troops and military advisers helped to save Barcelona, Louis XIII demanded that the Catalan leaders abandon their resolve to become an independent republic and instead recognize him as their sovereign. Most spectacularly of all, in 1644 the Ming commander Wu Sangui appealed to his northern neighbours for military assistance against the bandits, and allowed the Manchu Grand Army to pass through the Great Wall to destroy them; but once this mission had been accomplished, the Manchus claimed that their victory conferred upon them the Mandate of Heaven to rule all China, which they did until 1911.

Within the composite states of Europe, opponents of the same ruler in one area often took active steps to encourage others to rebel. Immediately

after his acclamation, King John IV of Portugal sent envoys to Barcelona to make common cause with the Catalan rebels; and somewhat later sent his principal advisor, the Jesuit António Vieira, to Rome to invite the pope to invest John's son as king of Naples (a papal fief). As soon as news arrived that protests in Palermo against excise duties in 1647 had secured their abolition, citizens of Naples put up 'pungent and bitter invectives' calling for 'a revolution like Palermo'; and as soon as the revolution began, 'some people from Palermo' urged the Neapolitans 'to demand everything, in the same way that had happened in Palermo'. In addition, in both kingdoms, revolt in the capital provoked copycat uprisings in numerous other towns (Chapter 14). The opponents of Charles I in different parts of his monarchy likewise created links across borders that aimed to improve their chances of success. Some Scottish ministers in northern Ireland found the earl of Strafford's religious policies so intolerable that in 1639 they chartered a vessel to take them to Massachusetts (John Winthrop had visited Ulster the previous year), but storms drove them back to their native land. They saw this as a divine sign that they should 'find an America in Scotland' and, once arrived there, joined the Covenanters' opposition to Charles I. In Russia, too, disorders spread throughout the empire largely because in June 1648 the capital was full of petitioners from provincial towns, and local uprisings followed as soon as the petitioners returned home with news of the Muscovites' apparently successful defiance of the tsar (Chapter 6).

If

Despite the unparalleled frequency of revolts in the mid-seventeenth century, it is possible to imagine a peaceful resolution to most of them. As Charles I reminded the Long Parliament in November 1640, while explaining how the Scots had managed to defeat his forces so swiftly: 'Men are so slow to believe that so great a sedition should be raised on so little ground'.<sup>14</sup> Accidents – totally unpredictable developments – could crucially affect the outbreak or outcome of a rebellion: the election by lot of two talented yet intransigent Catalan patriots, Pau Claris and Francesc de Tamarit, as the senior diputats of Catalonia, in 1638 (Chapter 9); the interregnum in the Polish-Lithuanian Commonwealth created by the death of King Władysław IV just after the Cossack rebels routed its field army in 1648 (Chapter 6); or the death from smallpox of William II of Orange without an adult heir just after he had defeated his domestic opponents in 1650 (Chapter 8).

Some accidents were more predictable – especially those that were caused by distance, which was (in Fernand Braudel's adage) 'the first enemy'. Philip IV's advisers hesitated to react immediately to the revolt of Naples 'because the state of affairs over there changes from one moment to the next,

and what seems appropriate today might not be so tomorrow'; while his envoy to the Irish Catholic Confederation complained that distance constituted 'the greatest problem of my job' because 'I can neither send successive accounts of what is happening nor receive in good time the royal orders of Your Majesty'. Even within the Iberian Peninsula, as Sir John Elliott noted:

The distance between Madrid and Barcelona meant that [the viceroy's] letters and those from Madrid never kept in step. While circumstances were changing from day to day in the Principality, Madrid was at least three days behind the news, and still legislating as if the situation was exactly the same as when the viceroy had written his last set of dispatches.<sup>15</sup>

Likewise, the central government in Madrid received the first reports of the Portuguese Revolution on 1 December 1640 just one week later, but refused to believe them. 'It is possible that a popular tumult might have produced a good deal of what we have heard', the Council of State informed Philip IV, 'but to proclaim a king the same day is not credible.' Philip did not sign letters warning ministers in Europe about 'the accident of Portugal' until 15 December; he did not instruct colonial administrators to take defensive measures until 27 December; he did not warn the treasure fleets coming from America to avoid Portuguese harbours until 5 January 1641; and he did not order the closing of all frontiers, both in the peninsula and in America, to commerce with the rebels until 10 January.<sup>16</sup>

Conversely, accidents could also unexpectedly derail rebellions. Lord Maguire's plot to seize Dublin Castle in 1641 failed because Owen Connolly, one of the conspirators, decided to betray his colleagues – but even then the magistrates 'gave at first very little credit to so improbable and broken a [story], delivered by an unknown, mean man, well advanced in his drink, and sent him away. Connolly only managed to sabotage the plot because he made a second attempt – this time successful – to betray his colleagues (albeit now too late to send a warning of the plot to Ulster, where it succeeded: see Chapter 11).<sup>17</sup> Likewise, ten years later, the samurai plot to seize Edo and destroy the Tokugawa regime came to light only because one of the conspirators became delirious and unwittingly shouted out the details (Chapter 16).

In each of these cases (and no doubt in many others) a minor rewrite of the historical record would produce a dramatically different outcome; and the same is true of natural disasters, such as earthquakes and volcanic eruptions, which occur with little or no warning: *if* the 1640s had not seen, at much the same time, the virtual disappearance of sunspots, much more volcanic activity, and double the number of El Niño episodes... Nevertheless, although contingency (like catastrophe) cannot be written out of history,

when constructing 'What if?' scenarios, historians must always consider second-order (or reversionary) counterfactuals: the possibility that rewriting the *short-term* historical record, as in the examples above, might still not change the *long-term* outcome.

Reversionary counterfactuals take two forms: one positive (an accident could delay but not permanently divert a particular development) and the other negative (a development that was, so to say, an accident waiting to happen). Positive examples are relatively easy to find. From the human archive, twenty-two years after the death of William II and the Dutch Revolution that followed, his posthumous son William III recovered almost all of the traditional powers and influence of the princes of Orange; and Charles II regained virtually all of his father's powers eleven years after the regicide in 1649. Turning to the natural archive, since some parts of the planet could feed their inhabitants only in good years, even had fewer volcanic eruptions and El Niño episodes occurred in the 1640s, sooner or later bad years would have come and caused heavy mortality.

Pomponne de Bellièvre, a French diplomat in London, provided a good example of a negative reversionary counterfactual as he contemplated the situation in Ireland in 1648. He informed Mazarin that

what surprises most of those who consider the affairs of that country [Ireland] is to see the people of the same country and the same religion, who know that the decision to exterminate them totally has been taken, so strongly divided by their private hatreds, so that zeal for their religion, the preservation of their country, and their own self-interest *does not suffice to make them abandon – at least for a while – the passions that incite them against each other.*<sup>18</sup>

The English conquest began the following year, and within three years Confederate Ireland was no more – but, in Bellièvre's view, even if the London government had delayed its campaign of repression, internal dissension still doomed the Catholic cause to ultimate defeat. Historian Julian Goodare has proposed a similar negative reversionary counterfactual for Scotland: given the character of both Charles I and the leading Covenanters, 'the Scottish crisis of 1637–38, with its momentous consequences for Britain, had been waiting to happen for some time; if the Prayer Book had not ignited it, something else soon would have done.'<sup>19</sup>

Many of Charles's fellow rulers – Dorgon, Alexei Romanov, Gustavus Adolphus and Christian IV – displayed similar inflexibility, and so did their principal ministers. None seemed prepared to contemplate alternatives to the policies they had adopted. In 1632 Thomas Wentworth, later earl of Strafford, informed a colleague 'Let the tempest be never so great, I will much rather put forth to sea, work forth the storm, or at least be found dead

with the rudder in my hand' – an uncanny echo of the claim seven years earlier by the count-duke of Olivares that 'As the minister with paramount obligations, it is for me to die unprotesting, chained to my oar, until not a fragment is left in my hands.'<sup>20</sup> Yet, sooner or later, persevering with unpopular policies during the economic and social tempest caused by the Little Ice Age was bound to provoke resistance and rebellion.

### The Two Worlds of Robinson Crusoe

Robinson Crusoe, perhaps the most famous fictional son of seventeenth-century Britain, grew up during the Civil War and left home in 1651, just after the execution of Charles I. After being marooned on a remote Caribbean island he returned to his native land in 1687, just in time to witness the flight of James II and the Glorious Revolution. Crusoe's 'Strange and surprizing adventures', first published in 1719, included not a word on these political changes: by contrast, Daniel Defoe, Crusoe's creator, repeatedly emphasized how the mental world in which his character had grown up differed from the mental world of his readers. For example, young Robinson kept a diary that initially resembled the spiritual journal and balance sheet maintained by many Puritans in the mid-seventeenth century (Chapter 20); but before long he filled it with balance sheets of profit and loss, reflecting the commercial outlook that had made England prosperous. Moreover, whereas England in the mid-seventeenth century had been riven by confessional strife, Crusoe despised religious intolerance. 'I allow'd liberty of conscience throughout my dominions' to Catholics, Protestants and pagans alike, and considered 'all the disputes, wranglings, strife and contention, which has happen'd in the world about religion . . . perfectly useless to us, as for ought I can yet see, they have been to all the rest of the world'. Crusoe favoured religious toleration because it facilitated international trade, which he pursued with great success and profit. He also successfully practised the new experimental philosophy (Chapter 22). He salvaged from his wrecked ship 'infinitely more than I knew what to do with', leading to the 'reflection, that all the good things of this world are no farther good to us than they are for our use'; and that, on the contrary, 'All I could make use of, was all that was valuable'. Crusoe also became a successful planter and soon found that his two most valuable assets were tools (the carpenter's chest he salvaged was 'much more valuable than a ship loading of gold would have been') and labour. Crusoe saved 'my man Friday', a fugitive from cannibals, and immediately set him to work on his colony (Crusoe's term), where the first English word Friday learned was 'Master'. Crusoe himself 'had never handled a tool in all my life', yet 'I improv'd myself in this time in all the mechanick exercises, which my necessities put me upon applying myself to'. A clearer example of experimental philosophy in action would be hard to find.<sup>21</sup>

The global climate had also changed by 1719. The frequency and violence both of volcanic eruptions and El Niño events diminished, an eleven-year sunspot cycle re-emerged, and surface temperatures on Earth began to rise. The benign climate, coinciding with a more systematic exploitation of the environment, permitted rapid population growth in more fertile areas. In China, the Kangxi emperor noted in 1716 that the population grew 'day after day', unlike the available arable land, and he complained – just like his predecessors a century before – about the increase in the number of 'unproductive consumers', singling out intellectuals (naturally), merchants and clerics. A few years later, a senior official in Fujian estimated that the population had doubled during the previous six decades. He too complained that 'while the population increases daily, the amount of land under cultivation does not'. The previous year, the central government had launched a drive to bring more land under cultivation because the 'population has increased of late, so how can [the people] obtain their livelihood? Land reclamation is the only solution.'<sup>22</sup> Thanks to such measures, by the mid-eighteenth century many parts of the globe boasted a denser population than ever before – but this time without a decline in life expectancy or standard of living. Equally important, the new equilibrium of population and resources made the demands of the fiscal-military state more bearable. The fatal synergy had ended.



## Epilogue: 'It's the Climate, Stupid'<sup>1</sup>

Once upon a time, climate change was a hot topic. In 1979 the World Meteorological Organization (WMO), the United Nations Environment Programme, the National Science Foundation, the Ford Foundation and the Rockefeller Foundation paid for 250 historians, geographers, archaeologists and climatologists from thirty countries to share their expertise at the first International Conference on Climate and History, hosted by the Climatic Research Unit at the University of East Anglia (England) – a unit sponsored by (among others) British Petroleum and Royal Dutch Shell. That same year, the WMO created the World Climate Program, with a mandate to 'insert climatic considerations into the formulation of rational policy alternatives'; President Jimmy Carter created the Federal Emergency Management Agency (FEMA) to consolidate federal policies related to the management of civil emergencies, including climate-induced disasters; and the United States Congress invited a committee of scientists 'to assess the scientific basis for projection of possible future climatic changes resulting from man-made releases of carbon dioxide into the atmosphere.' The committee predicted that if airborne concentrations of carbon dioxide (CO<sub>2</sub>) continued to increase, during the first half of the twenty-first century 'changes in global temperature of the order of 3°C will occur and . . . will be accompanied by significant changes in regional climatic patterns'. It also warned that 'A wait-and-see policy might mean waiting until it is too late.' In response, Congress passed the Energy Security Act, which (among other things) ordered a Carbon Dioxide Assessment Committee (CDAC) to prepare a comprehensive survey of the 'projected impact, on the level of carbon dioxide in the atmosphere, of fossil fuel combustion'.<sup>2</sup>

These initiatives took place in the shadow of a world food crisis. The price of wheat tripled and that of rice quintupled between 1972 and 1974, a reflection of harvest failures in South Asia, North America, the Sahel and the Soviet Union, leading the United Nations to convene a World Food Conference that called on all countries to cooperate in the establishment of 'a world food security system which would ensure adequate availability of, and reasonable prices for, food at all times, irrespective of periodic fluctuations and vagaries of weather'.<sup>3</sup> Then, thanks to the Green Revolution (new high-yielding varieties of wheat, maize and rice, combined with increased

investment in irrigation, fertilizers, pesticides and herbicides), food production dramatically increased. Famines virtually disappeared from the headlines, and concern about the vagaries of weather waned. The CDAC's report to Congress in 1983, entitled *Climate change*, categorically denied that 'the evidence at hand about CO<sub>2</sub>-induced climate change would support steps to change current fuel-use patterns away from fossil fuels', and instead asserted that 'The direct effects of more CO<sub>2</sub> in the air are beneficial'.<sup>4</sup>

*Climate change* nevertheless included disturbing data. If the amount of CO<sub>2</sub> in the atmosphere continued to increase at the same rate, as the report predicted, then global temperatures would rise 'by about 1°C' as early as the year 2000, and 'in polar latitudes a doubling of the atmospheric CO<sub>2</sub> concentration would cause a 5 to 10°C warming'. This would increase droughts, and decrease 'yields of the three great American food crops [wheat, maize and soybeans] over the entire grain belt by 5 to 10%'. It would also cause sea levels worldwide to rise by 5 or 6 metres, so that even 'The old dream of a "Northwest passage" might become a reality'.<sup>5</sup> To avert alarm concerning these eerily accurate predictions, *Climate change* cited a few historical precedents to demonstrate how easily humans adapt to abrupt climate change: Europe in the fourteenth century (based entirely on Barbara Tuchman's *A distant mirror*); Dakota in the 1880s (citing *The Bad Lands cow boy* newspaper); and the Dust Bowl of the 1930s ('a natural experiment with results dramatized in John Steinbeck's *Grapes of wrath*'). Therefore, the report concluded cheerily: 'The safest prediction of any we shall make is: Farmers will adapt to a change in climate, exploiting it and making our preceding predictions too pessimistic.' Moreover, should local adaptation fall short, the CDAC argued that migration would solve all problems. Once again the report cited apparently reassuring precedents:

People have moved from the seacoast to the prairie, from the snows to the Sun Belt. Not only have people moved, but they have taken with them their horses, dogs, children, technologies, crops, livestock, and hobbies. It is extraordinary how adaptable people can be in moving to drastically different climates.

In the unlikely event of a future climate-induced crisis, farmers would 'move as promptly as the Okies, saving themselves while abandoning the cropland to some other use'. Despite these spurious historical parallels, the CDAC report immediately became a foundational text for those who sought to deny global warming.<sup>6</sup>

*Climate change* failed to mention another precedent: the events of 1816, a year without a summer (the first since 1675, and the most recent). It occurred in the middle of a prolonged sunspot minimum amid major volcanic activity, which (as in the seventeenth century) both reduced

average global temperatures by between 1°C and 2°C and caused extreme weather events. Intense cold prevailed from Finland to Morocco for most of the summer; rain fell on Ireland for 142 out of 153 days between May and September; grapes in French and Swiss vineyards ripened later than in any other year since continuous records began in 1437; the monsoon failed in India; and snow fell in Jiangnan and Taiwan. In America, north of a diagonal line stretching from British Columbia to Georgia, fronts of Arctic air produced temperature oscillations throughout the summer from 35°C to freezing in a single day, killing the crops: the price of wheat in New York City in 1816 would not be surpassed until 1973. The 'Yankee Chills', as survivors in North America called their miserable summer, produced massive migration from New England to the Midwest. 'The lands to the westward are luxuriant, and the climate mild and salubrious' crooned a land promoter, and from 1817 to 1820 the population of the State of Ohio rose by 50 per cent. Most newcomers were New Englanders fleeing the sudden climate change.<sup>7</sup>

If, two centuries later, the Yankee Chills (or any other natural disaster) should strike New England, flight to Ohio would bring little relief. As the 2011 version of the *State of Ohio homeland security strategic plan* points out: 'Getting food from farms to dinner tables involves a complex chain of events that could be interrupted at many different stages. Because food and agriculture are such vital industries to our state, Ohio must vigilantly protect animal, plant, and food supply chains' – but with over 11 million Ohioans, it is hard to see how the state could feed an additional 50 per cent in an emergency.<sup>8</sup> Admittedly, if the Chills killed *only* corn, or *only* affected New England, the transport and distribution infrastructure developed since 1816 could probably import sufficient emergency food rations to Ohio from unaffected (or less affected) areas; but this might prove impossible in the wake of a large-scale natural disaster, not least because, in the words of the current *State of Ohio emergency operations plan*, 'Manufacturing agencies within in the United States employ just-in-time inventory systems and do not stock large inventories, thus there may be a supply shortage nationwide for critical items.'<sup>9</sup> This is an understatement. Whereas once, as Stephen Carmel of Maersk Lines pointed out, 'We were self-sufficient in some but not all of what we needed, and we could trade the excess of what we made to fill the gaps . . . Now we are self-sufficient in nothing.' Therefore, 'As in any conveyor belt linking assembly lines, a disruption to any part of the system becomes a disruption to the whole system.' In addition, we are 'completely dependent on the uninterrupted flow of accurate information. Without it, trade simply will not happen' – and neither will relief efforts.<sup>10</sup>

The tragic experience of the Gulf Coast region after Hurricane Katrina struck in August 2005 highlighted the consequences of extreme weather when a society relies on just-in-time inventory systems and the uninterrupted

flow of accurate information: almost 2,000 people killed; tens of thousands left without basic essentials for almost a week; over 1 million displaced; 92,000 square miles of land laid waste; and 200,000 homes destroyed. It was the largest and costliest natural disaster in the history of the United States, and it led to the largest domestic deployment of military forces since the Civil War. Yet, as a House of Representatives investigative committee reported, 'None of this had to happen. The potential effects of a Category 4 or 5 storm were predictable and were in fact predicted'; but 'despite years of recognition of the threat that was to materialize in Hurricane Katrina, no one – not the federal government, not the state government, and not the local government – seems to have planned for an evacuation of the city from flooding through breached levees.' The committee's report, entitled *A failure of initiative*, was especially scathing about the inability of the numerous teams of responders to contact one another: 'Catastrophic disasters may have some unpredictable consequences', they noted, 'but losing power and the dependent communications systems after a hurricane should not be one of them.' They cited the lament of the adjutant-general of the Mississippi National Guard that 'We've got runners running from commander to commander. In other words, we're going to the sound of gunfire, as we used to say in the Revolutionary War' (and also in the seventeenth century). The report concluded: 'We are left scratching our heads at the range of inefficiency and ineffectiveness that characterized government behavior right before and after this storm. But passivity did the most damage.' Its authors therefore wondered 'How can we set up a system to protect against passivity? Why do we repeatedly seem out of synch during disasters? Why do we continually seem to be one disaster behind?'<sup>11</sup>

A few months later, a United States Senate investigative committee reached similar conclusions in a report entitled *Hurricane Katrina: a nation still unprepared*. The 'still' referred to the inadequate responses to another catastrophic event revealed by the independent commission that studied the 9/11 attacks just four years earlier, and several members of Congress called for a similar independent commission into Katrina in order to learn from mistakes made – but the White House thwarted them.<sup>12</sup> So the United States remained 'one disaster behind': although the federal government improved its ability to mobilize and deliver massive quantities of supplies to assist state and local government in the days and weeks after a disaster (search and rescue, law enforcement, temporary shelter, emergency distribution of food, water and medicine), it did far less to help vulnerable localities prepare for long-term recovery (how to keep local government operating, rehouse displaced people, and prepare for the inevitable health problems, mental as well as physical).

When Hurricane Sandy struck New York and New Jersey in October 2012, therefore, entirely predictable infrastructure failures (loss of electrical

power, closure of transportation systems, shortage of gasoline) once again afflicted tens of millions of people for days and sometimes weeks, and a smaller (but still substantial) number for months and sometimes years. For Adam Sobel, an earth scientist, the primary culprit for these defects was what *A failure of initiative* had termed 'passivity':

Most of the damage could not have been prevented by any decision made or action taken in the days leading up to the storm. Most of it resulted from decisions made in the years, decades, and even centuries prior. Most was caused, perhaps unconsciously, by decisions to do nothing, or the absence of a decision to do something. These nondecisions were made not in response to scientific predictions, but despite them.<sup>13</sup>

The same passivity had characterized responses to many seventeenth-century disasters. To take one glaring example, plague epidemics in 1603, 1625 and 1636 had killed tens of thousands of Londoners, and when a new epidemic ravaged continental Europe in 1664–65 it was easy to anticipate the consequences if it reached the English capital. Nevertheless, neither local nor national government took appropriate action. Instead, when plague struck, the king and his court, many magistrates and almost all the rich fled. Parliament assembled in Oxford to debate appropriate measures, but no legislation passed because the peers demanded an exemption from restrictive measures such as quarantine and insisted that no plague hospitals be erected near their own homes. One may wonder why the central government did not act unilaterally to save its capital; but, as a contemporary pamphlet pointed out, 'their power was *limited* and they must proceed legally'. The rule of Oliver Cromwell and his army officers (which had ended only five years before) had left a bitter legacy, and Charles II dared not risk alienating his new subjects by imposing unpopular measures. The consequences of government nondecisions were therefore measured in the corpses of plague victims dumped daily into mass graves. In all, the epidemic killed 100,000 Londoners, one-quarter of the total population of the capital, plus 100,000 more victims elsewhere in England. Nevertheless, unlike Katrina and Sandy, this catastrophe proved to be a tipping point: the English government introduced and enforced stringent controls that ensured its citizens never again suffered a major plague epidemic (Chapter 21).<sup>14</sup>

Social psychologist Paul Slovic has argued that 'the ability to sense and avoid harmful environmental conditions is necessary for the survival of all living organisms', whereas 'humans have an additional capability that allows them to alter their environment as well as respond to it' – but only if they deploy two distinct skills: *learning processes* (the observation, measurement and classification of natural phenomena) and *learning steps* (the

development of techniques, practices and instructions designed to reduce vulnerability in future hazards). In order to activate this additional capability, humans apparently need to experience natural disasters 'not only in magnitude but in frequency as well. Without repeated experiences, the process whereby managers evolve measures of coping with [disasters] does not take place.'<sup>15</sup> The National Hurricane Center, a division of the United States National Weather Service, confirmed this insight in the wake of the disastrous hurricane seasons of 2004 and 2005 (which included not only Katrina but seven of the nine costliest storm systems ever to strike the United States). Another 'disastrous loss of life is inevitable in the future', they concluded sadly, because the majority of those living in areas at risk have 'never experienced a direct hit by a major hurricane' and seemed incapable of envisaging what one is like, while the rest 'only remember the worst effects of a hurricane for about seven years'.<sup>16</sup> Adam Sobel reached a similar conclusion after Sandy:

When a particular type of event has not happened before, predictions that the risk of that event is significant do not, historically, generate the collective will necessary for us to make investments in resiliency. This is true even when the science indicates quite clearly that the event is quite likely to happen eventually, and that the consequences of being unprepared for it will be severe. Just as the vulnerability of New Orleans was known for decades before Katrina, the vulnerability of New York City and the coastal areas around it was known for decades before Sandy.

In the words of Australian Professor of Public Ethics Clive Hamilton, 'Sometimes facing up to the truth is just too hard. When the facts are distressing it is easier to reframe or ignore them.'<sup>17</sup>

Perhaps cognitive dissonance explains why many societies fail 'to make investments in resiliency' to cope with our changing climate, despite the fact that the global temperature in 2016 was the warmest ever recorded, that it was the third consecutive year in which a new annual temperature record was set, and that the first sixteen years of the twenty-first century all ranked among the seventeen warmest on record; and despite the unprecedented extreme weather events – notably prolonged periods of unusual heat, heavy downpours and flash floods – that disrupted people's lives and damaged infrastructure. One may deny that the global climate is changing, but it is hard to deny that a heatwave in Europe in 2003 that lasted just two weeks caused the premature deaths of 70,000 people; that eighteen major flood events hit Texas, Louisiana, Oklahoma and Arkansas between March 2015 and August 2016; or that almost 18 inches of rain fell on Sacramento and other parts of California in January and February 2017, causing damage to roads, dams and other infrastructure that may cost \$1 billion to repair.<sup>18</sup>

The scientific community is virtually unanimous on the reality of global warming: of 69,406 authors of recent peer-reviewed articles on the subject, only five rejected it. Likewise, only 2 per cent of the members of the American Association for the Advancement of Science, the world's largest multidisciplinary scientific professional society, denied that the Earth is warming (the same proportion who rejected evolution), a figure that fell to 1 per cent among earth scientists surveyed. By contrast, a 2016 Pew Research Center survey of adults living in the United States revealed that less than half believe 'that the Earth is warming mostly due to climate change', and scarcely a quarter believe that 'almost all climate scientists agree that human behaviour is mostly responsible for climate change'.<sup>19</sup>

These findings, and similar ones elsewhere, prompted a team of researchers to ask people in forty-seven different countries 'How serious do you consider global warming?' and to share their rationale.<sup>20</sup> The responses revealed three broad reasons for popular scepticism:

- A marked negative correlation between biblical fundamentalism and concern for the environment is evident, particularly among Christians in the United States, many of whom see natural disasters as divine punishments for sin, so that both preparation and mitigation are a waste of time and money (a peccatogenic outlook also common in the seventeenth century: see Chapter 1).<sup>21</sup>
- A negative correlation also exists between residence in regions highly exposed to natural disasters such as hurricanes and concern about global warming, either because hazard and disaster are accepted as aspects of daily life, or because it may be hard to admit that buying property in a location at high risk of damage from natural disasters such as hurricanes is foolish.
- Respondents in rich countries, and in countries with large carbon dioxide emission levels, showed less concern about global warming than those in poor countries or in countries with low emissions, no doubt because it is harder to accept global warming as a problem when it requires recognition that it is partly your fault and when mitigation requires major personal sacrifices.

All three reasons reflect the culture of passivity described in *A failure of initiative*, but they receive reinforcement from a small but powerful group of activists.

In his blueprint for scientific research, the *New Atlantis* in 1626, Francis Bacon extolled the 'merchants of light' who travelled afar to bring back scientific knowledge and then collaborated to debate its significance and apply its practical benefits (page 486). Almost all scientists today do precisely this, but on a few subjects they have to contend with 'merchants of doubt'

who seek to discredit their research and promote distrust of their conclusions.<sup>22</sup> Over the past half-century, the merchants of doubt have vigorously challenged the scientific evidence for links between tobacco-smoking and lung cancer, between acid rain and environmental damage, and between chlorofluorocarbons (CFCs) and the depletion of the ozone layer, as well as between CO<sub>2</sub> emissions and climate change. In each case, they have found and funded contrarian experts (almost always from a scientific field not relevant to the environmental or public health issues in question) and insisted that journalists devote equal attention to the deniers, however few and however unqualified. Although the deniers eventually lose, they still cause immense harm. Thus, in 2006, after seven years of litigation, US Federal Judge Gladys Kessler determined that the tobacco industry had engaged in an 'unlawful conspiracy to deceive the American public about the health effects of smoking' since the 1950s. Moreover, because it 'consistently, repeatedly, and with enormous skill and sophistication, denied these facts to the public, to the Government, and to the public health community', it managed to delay the regulation of cigarettes by almost half a century, thereby causing 'a staggering number of deaths per year, an immeasurable amount of human suffering and economic loss'.<sup>23</sup>

In the case of climate change, the number of deaths, the amount of human suffering and the economic loss will be far higher. Extreme weather caused 91 per cent of almost 16,000 natural disasters recorded worldwide between 1980 and 2015. More specifically, in Europe, where extreme weather accounted for 92 per cent of all natural disasters reported in the same period, economic losses caused by weather-related events increased from a decadal average (adjusted for inflation) of over €7 billion in the 1980s, to over €13 billion in the 1990s, and over €14 billion in the 2000s.<sup>24</sup>

These alarming statistics have attracted the attention of the world's insurance companies. The International Association for the Study of Insurance Economics, also known as the Geneva Association, estimates that 'losses from weather events are growing at an annual 6 per cent, thus doubling every twelve years'; it predicts that 'rising loss trends will continue'; and it blames the loss trends on a synergy between climate change and human perversity.

The lack of preventive strategies (for instance, land zoning, building codes, and so on) in many countries' development planning results in increasing vulnerabilities and risks due to disasters and climate change. Further, ever more people and assets are concentrated in exposed (urban) areas such as coastal regions in low- and middle-income countries. At the same time, interconnected global supply and manufacturing chains are highly vulnerable to disaster-induced disruption. And, last but not least, climate change is believed to add to the increasing severity and frequency of extreme events.<sup>25</sup>

Amitav Ghosh has emphasized the special vulnerability of Asia. 'If we consider the location of those who are most at threat from the changes that are now under way across the planet,' he wrote, 'the great majority of potential victims are in Asia.' Because of rising sea-levels, falling aquifers and desertification, 'the lives and livelihoods of half a billion people in South and Southeast Asia are at risk. Needless to add, the burden of those impacts will be borne largely by the region's poorest people, and among them, disproportionately by women' – and yet 'there exist very few polities or public institutions that are capable of implementing, or even contemplating, a managed retreat from vulnerable locations.'<sup>26</sup>

High-impact natural disasters will not be confined to South and Southeast Asia. A report published in 2007 by the military advisory board of the Center for Naval Analyses, a non-profit research organization based in Arlington, Virginia, presciently warned that 'Climate change acts as a threat multiplier for instability in some of the most volatile regions of the world. Projected climate change will seriously exacerbate already marginal living standards in many Asian, African, and Middle Eastern nations, causing widespread instability and the likelihood of failed states.' 'The major impact on Europe from climate change is likely to be migrations,' they continued, 'now from the Maghreb (Northern Africa) and Turkey, and increasingly, as climate conditions worsen, from Africa.' Their prediction soon came true. In Syria, a country whose population had grown sevenfold in two generations, a multi-season, multi-year extreme drought, which began in the winter of 2006–7, reduced yields of wheat and barley by one-half and two-thirds respectively, and destroyed livestock herds. Over 1 million hungry and homeless people fled from rural areas to the cities, just as their ancestors had done when a similar prolonged drought struck in the seventeenth century (Chapter 7). There they raised the population of some cities by one-third, dramatically driving up food and housing prices, overstraining services such as hospitals and schools, increasing urban unemployment, economic dislocation and social unrest. Civil war broke out in 2012, resulting in over 1 million starving refugees crossing into Turkey and thence into Europe. By 2016, half the population of Syria had been displaced.<sup>27</sup>

What can be done to avoid such heart-rending scenarios? The Church of Jesus Christ of the Latter Day Saints currently enjoins its members to prepare for a sudden natural disaster by taking 'the amount of food you would need to purchase to feed your family for a day and multiply that by seven. That is how much food you would need for a one-week supply. Once you have a week's supply, you can gradually expand it to a month, and eventually three months.' More modestly, the State of Ohio recommends that each family should store 'enough food and water to last from several days up to two weeks'. In particular, since 'you can exist on very little food for a long time, but after a short time without adequate water, your body will not be

able to function ... a family of 4 who wanted to keep a 1-week supply of water on hand would need to store 28 gallons.'<sup>28</sup> And after that? The devastation caused by Hurricanes Katrina and Sandy and countless other abrupt high-impact weather events lasted for months, and in a few areas for years, far exceeding the resilience of even the most forward-looking family or local government acting alone.

In December 2012, two months after Sandy, Mayor Michael Bloomberg of New York City created a Special Initiative for Rebuilding and Resiliency and tasked it with producing a plan for 'a stronger, more resilient New York'. Its report, 445 pages long, laid out over 250 initiatives to 'make our city even tougher', at a combined cost of almost \$20 billion – but not alone. The report concluded: 'Given the important role played by the Federal government in flood risk assessment, flood insurance, and coastal protection measures, a clear Federal agenda for the City to pursue (in partnership with the State and the Congressional delegation) is critical to the successful implementation of the plan outlined in this report.' It added: 'While this list does not reflect all of New York City's needs from the Federal government, it does reflect a set of priorities that require immediate attention.'<sup>29</sup>

This recognition reflects the experience of other societies: preparing for, and coping with, a major weather-induced catastrophe requires resources that only a central government can command. The construction of the Thames Barrier in southeast England offers an instructive example. The river Thames has frequently burst its banks and flooded parts of London. In 1663 Samuel Pepys reported 'the greatest tide that ever was remembered in England to have been in this river: all White Hall having been drowned'. Proposals were made to erect a barrier to prevent the recurrence of similar catastrophes but the opposition of London merchants, whose trade would suffer if ships could not sail up the Thames, and disagreements among competing jurisdictions over the cost, thwarted them. Then, in 1953, a tidal surge in the North Sea flooded some 150,000 acres of eastern England and drowned more than 300 people. The government declared: 'We have had a sharp lesson, and we shall have only ourselves to blame if we fail to profit from it, and set up a committee to propose remedies. It, too, recommended the immediate construction in the Thames estuary of a 'suitable structure, capable of being closed', but opposition from shipping interests and cash-strapped local authorities again prevented action.<sup>30</sup>

In 1966 the government asked its chief scientific adviser, Hermann Bondi, to examine the matter afresh. A mathematician by training, Bondi devoted much attention to assessing risks; but he also consulted historical sources and found that the height of storm tides recorded at London Bridge had increased by more than 1 metre since 1791 (when records began). Although he could not identify the cause of this alarming development,

Bondi predicted that sea levels would continue to rise, increasing the probability of another 'major surge flood in London' that would deliver 'a knock-out blow to the nerve centre of the country'. He compared the likelihood of this with other low-probability/high-impact events, such as an asteroid or meteorite hitting central London, which would also cause immense damage; but concluded that the risk was remote and prevention almost impossible – whereas, given the rising level of the North Sea, another disastrous flood similar to, or worse than, that of 1953 was inevitable. He therefore unequivocally recommended the construction of a Thames Barrier.<sup>31</sup>

Although shipping interests and local authorities did their best to thwart this plan, too, in 1972 Parliament passed the Thames Barrier and Flood Protection Act and promised to fund Bondi's recommendation. By its completion in 1982, the barrier had cost £534 million – but the property it protects now exceeds £200 billion in value, and includes 40,000 commercial and industrial properties and 500,000 homes with over 1 million residents. If the Thames Barrier were not in place, and another flood were to 'drown' Whitehall, the heart of government today as in the time of Pepys, it would displace the 87,000 members of the central administration who work there. It would also flood the new Docklands economic development as well as sixteen hospitals, eight power stations and many fire stations, police stations, roads, railway lines, rail stations and underground stations, as well as the shops and suppliers needed to repair and replace items damaged in the flood. Londoners would therefore lose not only their homes and their jobs but also the essential means of response and recovery. In short, without the Thames Barrier, London would resemble New Orleans in 2005: vulnerable to a natural disaster that, like Katrina, is sooner or later inevitable. By 2016 the Thames Barrier had been activated to prevent flooding 176 times, 50 of them over the winter of 2013–14.<sup>32</sup>

Extreme weather is a great leveller. Despite all the obvious differences, humans in advanced societies have the same basic needs as humans elsewhere. We all need shelter, sufficient water and at least 2,000 calories a day; and we are all vulnerable during 'the hungry time' (the term used by the Aboriginal people of Western Australia for the season between the end of one annual cycle and the beginning of the next: Chapter 15), because if the power grid fails, very soon there will be no food on supermarket shelves and no water. The changing geographical distribution of the global population is increasing that vulnerability. In 1950, Europe had three times the population of Africa, but in 2016 the population of Africa was at least 50 per cent larger than that of Europe – a disparity that widens every year as the former grows and the latter declines. This shift increases the percentage of the global population that spends a high proportion of disposable income on basic needs such as water, food, energy and housing, often in areas where

even central governments lack effective means of dealing with major disasters, making them more vulnerable to the effects of climate change. The Global Crisis of the seventeenth century prematurely ended the lives of millions of people. A natural catastrophe of similar proportions and duration today would prematurely end the lives of billions of people.

We face clear choices. As Britain's chief scientific adviser observed in 2004, summarizing the research of nearly ninety leading experts on the risks of flooding, 'We must either invest more in sustainable approaches to flood and coastal management or learn to live with increased flooding.' Anthony Zinni, former commander-in-chief of US Central Command (responsible for the Middle East, North Africa and Central Asia), made a similar point with characteristic bluntness in a 2007 interview: "We will pay for this one way or another", he said. "We will pay to reduce greenhouse gas emissions today, and we'll have to take an economic hit of some kind. Or we will pay the price later in military terms. And that will involve human lives. There will be a human toll. There is no way out of this that does not have real costs attached to it". In 2011, a study of the impact of climate change, based on thirty years of empirical data, prepared for New York State and published (ironically) just eleven months before Sandy struck, quantified the equation: "There is an approximate 4-to-1 benefit-to-cost ratio of investing in protective measures to keep losses from disaster low."<sup>33</sup> In short, we can pay to prepare, and commit substantial resources now, or we can incur far greater costs to repair at some future date.

Like Cassandra, historians who prophesy rarely receive much attention from their colleagues (or anyone else), and those who prophesy doom (whether or not they are historians) are normally dismissed as whiners – *hoggidiani*, to use the dismissive term in Secondo Lancellotti's 1623 best-seller *Nowadays* (page 299). Yet *hoggidiani* are not always wrong. As environmental historian Sam White has observed, 'Studying climate without considering the history of climate is like driving without a rearview mirror: it provides not just parables but also parallels about past climate change and its effects.' Earth scientists Tim O'Riordan and Tim Lenton concurred; because 'there is no single template for anticipating and adjusting' to weather-induced disasters, they argued that there is 'no substitute for good case history of successful practice'. We therefore 'need to follow examples of successful anticipation' and adjustment in the past 'in order to offer the best set of learning experience for others to follow'.<sup>34</sup>

The seventeenth-century Global Crisis offers two successful but very different learning experiences. Famine and unrest in Japan led Tokugawa Iemitsu and his advisers to create more granaries, upgrade the communications infrastructure, issue detailed economic legislation and avoid foreign wars in order to preserve sufficient reserves to cope with the consequences

of extreme weather. But, as Ghosh notes, 'Climate change poses a powerful challenge to what is perhaps the single most important political conception of the modern era: the idea of freedom, which is central not only to contemporary politics but also to the humanities, the arts, and literature.'<sup>35</sup> The successful efforts of the Tokugawa to protect their subjects from starvation involved policies that few today would deem acceptable: they forbade freedom of speech, belief, assembly or movement; monopolized the possession and use of firearms; conducted constant surveillance and summarily executed offenders; and, when all else failed, they permitted *mabiki*, literally 'thinning out', but also the metaphor of choice for infanticide (Chapter 16). England followed a different strategy for adjusting to weather-induced disasters. Successive dearths in the 1590s, 1629–31, 1647–49 and the 1690s gradually forced reluctant property owners to accept the central government's argument that it was both cheaper and more efficient (as well as more humane) to support those who became old, widowed, ill, disabled or unemployed locally, thus creating the foundations of the world's first welfare state.

Nevertheless, not even England could cope with an abrupt change in the global climate, as George Gordon, Lord Byron, discovered in 1816 after he had fled the country amid accusations of incest, adultery, wife-beating and sodomy. He planned to relax in a villa near Lake Geneva with a former mistress, his personal physician John Polidori and a select group of close friends. Instead, the party spent a 'wet, ungenial summer' (Switzerland was one of the areas worst affected by global cooling), which forced Byron and his companions to spend almost all their time indoors. Among other recreations, they competed to see who could compose the most frightening story. Mary Wollstonecraft Shelley began work on *Frankenstein*, one of the first horror novels to become a bestseller; Polidori wrote *The vampyre*, the progenitor of the Dracula genre of fiction; Byron composed a poem that he called 'Darkness'. All three works reflected the disorientation and desperation that even a few weeks of sudden climate change can cause. As we debate whether it makes better sense today to invest more resources in mitigation or 'continually seem to be one disaster behind', we might re-read with profit Byron's poem because, unlike our ancestors in 1816 (and in the seventeenth century), we possess both the resources and the technology to choose whether to prepare today or repair tomorrow.

'Darkness' by Lord Byron<sup>36</sup>

I had a dream, which was not all a dream.  
The bright sun was extinguish'd, and the stars  
Did wander darkling in the eternal space,  
Rayless, and pathless; and the icy Earth  
Swung blind and blackening in the moonless air.

Morn came and went – and came, and brought no day,  
And men forgot their passions in the dread  
Of this their desolation; and all hearts  
Were chill'd into a selfish prayer for light:  
And they did live by watchfires – and the thrones,  
The palaces of crowned kings – the huts,  
The habitations of all things which dwell,  
Were burnt for beacons; cities were consum'd,  
And men were gather'd round their blazing homes . . .

And War, which for a moment was no more,  
Did glut himself again: a meal was bought  
With blood, and each sat sullenly apart  
Gorging himself in gloom: no love was left.  
All Earth was but one thought – and that was death,  
Immediate and inglorious; and the pang  
Of famine fed upon all entrails . . .