INTRODUCTION

breakdown, and the 'continual fear and danger of violent death,' cooled the ardour of many advocates of economic, political and religious change, leading to greater political stability, economic innovation and religious toleration. It also led many governments to switch resources from warfare to welfare, fostering economic regeneration (chapter 21). Finally, chapter 22 examines a variety of intellectual responses devised to cope more effectively with future crises, some (like compulsory universal schooling) imposed by the state, others emerging among subjects - including 'practical knowledge' in China and Japan, the 'new reason' in Mughal India and the 'Scientific Revolution' in Europe. For various reasons, these innovations put down deeper roots in the West than elsewhere and formed a crucial ingredient in the 'Great Divergence' between East Asia and Northwest Europe that later developed.

The Conclusions considers some implications of recognizing that, far from being an aberration, 'catastrophe' forms an integral part of human history, while the Epilogue suggests that the current debate on 'global warming' confuses two distinct issues: whether human activity is making the world warmer, and whether or not sudden climate change can occur. Although some may still legitimately question the first, the seventeenth-century evidence places the second beyond doubt. The critical issues are not whether climate change occurs, but when, and whether it makes better sense for states and societies to invest money now to prepare for natural disasters that are inevitable - hurricanes in the Gulf and Atlantic coasts of North America; storms surges in the lands around the North Sea; droughts in Africa; prolonged heatwaves - or instead wait to pay the far higher costs of inaction.

PART I

THE PLACENTA OF THE CRISIS

The French philosopher and author Voltaire was the first to write about a Global Crisis in the seventeenth century. His Essay on the customs and character of nations, and on the principal facts of history from Charlemagne to Louis XIII, composed in the 1740s for his friend, the Marquise du Châtelet (who, although an eminent mathematician, found history boring), set the wars and rebellions a century earlier within a global framework. Thus, after describing the murder of an Ottoman sultan in 1648, Voltaire immediately noted:

This unfortunate time for Ibrahim was unfortunate for all monarchs. The Holy Roman Empire was unsettled by the famous Thirty Years' War, civil war devastated France and forced the mother of Louis XIV to flee with her children from her capital. In London, Charles I was condemned to death by his own subjects. Philip IV, king of Spain, having lost almost all his possessions in Asia, also lost Portugal.

Voltaire went on to consider the careers of Cromwell in England, Li Zicheng in China, Aurangzeb in India, and others who had seized power by force, concluding that the mid-seventeenth century had been a period of usurpations almost from one end of the world to the other.

Voltaire's Essay repeatedly stressed the global dimension of the crisis: 'in the flood of revolutions which we have seen from one end of the universe to the other, a fatal sequence of events seems to have dragged people into them, just as winds move the sand and the waves. The developments in Japan offer another example... Eventually, fearing that the marquis might still find his 174 chapters and 800 pages of 'examples' boring, he delivered his analysis in a single sentence: 'Three things exercise a constant influence over the minds of men: climate, government and religion.' Taken together, Voltaire proclaimed, they offer 'the only way to explain the enigma of this world.' Two decades later, Voltaire re-read his Essay and added a number of Remarks, including a fourth 'thing' that, he now believed, could reconcile what was irreconcilable and explain what is inexplicable in human history: changes in population size.

Voltaire's global vision has attracted few imitators. Although many subsequent historians have provided accounts filled with facts on 'government and religion' in the seventeenth century, until very recently few noted population trends and
virtually none considered the influence of the climate. Nevertheless, recent work by
 démographers and climatologists suggests that around 1618, when the human
 population of the northern hemisphere was larger than ever before, the average
 global temperature started to fall, producing extreme climate events, disastrous
 harvest failures and frequent disease epidemics. Human demographic systems can
 seldom adapt swiftly enough to such adverse events, yet instead of seeking ways to
 mitigate the natural disasters and save lives, most governments around the globe
 exacerbated the situation by continuing their existing policies, above all their wars.
 These various natural and human factors constituted a 'placenta' capable of nour-
 ishing a global catastrophe. Even though they did not constitute the catastrophe
 itself, an examination of the placenta explains why the catastrophe lasted for
 two generations, why it killed up to one-third of the human population, and why it
 transformed the world inhabited by the survivors.5

The Little Ice Age

'A strange and wondrous succession of changes in the weather'

IN 1614 RENWYARD CYSAT, BOTANIST, ARCHIVIST AND TOWN HISTORIAN OF
Luzern, Switzerland, began a new section of his chroniclentitled 'The Seasons
of the Year', because 'the past few years have been such a strange and wondrous
succession of changes in the weather'. He decided to

Record the same as a service and a favour to future generations because, unfortun-
ately, on account of our sins, for some time now the years have shown themselves
to be more rigorous and severe in the recent past, and we have seen deterioration
amongst living things, not only among mankind and the animal world but also in
the earth's crops and produce.2

Cysat was correct: 'a strange and wondrous succession of changes in the weather'
had begun around the globe — and it would continue for almost a century. In west
Africa, records reveal a prolonged drought from 1614 until 1619 both for Angola
and the Sabel (the semi-arid belt of savannah south of the Sahara that stretches
from the Atlantic Ocean to the Red Sea). In Europe, Catalonia suffered 'the year of
the flood' in 1617: after over a month of continuous rain, a final four-day downpour
washed away bridges, mills, drainage works, houses and even town walls. All Europe
experienced an unusually cold winter in 1620–1: many rivers froze so hard that for
three months they could bear the weight of loaded carts and, most spectacularly, the
Bosphorus froze over so that people could walk across the ice between Europe and
Asia (apparently a unique climatic anomaly).3

Other parts of the northern hemisphere also experienced abnormal weather.
Japan endured its coldest spring of the seventeenth century in 1616, while Chinese
Cortezes recorded heavy snowfall in 1618 in subtropical Fujian (almost as rare as
the Bosphorus freezing over). Four provinces reported a severe winter in 1620, as did
four more in 1621. In the Americas, drought affected the valley of Mexico for five
years out of six between 1616 and 1621, and reduced the crops in the Chesapeake
basin so severely that the new Virginia colony almost failed. After six better harvests,
the summer of 1627 was the wettest recorded in Europe during the past 500 years,
while 1628 was a 'year without a summer', with temperatures so low that many crops
never ripened. Between 1629 and 1632, much of Europe suffered excessive rains
followed by drought. Conversely northern India suffered a 'perfect drought' in 1630–1 followed by catastrophic floods in 1632. Of all these regions experienced dramatic falls in population.6

Some better weather followed in the 1630s, but then came three of the coldest summers ever recorded in the northern hemisphere. Drought and cold significantly stunted the growth of trees throughout the western United States between 1640 and 1644, while the Iberian Peninsula experienced severe and prolonged drought from 1641 until 1653. Since virtually no rain fell in the valley of Mexico in 1640, 1641 and 1642, the clergy of Mexico City organized processions with the 'Virgen de los Remedios', an image believed to possess special efficacy in bringing rain, to beg God's intervention before everyone starved to death (the first time the image had ever been used in consecutive years). Early in 1642, John Winthrop, governor of the Massachusetts Bay colony, noted that

The frost was so great and continual this winter that all the hay 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 so 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.

To the north, English settlers on the coast of Maine complained of the 'most intolerable piercing winter' and found it 'incorrible to relate the extremity of the weather'.7

Abnormal droughts also prevailed on the other side of the Pacific. The Indonesian rice harvest failed in both 1641 and 1642, and between 1643 and 1671 Java experienced the longest drought recorded during the past four centuries. In Japan the first winter snow of 1641 fell on Edo (as Tokyo was then known) on 28 November, almost the earliest date on record (the average date is 5 January), and both that year and the next saw unusually late springs. According to a 1642 pamphlet published in the Philippines, because of the 'great drought' throughout the archipelago 'a great famine is feared', and two years later, a resident of Manila recorded that once again 'there has been much famine among the Indians (Filipinos) because the rice harvest was a poor one on account of the drought'. In North China, numerous Gazetteers reported drought in 1640 and the following year the Grand Canal, which brought food to Beijing, dried up for lack of rain (another unparalleled event); while in the lower Yangzi valley chroniclers recorded abnormal rain and cold throughout the spring of 1642.8

The lands around the Mediterranean also experienced extreme weather at this time. In March 1640 a messenger approaching Istanbul, 'with snow up to the horses knees', experienced 'such a frost that I caught two frozen birds on the way simply with my own hand'. Catalonian endured a drought in spring 1640 so intense that the authorities declared a special holiday to enable the entire population to make a pilgrimage to a local shrine to pray for water - one of only four such occasions in the past five centuries. In 1641 the Nile fell to the lowest level ever recorded while the narrow growth rings laid down by trees in Axetatia reveal a disastrous drought. In Istanbul, by contrast, a chronicler recorded that rain flooded areas near High

S Sophia so that the shops were under water and destroyed! While in Macedonia, the autumn saw 'so much rain and snow that many workers died through the great cold'. Early in 1642 the Guadalquivir broke its banks and flooded Seville, and the years 1640–3 were the wettest on record throughout Andalucia.9

Further north, English men and women noted the extraordinary dislocation of the weather in August 1640, when the land seemed to be threatened with the extraordinary violence of the winds and uncustomed abundance of wet; while in Ireland, frost and snow in October 1641 began what contemporaries considered 'a most bitter winter than was of some years before or since seen in Ireland'. Hungary experienced uncommonly wet and cold weather between 1638 and 1641, while summer frosts repeatedly devastated crops in Bohemia. In the Alps, unusually narrow tree rings reflect poor growing seasons throughout the 1640s, while estates papers record the disappearance of fields, farmsteads and even whole villages as glaciers advanced up to 1.2 miles beyond their current positions (their furthest extent in historical times). In eastern France, each grape harvest between 1640 and 1643 began a full month later than usual and grain prices surged, indicating poor cereal harvests. In the Low Countries, all along the river Maas (or Meuse), floods caused by snowmelt early in 1643 created 'the greatest delocation that one could imagine' the houses all broken open and overturned, and people and animals dead in the hedgerows. Even the branches of the highest trees contained a number of cows, sheep and chickens. In Ireland, the unusual cold and constant rain ruined the hay, and in 1640 farmers resorted to dried fish for fodder for their cattle. Perhaps most striking of all, a soldier serving in central Germany recorded in his diary in August 1640 that 'in this time there was such a great cold that we almost froze to death in our quarters and, on the road, three people did freeze to death: a cavalryman, a woman and a boy'; while 1641 remains the coldest ever recorded in Scandinavia.9

Data from the southern hemisphere reveal a similar climatic aberration. In Chile, drought in the 1630s led the chief inquisitor to apologise to his superiors that he could not send them any protocols from Lima and confessions because 'for the past three years we have not collected a penny on account of the drought'; while glaciers, tree rings and carbon-14 deposits all show significantly cooler weather in Patagonia in the 1630s.10 In Sub-Saharan Africa, a severe drought afflicted both Senegambia and the Upper Niger between 1640 and 1644; while Angola records a unique concentration of droughts, locust infestations and epidemics throughout the second quarter of the seventeenth century, with a major drought and famine in 1639–45.

The decade ended with another bout of extreme weather around the globe. In 1648, on the Isle of Wight in southern England, a local landowner lamented that 'from May till the 15th of September, we had scarce three dry days together', and when a visitor asked him 'whether that weather was usual in our island' I told him that in this forty years I never knew the like before. Meanwhile, in Scotland, 'The long great rains for many weeks did prog nosticate famine', and produced 'so great a death of corn as Ireland has not seen in our memory, and so cruel a famine, which has already killed thousands of the poorer sort'.11 The following
winter, the river Thames froze over as far as London Bridge and the barges carrying the cargoes of Charles I to its final resting place after his execution on 30 January 1649 avoided ice floes in the river only with difficulty. Other parts of northwest Europe also experienced unusual precipitation that year—226 days of rain or snow according to a meticulous set of records from Fulda in Germany (compared with an upper limit of 180 days in the twentieth century)—followed by ‘a winter that lasted six months’. In France, appalling weather delayed the grape harvest into October in 1648, 1649 and 1650, and drove bread prices to the highest levels in almost a century, while floods covered central Paris for much of spring 1649. In China, the winter of 1649–50 seems to have been the coldest on record.13

The 1650s brought no respite. In the Dutch Republic, so much snow fell early in 1651 that the state funeral of Statesman William II had to be postponed because mourners could not reach The Hague, and then the combination of snowmelt and a strong tide caused the worst flooding for 80 years in coastal regions. Catastrophic floods caused by snowmelt also occurred along the Vistula and the Seine. Conversely, 1651 saw the longest recorded drought in Languedoc and Roussillon, the Mediterranean borderlands between France and Spain: 360 days, or almost an entire year. In the Balkans, in spring 1654 ‘it snowed abundantly, [and] the snow covered the ground until Easter. I have never before seen such snowstorms and frost, moisture and cold’. Even olive oil and wine got frozen in the jar! England experienced an ‘unusual drought’, which has lain upon us for some years, and still continues and increases upon us, threatening famine and mortality’; while in 1658 John Evelyn judged that he and his compatriots had just lived through ‘the severest winter that man alive had known in England: the crow’s feet were frozen to their pretty islands of ice enclosed both fish and foul frozen, and some persons in their boats’.14

The same ‘landmark winter’ of 1657–8 affected other parts of the northern hemisphere. Along America’s Atlantic coast, Massachusetts Bay froze over while the Delaware river froze so hard that deer ran across it. In Europe, people rode their horses on the ice across the Danube at Vienna, across the Main at Frankfurt and across the Rhine at Strasbourg, while barge traffic along the rivers and canals of the Netherlands gave way to sledges. The canal between Haarlem and Leiden remained frozen for 63 days. A Swedish ambassador returning home from Edirne (modern Turkey-in-Europe) noted in February 1658 that the weather was so cold that even migrating birds turned back, ‘causing everyone to wonder’, while the Baltic froze so hard that a horse and cart could pass easily from the mouth of the Vistula at Danzig to the Hell Peninsula, and the Swedish army with all its artillery marched 20 miles over the Danish Sound from Jutland to Copenhagen. Inevitably, the following spring brought disastrous flooding as the snow and ice melted. The Seine again inundated Paris and many other towns, while the dikes in the Netherlands broke in 22 different places. Louis van Altena, the official historian of the Dutch Republic, devoted two pages of his chronicle to the extreme climatic events around Europe during 1658, a year in which the winter was as harsh and severe at the beginning as at the end.15
far because of the cold.' Meanwhile, in the Sahara, drought in the 1680s became so severe and so widespread that Lake Chad fell to its lowest recorded level.16

Two artefacts from these years still strikingly reflect the unusually cold climate that prevailed. First, the abnormal frost, snow and ice gave rise to the popular genre of 'winter landscapes' by Dutch painters; most art galleries possess at least one, and almost all date from the later seventeenth century. Second, the wooden backs of the peerless violins made by Antonio Stradivari of Cremona in northern Italy display remarkably narrow growth rings, reflecting the unique succession of cold summers in the mid-seventeenth century that stunted the growth of the trees with which he worked.

So much abnormal weather led some contemporaries to suspect that they lived in the middle of a major climate change. In June and July 1675 (the century's second 'year without a summer'), the Paris socialite Mademoiselle de Sévigné complained to her daughter, in Provence, that 'it is horribly cold: we have the fire lit, just like you, which is very remarkable'...and speculated that 'like you, we think the behaviour of the sun and of the seasons has changed.' A generation later the Kangxi emperor, who collected and studied weather reports from all over China, noted how the climate has changed: For example, His Majesty noted, 'in Fujian, where it never used to snow, since the beginning of our dynasty [1666], it has.'

The Search for Scapegoats

Early modern people had good reason to monitor and to fear climate change. In the eloquent assessment of historian Thomas C. Smith:

'Farming, with its allied tasks, was the principal occupation and nearly the sole source of income for most families, and its rhythms defined the annual cycle of work, rest and worship. Severe annual variations in the harvest reverberated through family life, determining whether the family ate well or meagerly, whether the old might live another winter, whether a daughter could marry.'

Men and women therefore searched anxiously for explanations.

Many attributed natural disasters to divine displeasure. In China, the heavy and prolonged snows in 1641–2 convinced the scholar Qi Baozhi that 'Heaven is extremely angry'; somewhat later, the Kangxi emperor claimed that 'If our administration is at fault on earth, Heaven will respond with calamities from above'...while Chinese folk song from the period reproached the Lord of Heaven for the catastrophic conditions:

Old empress, you're getting on
Your sun is dead, your eyes are gone.
Can't see people, can't hear words.
Glory for those who kill and burn;
For those who fast and read the scriptures.
Starvation.

Similarly, a Jesuit living in the Philippines speculated that the simultaneous eruption of three volcanoes in 1641 meant that 'Divine Providence wishes to show us something, perhaps to warn us of some approaching catastrophe, which our sins so deserve, or the loss of some territory, because God is angry.'

Such statements reflected the prevailing 'pseudoscientific' outlook (from precurium, the Latin word for 'air'): attributing disasters, including military defeats as well as bad weather and famine, to human misconduct. A circular letter written in 1648 by a new president of the Council of Castile, the minister responsible for internal affairs, was typical: "The principal cause of the calamities that afflict this kingdom are the public sins and injustices committed, and punishing the former and administering justice with due rectitude and speed are the most important ways to oblige Our Lord to provide the successes that this Monarchy needs so much." In Germany the Protestant magistrates of Nuremberg commanded citizens to avert divine displeasure by showing moderation in food, drink and fashion and by refraining from sensual pleasure (especially if it involved adultery, sodomy or dancing). For the same reason, their Catholic neighbour, Maximilian of Bavaria, issued a stream of orders that forbade dancing, gambling, drinking andextramarital sex; limited the duration and cost of wedding festivities; forbade women to wear skirts that revealed their knees; proscribed the joint bathing of men and women; and periodically prohibited carnal and festivities at Christmastime. The same logic appears in an edict issued by the English Parliament in 1642:

'Whereas the distressed state of Ireland, steeped in her own blood, and the distressed 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 spars 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.'

Parliament would later ban Maypoles and prohibit the celebration of Christmas, and in 1648 it "authorized and required" the magistrates of London 'to pull down and demolish' all theatres, to have all actors publicly whipped, and to fine all players, because they tended to the high provocation of God's wrath and displeasure, which lies heavy upon this Kingdom.'

The search for scapegoats targeted individuals as well as activities. In Europe, the climatic and economic disasters of the mid-seventeenth century fed a 'witchcraft' in which thousands of people were tried and executed because their neighbours blamed them for causing their misfortunes. Most of the victims were women, many of whom unable to support themselves enslaved, many lived in marginal areas for crop cultivation - in Lorraine, the Rhine and Main valleys for vines; in Scotland and Scandinavia for cereals - where the impact of global cooling was felt first and worst. Thus in southern Germany, a hailstorm in May 1626 followed by Arctic temperatures led to the arrest, torture and execution of 900 men and women suspected of producing the calamity through witchcraft. Two decades later, the Scottish Parliament likewise blamed a winter of heavy snow and rain followed by a cereal
harvest of small bullae" on the sin of witchcraft (which daily increases in this age), and, to evict more divine displeasure, it authorized more executions for sorcery than at any other time in the country's history. A 'witch panic' also gripped the Husto of North America between 1635 and 1645, although most of the accused were men, while in China, too. "To anyone oppressed by tyrannical liensmen or grasping creditors, a witchcraft accusation offered relief. To anyone who feared prosecution, it offered a shield. To anyone who needed quick cash, it offered rewards. To the envious it offered redress to the bully, power; and to the sadist, pleasure." The popularity of stage plays, sodomy and society as explanations for catastrophe in the seventeenth century paled in comparison with five 'natural' scapegoats: stars, eclipses, earthquakes, comets and sunspots. In Germany, a Swedish diplomat wondered in 1648 whether the state of contemporaneous rebellions might 'be explained by some general configuration of the stars in the sky,' while, according to a chronicler in Spain, only 'the malign influence of the stars' could explain the coincidence that 'in a single year [1647–8] in Naples, Studly, the Papal States, England and France, such atrocities and extraordinary events' had occurred. A few years later, the Italian historian Maqloino Magistrone likewise argued that only 'the influence of the stars' could have created so much 'wrath among the people against the governments' of his day."

Others blamed eclipses. The author of a Spanish almanac felt complete confidence that a recent eclipse of the sun had produced 'great upsets in war, political upheavals and damage to ordinary people' between March 1640 and March 1642 (as well as future catastrophes meticulously charted down to the year 2400). A similar English compilation predicted that the two lunar eclipses and unusual planetary conjunction forecast for 1642 would bring 'many strange accidents', namely 'sharp tertian fevers, war, famine, pestilence, house-burnings, rapes, depopulations, manslaughter, secret seditions, banishments, imprisonments, violent and unexpected deaths, robberies, thefts and piratical invasions'. An otherwise hard-boiled chronicler writing two years after the Naples revolution of 1647 blamed it all on a recent solar eclipse, while in Iran, another solar eclipse in 1644 led some 'Persian wise men' to assert that it meant 'that the King had died; others said that there would be a war and blood would be shed; still others said wholesale deaths would occur.' In India, even the Mogul emperors took special precautions during eclipses, staying indoors and eating and drinking little, while in Paradise Lost, composed between 1658 and 1663, John Milton noted the popular panic whenever the sun

...from behind the Moon
In dim eclipse disconsolate skies shed
On half the Nations: and with fear of change
Perplexes Monarchs."

Many seventeenth-century people also speculated that earthquakes and comet presaged catastrophe — perhaps because the frequency of both increased notably. Thus an account of the destruction wrought by an earthquake, volcano and tsunami...
for the deposition of one sultan in 1618, the murder of another in 1622, and the provincial revolts that followed.22

Belief in the taleful effects of the comets of 1618 proved remarkably enduring. In 1643 a Dutch pamphleteer claimed that the

Star with a tail, seen in the year 1618, was a warning and type of a rod that should come over all Christendoms, whereupon followed those bloody effects, those horrible wars, lamentable sufferings, barbarous destruction of countries and cities, the ruin of so many costly buildings, of so many gentlemen, so many inhabitants, men and women, young and old, in Germany.

In 1649 a London newspaper considered that the end of the Thirty Years War the previous year was 'foretold by the Blazing Star which, in the year the war began, appeared over Europe for thirty days and no more'. A generation later in Boston, Massachusetts, the Reverend Increase Mather devoted three pages of his Kalendaria, or a discourse concerning comets to the 'prodigy' of 1618 which, he claimed, had 'caused' not only a major drought throughout Europe, an earthquake, in Italy, a plague in Egypt and 'the Bohemian and Germanic war, in which rivers of blood were poured forth', but also 'a plague amongst the Indians here in New England which swept them away in such numbers, as that the living were not enough to bury the dead'.

Some contemporaries blamed the catastrophe that afflicted them on a combination of these natural phenomena. A popular Chinese encyclopedia argued that when Venus has dominated Heaven, wars have arisen on a great scale, and that when comets have dominated Heaven, there have been conflicts over the succession to the throne; while the Spanish almanac of 1640 already quoted reminded readers that 'whencever eclipses, comets and earthquakes and other similar prodigies have occurred, great miseries have usually followed. In 1638 Robert Burton's Anatomy of Melancholy provided the most comprehensive 'catastrophe catalogue' of all. He felt sure that

The heavens threaten us with their comets, storms, planets, with their great conjunctions, eclipses, oppositions, quarrels, and such unkindly aspects. The air with its meteors, thunder and lightning, intertemperate heat and cold, rainy winds, tempests, unreasonable weather; from which proceed death, famine, plague, and all sorts of epidemic diseases, consuming infinite myriads of men.

Others doubted such precise links. One Italian historian expressly ridiculed the idea that 'certain celestial constellations have the power to move the spirits of the inhabitants of a country to seditions, tumults and revolutions' in many different places at once; while the comets of 1618 provoked animated debates between the astronomers and astrologers over whether or not they were capable of causing 'catastrophes'. Such uncertainty prompted a handful of observers to suggest an alternative natural scapegoat for the extreme weather of the seventeenth century: fluctuations in the number of sunspots—those dark regions of intense magnetic activity on the solar surface surrounded by 'flares' that make the sun shine with greater intensity. Even though they incorrectly argued that more sunspots would produce cooler temperatures on earth (whereas the reverse is true), unlike comet and star-gazers, the early solar astronomers had stumbled upon an important cause of climate change in the seventeenth century.

The development of telescopes as astronomical instruments after 1609 enabled astronomers to track the number of sunspots with unprecedented accuracy. They noted a maximum between 1612 and 1614, followed by a minimum with virtually no spots in 1617 and 1618, and markedly weaker maxima in 1625–6 and 1637–9. And then, although astronomers around the world made observations on over 8,000 days between 1645 and 1715, they saw virtually no sunspots: the grand total of sunspots observed in those 70 years scarcely reached 100, fewer than currently appear in a single year. This striking evidence of absence suggests a reduction in solar energy received on earth.

Four other sets of data confirm this hypothesis. First, trees (like other plants) absorb carbon-14 from the atmosphere, and the amount rises as solar energy received on earth declines; and many tree-rings laid down in the seventeenth century contain increased carbon-14 deposits, which suggests reduced global temperatures. Secondly, between October 1643 and October 1644, Johannes Hevelius of Danzig made daily drawings of the sun that recorded the precise location of all spots, and he later printed his findings in a series of 26 'composite disks' that showed not only the number but also the movement of the spots over a few days (Plate 1). Hevelius's 'disks' reveal that sunspots were already rare; he seldom saw more than one or two groups at a time. Third, the aurora borealis (the 'northern lights' caused when highly charged electrons from the magnetosphere interact with elements in the earth's atmosphere) became so rare that when the astronomer Edmund Halley saw an aurora in 1716 he wrote a learned paper describing the phenomenon—because it was the first he had seen in almost fifty years of observation. Finally, neither Halley nor other astronomers between the 1640s and the 1700s mentioned the brilliant corona nowadays visible during a total solar eclipse; instead they reported only a pale ring of dull light, reddish and narrow, around the moon. All four phenomena confirm that the energy of the sun diminished between the 1640s and the 1710s, a condition normally associated with both reduced surface temperatures and extreme climatic events on earth.

A further astronomical aberration also troubled seventeenth-century observers living in the northern hemisphere: the appearance of 'dust wells' in the sky that made the sun seem either paler or redder than usual. Thus a Seville shopkeeper lamented that during the first six months of 1649 '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'. Thousands of miles to the east, Korea's royal astronomers reported darkened skies during the daytime on 38 occasions during the seventeenth century. On some days they recorded that 'the skies all around are darkened and grey as if some kind of dust had fallen'. Both the dust and the reddened skies stemmed from an unusual state of major volcanic eruptions in the mid-seventeenth century. Each hurled sulphur dioxide into the stratosphere where it reflected some of the sun's radiation back into
space and, thus, significantly reduced temperatures in all areas of the earth beneath the dust clouds.

Vivid descriptions have survived for two of these volcanic eruptions. In February
1640, in Chile, Mount Villarica 'began to erupt with such force that it expelled
burning rocks ... So much burning ash fell into the river Aleyen that the water
burned in such a way that it cooked all the fish there.'60 Less than a year later, on
the other side of the Pacific, a Spanish garrison in the southern Philippines saw one day
at noon 'a great darkness approaching from the south which gradually extended over
that entire hemisphere and blocked out the whole horizon. By 1 p.m. they were
already in total night and at 3 p.m. they were in such profound darkness that they
could not see their own hands before their eyes.' Ash fell on them for 12 hours until,
early the following morning, 'they began to see the moon.' They had just witnessed
a 'force six' eruption, an event so terrifying that the authorities in Manila mounted
an inquiry in which various priests and other trustworthy people testified that the
eruption was heard at exactly the same time 'throughout the Philippines and the
Melaccas, and as far as the Asian mainland, in the Kingdom of Cochino-China,
Champa and Cambodia — a radius of 900 miles, a wondrous thing which seems to
exceed the bounds of the natural world.'61 The dust veils produced by the 12 known
volcanic eruptions around the Pacific between 1638 and 1644 (apparently an all-
time record) combined with the sunspot minimum both to cool the earth's atmos-
phere and to destabilize its climate (Fig. 2).

Blame it on El Niño?

The global cooling caused by reduced sunspot and increased volcanic activity seems to
have triggered a dramatic change in the climatic phenomena known as El Niño.
In normal years, the surface air pressure in the equatorial region of the Pacific is
higher in the east than in the west, which means that easterly winds blowing from
America to Australia and South East Asia prevail. In cooler years, however, surface
air pressure in the equatorial region of the Pacific falls in the east and rises in the
west, so the pattern reverses: westerly winds blowing from Asia to America prevail.
El Niño episodes dramatically affect the world's climate. As the air above the equato-
rial Pacific warms each spring it creates massive rain clouds: in a normal year, these
fall on Asia as the 'monsoon', which nurtures the harvest, but in an El Niño year the
monsoon weakens and heavy rains fall instead on America, causing catastrophic
floods. Today this reversal — also known as ENSO (El Niño-Southern Oscillation)
— happens about once every five years, but in the mid-seventeenth century it
happened twice as often: in 1638, 1639, 1641, 1642, 1646, 1650, 1651, 1652,
1659, 1660 and 1661. This same period saw some of the weakest East Asian
monsoons of the past two millennia.62

Admittedly historians cannot 'blame El Niño' for everything. Some regional
climes are El Niño sensitive; others, even though contiguous, are not. Thus, in
southern Africa, the eastern Cape is susceptible to El Niño-related droughts whereas
the western Cape is not; likewise, droughts in northeast Brazil appear to occur in El

3. Sunspot cycles, volcanic cycles, and summer temperature variations in the seventeenth
century. The number of sunspots observed and recorded by European astronomers (top) shows the
Mainland Minimum (1643-7715), in which fewer sunspots appeared in seventy years than appear in a
single year now. Measurements of volcanic deposits in the polar icecap (the 'Geo-Volcanic Index')
reveal a peak in the 1640s. Both phenomena show a striking correlation with lower summer
temperatures in the northern hemisphere.
The Placenta of the Crisis

Nineteen years but those in western Mexico do not. The global footprint of El Niño normally includes three regions besides the lands adjoining the Pacific: the Caribbean suffers floods; Ethiopia and northwest India experience droughts, and Europe suffers hard winters. In most of the 20 El Niño episodes recorded between 1618 and 1669, and in all 12 between 1638 and 1661, each of these regions experienced adverse weather.

The changed weather conditions in the Pacific Ocean during this period emerge starkly from two anomalies recorded in historical sources. On the one hand, the coastal province of Guangdong in southern China suffered more typhoons and falls between 1660 and 1680 than at any other time in recorded history. On the other hand, the voyages of galleons sailing from Acapulco in Mexico to Manila in the Philippines took longer than in any other period. In the first and last decades of the seventeenth century the crossing took an average of 80 days (a few took only 50 days), but between 1640 and 1670 the average duration rose to over 130 days (and three took over 160). Some ships never arrived: of the 11 galleons known to have sunk or run aground before reaching Manila during the seventeenth century, nine did so between 1639 and 1671. The return voyage from Manila to Acapulco also took much longer: the average duration rose from 160 to over 200 days, and the longest voyages ever recorded (240 days, or eight months) took place in the 1660s. Nothing except a major shift in wind patterns could explain such a dramatic change. Diego de Villatoro, a crown official who had made the voyage twice, saw the connection clearly. In a memorial written in 1676 he noted sadly that 'now we consider a voyage from the Philippines to Acapulco that takes less than seven months to be good, and he perceptively ascribed the longer duration 'to a change in the monsoons'.

Villatoro, of course, lacked the expertise either to blame this change on the increased frequency of El Niño activity or to associate El Niño with reduced solar activity, weaker Asian monsoons and increased volcanic activity. But we now know that in 'normal' years, when easterly winds prevail, the Pacific stands some 24 inches higher off the Asian than off the American coast, whereas in El Niño years, when westerly winds prevail, those levels reverse. The movement of such a huge volume of water places enormous pressure on the edges of the earth's tectonic plates around the Pacific periphery, where the most violent and most active volcanoes in the world are located, and this may trigger a spate of eruptions. If this hypothesis is true, it creates a deadly cycle:

- Reduced solar energy received on earth lowers temperatures, which increases the risk of more, and more severe, El Niño events.
- El Niño events may trigger volcanic eruptions around the Pacific that throw sulphur dioxide into the stratosphere, which further reduces the solar energy received on earth.
- El Niño activity becomes twice as likely after a major volcanic eruption.

Whatever the exact connections between these natural phenomena (and not all scientists agree), the mid-seventeenth century certainly experienced both an unusual spate of earthquakes, fireball flares, volcanic eruptions and El Niño episodes, and a drastic reduction in sunspot activity, the weakest monsoons and some of the lowest global temperatures recorded in the past few centuries.

Climate and Crops

So what? To a sceptic, 'global cooling' that amounts to a fall of only one or two degrees Celsius in mean summer temperatures, and a modest glacier advance, may seem insignificant; but that is to think in linear terms. On the one hand, the mean global temperature has shown remarkable stability over the last six millennia: the difference at the equator between the Medieval Optimum (the hottest temperatures recorded until the late twentieth century) and the Little Ice Age was probably less than 3°C. A change of even one degree is thus highly significant. On the other hand, in the northern hemisphere, home to the majority of humankind and site of most of the wars and revolutions of the seventeenth century, solar cooling reduces temperatures far more than at the equator, in part because increased snow cover and sea-ice reflect more of the sun's rays back into space. The extension of the polar icecaps and glaciers in the mid-seventeenth century would thus have reduced mean temperatures in northerly latitudes dramatically.

A recent 'model' of the probable global climate in the late seventeenth century shows significantly colder weather in Siberia, North Africa, North America and northwest India; colder and drier weather in central China and Mongolia; and cooler and less stable conditions in the Iberian Peninsula, France, the British Isles and Germany. As already noted, these same areas – the Russian and Ottoman empires in Eurasia, the Ming and Qing states in East Asia and the dominions of Philip IV, Charles I, Louis XIV and Ferdinand II in Europe – reported not only cooler weather in the 1640s and 1650s but also a significant number of extreme weather events and serious political upheavals. The former should cause no surprise: an overall decline in mean temperatures is normally associated with a greater frequency of severe weather events – such as flash floods, freak storms, prolonged droughts and abnormalities (as well as abnormally long) cold spells. All of these climatic anomalies can critically affect the crops that feed the people.

In the 'temperate zone', which stretches roughly from 30 to 50 degrees of latitude, crop yields suffer disproportionately from a cold spell during germination, a drought in the early growing season and a major storm just before harvest. To take a single example, a Gazetteer from Zhejiang in eastern China reported that 'When on the 13th day of the 5th moon in 1640 the fields were inundated, those who had planted out on the 12th or earlier had no disaster once the flood had subsided, but those who planted on or after the 13th lost everything.' An unseasonal frost could prove equally disastrous. In areas of wet rice cultivation, a fall of 0.5°C in the average spring temperature prolongs the risk of the last frost by 10 days, while a similar fall in the average autumn temperature advances the risk of the first frost by the same amount. Either event suffices to kill the entire crop. Even without frosts, a fall of 2°C during the growing season – precisely the scale of global cooling in the 1640s – reduces rice harvest yields by between 30 and 50 per cent, and also lowers
the altitude suitable for wet-rice cultivation by about 1,300 feet. Likewise, in cereal-growing regions, a fall of 2°C shortens the growing season by three weeks or more, diminishes crop yields by up to 15 per cent, and lowers the maximum altitude at which crops will ripen by about 300 feet. Drought, too, destroys harvests by depriving crops of the precipitation they required. As a Chinese manual of agriculture, published in 1637, warned: 'All rice plants die if water is lacking for ten [consecutive] days.'

Extreme weather could also destroy crops indirectly. Excessive rain might allow rodents to multiply. In Moldavia in 1670 'thousands of mice' not only ate 'all they found in the vegetable gardens' but also, 'climbing up the trees, ate all the fruit, finishing them up, and to end the job they finished the wheat in the field.' Drought favoured locusts. In 1647 the Moldavian nobleman Miron Costin reported that 'about the time of the year when people pick up their sickles to harvest the wheat', he and some companions were on the road and 'suddenly noticed a cloud towards the south: We thought it was a rainstorm until we were suddenly hit by the locust swarm, coming at us like a flying army. The sun disappeared immediately, veiled by the blackness of these insects. Some of them flew high, at three or four metres, while others flew at our level, or even right above the ground... They flew around us without fearing anything... It took an hour for a swarm to pass, and then after an hour and a half there came another, and then another, and so on. It lasted from noon till dusk. No leaf, no blade of grass, no hay, no crop, nothing remained.'

In latitudes north of the 'temperate zone', where the growing season is shorter, the impact of climate change on crop cultivation increases. First, it radically reduces yields. In Manchuria, with a total of only 150 frost-free days in every good year, a fall of 2°C in mean summer temperature reduces harvest yields by a stunning 80 per cent. In Finland, the growing season even in 'normal' years is the shortest compatible with an adequate harvest so that even a single summer night's frost can kill an entire crop. Seventeenth-century Finland saw 11 crop failures (compared with only one in the eighteenth century). Second, global cooling increases the frequency of harvest failure in northern latitudes.

- In the 'temperate zone', if early winters or summer droughts occur with a frequency of P = 0.1, the harvest will fall once every 10 years, and two consecutive harvests will fall once every 100 years. If, however, early winters or summer droughts occur with a frequency of P = 0.2, the harvest will fail once every 5 years (double the risk) while two consecutive harvests will fail every 25 years (quadruple the risk).

- In latitudes north of the 'temperate zone', each fall of 0.5°C in mean summer temperatures decreases the number of days on which crops ripen by 10 per cent, doubles the risk of a single harvest failure, and increases the risk of a double failure six-fold.

- For those farming 1,000 feet or more above sea level, a fall of 0.5°C in mean summer temperatures increases the chance of two consecutive failures 100-fold.

In densely populated parts of the early modern world, whether sub-boreal, temperate or tropical, most people relied on a single crop, high in bulk and in carbohydrates, known as a ' staple'. Cereals (wheat, rye, barley and oats) formed the principal staple in Europe, northern India and northern China. Rice occupied the same role in Southeast Asia, maize in the Americas, and millet in upland India and Sub-Saharan Africa. The economic allure of staple crops is almost irresistible to farmers. An acre under cereals feeds between ten and twenty times as many people as an acre devoted to animal husbandry; furthermore, the same amount of money usually bought 10 pounds of bread but only 1 pound of meat. An acre planted with wet-rice yields up to 6 tons of food — three times as much as an acre of wheat or maize and sixty times as much as an acre devoted to animal husbandry. Not surprisingly, therefore, according to a Chinese textbook printed in 1637, '70 per cent of the people's staple food is rice', while in Europe, cereals likewise provided up to three-quarters of the total calorie intake of every family (not only in the form of bread but also as a 'killer' for soups and as the basic ingredient for beer and ale).

Steven Kaplan has rightly insisted on the 'synergy' of popular dependence on staple crops — cereals, rice, maize or millet, depending on the region — in the pre-industrial world in Europe. Cereal dependence conditioned every phase of social life. Grain was the pilot sector of the economy, beyond its determinate role in agriculture, directly and indirectly grain shaped the development of commerce and industry, regulated employment, and provided a major source of revenue for the state, the church, the nobility, and large segments of the Third Estate... Because most of the people were poor, the quest for subsistence preoccupied them relentlessly. No issue was more urgent, more pervasively felt, and more difficult to resolve than the matter of grain provisioning. The dread of shortages and hunger haunted this society. 'Shortage and hunger' could arise in three distinct ways. First, throughout the early modern world, food accounted for up to half the total expenditure of most families, and so any increase in staple prices caused hardship because most families had little spare cash and soon faced the risk that they could not feed themselves. Second, spending more on food left little or nothing with which to purchase other goods, leading to a fall in demand: this meant that many non-agricultural workers lost their jobs and reduced the wages received by the rest — that is, their income fell just as their expenditure rose. Third, since the impact of harvest failure on the price of cereals is non-linear, any shortfall in the harvest reduced the food supply geometrically and not arithmetically. Suppose that

- In a normal year a European farmer sowed 50 acres with grain and harvested 10 bushels an acre, a total of 500 bushels. Of this, he needed 175 bushels for animal fodder and feed corn and 75 bushels to feed himself and his family — a total of 250 bushels — leaving 250 for the market.
If bad weather reduced his crop by 30 per cent, the harvest would produce only 350 bushels yet the farmer still needed 250 of them for his immediate use. The share available for the market therefore dropped to 100 bushels—a fall of 60 per cent.

But if bad weather reduced crops by 50 per cent, the harvest would produce only 250 bushels, all of them needed by the farmer, leaving virtually nothing for the market.

This non-linear correlation explains why a 30 per cent reduction in the grain harvest often doubled the price of bread, whereas a 50 per cent reduction quintupled it. It also explains why, if the harvest failed for two or more consecutive years, starvation almost always followed.

Steven Kaplan concluded his study of famines in eighteenth-century France by suggesting that this cruel calculus produced a chronic sense of insecurity that caused contemporaries to view their world in terms that may strike us as grotesquely or histrionically overdrawn. However, a study by Alex de Waal of the Darfur famine of 1984–5 in East Africa rejected the notion of ‘overdrawn’ where harvest shortfalls are concerned because, even today, failures can cross a threshold of awfulness and become an order of magnitude worse. Not only do large numbers of people die, so does their entire way of life.

De Waal identified three characteristics of these ‘landmark famines’:

1. First, they force those affected to use up their assets, including investments, stores and goods. Although a family might choose to go hungry for a season in order to preserve its ability to function as a productive unit (for example by keeping back grain to feed livestock or to use as seed corn instead of eating it all), it can rarely maintain that strategy for a second, let alone a third year. Two or three successive harvest failures therefore leave victims permanently destitute.

2. Second, prolonged starvation also forces those affected to use up their social claims (‘entitlements’). A hungry family may refrain from begging for assistance from other individuals and institutions for a short period, but once again it can rarely maintain that strategy for long. If a large number of families suddenly becomes destitute, it may cripple and even destroy the communities in which they live.

3. Third, as communities cease to be viable, some families migrate. Initially, migration may form a reasonable ‘coping strategy’ in a famine because, although the migrants necessarily abandon both their assets and their ‘entitlements’ by leaving their local community, those who survive can return to their homes and their previous way of life when conditions improve. Prolonged death, however, will sever the links with the world they have left and thus, according to De Waal, lead to the ‘mortality’ of their entire way of life.

Calories and Death

Each day, every human needs to consume at least 1,500 calories to maintain her or his basic metabolic functions and to resist infection. Pregnant women and those who earn their living by physical labour require at least 2,500 calories. Few people

in the early modern period were so lucky: during the Italian plague of 1630–1, hospital records show that each patient received a daily ration of half a loaf of bread, a quarter of a kilo of meat (probably in a stew), and half a litre of wine—a daily intake of scarcely 1,500 calories (and one seriously deficient in vitamins). Even the ‘normal’ years of the seventeenth century, the average Frenchman consumed barely 900 calories more than his basic metabolic requirement, and the average Englishman barely 700 calories more.

Two short-term ‘safety mechanisms’ help humans to adjust to malnutrition. We may cut back on energy demands (working more slowly, resting longer) and, as body weight declines, we can get by with fewer calories to sustain the basic metabolism (and the reduced physical activity). Nevertheless, in the long term, even a small reduction in our daily caloric intake can have dramatic consequences. A decrease of one-fifth, from 2,500 to 2,000 calories, halves our ability to work efficiently because the body’s basic metabolism still requires 1,500 calories. In the case of a pregnant woman, a similar reduction impairs the health of both mother and child. Furthermore, a weight loss of 10 per cent reduces energy by about one-sixth, but a weight loss of 20 per cent reduces energy by about one-half, and if a woman or man loses 30 per cent of their normal body weight, blood pressure falls and the ability to absorb nutrients fails.

In this weakened condition, any additional stress on the body, such as disease, usually proves fatal—and, amid the social disruption normally associated with famine, infectious diseases often spread rapidly—while cold and damp further weaken those who are starving. According to a report on an Indian famine in the nineteenth century, the most common termination of life in those debilitated by famine was diarrhea or dysentery, aggravated by damp and exposure... Cold and damp had a most detrimental effect upon the starving poor, and those in a physically reduced condition from chronic insufficiency of food. Observers in the seventeenth century described the same fatal decline. According to Yang Dongming, a government official and philanthropist in central China:

All beings are physically the same, alike in their intolerance of cold. Those people with old, tattered clothing... go nearly naked in the dead of winter, their hair dishevelled and feet bare and their teeth chattering, crying out and terrorised... Being solitary, they have no place to go... and falling snow covers their bodies. At this point, their organs freeze and their bodies stiffen like pieces of wood. At first they are still able to groan. Gradually they cough up phlegm. Then, their lives are extinguished.

Five thousand miles to the west, Sir Robert Sibbald, a Scottish physician and geographer lamented that

The bad seasons these several years past hath made so much scarcity and so great a death that for want, some die by the way-side, some drop down on the streets, the poor sucking babes are starving for want of milk, which the empty breasts of their mothers cannot furnish them. Every one may see death in the face of the poor
that abound everywhere: the thinness of their visage, their ghastly looks, their feebleness, their airs and their fluxes threaten them with sudden death, if care be not taken of them. And it is not only common wandering beggars that are in this case, but many housekeepers who lived well by their labours and industry are now by want forced to abandon their dwellings and they and their little ones must beg.26

Famines afflicted 'little ones' with especial severity. Starvation killed many infants because their mothers had no milk to feed them; but, famished children, especially when they are also cold and exposed to disease, suffer 'stunting'. Because simply staying alive and keeping warm absorbs so many calories, and a famine diet usually lacks adequate protein and vitamins, the long bones in the legs and arms of children cease to grow. Human remains from the Little Ice Age show unmistakable evidence of such 'stunting'. When archaeologists excavated the skeletons of 50 workers buried in the permafrost at Sinnerøya ('Blubbe' Towner), a whaling station maintained by the Dutch on Spitsbergen Island in the Arctic between 1615 and 1670 (when the intolerable cold forced them to withdraw), no fewer than 43 showed evidence of stunting and a corresponding reduction in height.27 Even more striking, French soldiers born in the second half of the eighteenth century were on average about an inch shorter than those born after 1700; and those born in famine years were notably shorter than the rest. Thus 'stunting' reduced the average height of those born in 1675, the 'year without a summer', or during the years of cold and famine in the early 1690s, to only 63 inches, the lowest ever recorded. Once warmer weather and better harvests returned in the eighteenth century, the average height of Frenchmen increased by almost 1.5 inches — an unparalleled surge — and the 'bantam soldiers' never reappeared (Fig. 3).

'Sturning' does not only adversely affect the long bones of children: because malnutrition often impairs the development of major organs as well as long bones, it makes children more vulnerable to both contagious and chronic diseases, which can in turn further diminish stature. Children living in the countryside might experience a catch-up growth spurt, which partially compensates for stunting, but those living in overcrowded and insanitary towns often stayed short (which probably explains why recruits for the French Army from Paris were always shorter than the rest). John Koroloff, the demographer whose research revealed the reduced height of Louis XIV's soldiers, was surely correct that the seventeenth-century crisis 'had an immense impact on the human organism itself'. His data provide perhaps the clearest — and saddest — evidence of the consequences of the Little Ice Age for the human population. The repeated famines not only killed: many of those who survived literally embodied Thomas Hobbes's assertion that 'the life of man had indeed become solitary, poor, nasty, brutish and short'.28

An Overpopulated World?

Although Hobbes and his contemporaries apparently stood somewhat shorter than their grandparents, they were far more numerous. A run of warm summers in the

3. Estimated heights of French males born between 1650 and 1770. John Koroloff assembled 30,780 'observations' from the personal records of French males who enlisted in the army between 1671 and 1786. Even though recruiting officers rejected the shortest volunteers, the 'stunting' effect of global cooling is evident, especially for those born in 1675, the 'year without a summer' (one of two experienced in the eighteenth century). The average height of Louis XIV's soldiers was 6'17" tall, or 5 foot 3 inches.

sixteenth century had allowed the human population in most parts of Europe and Asia to increase and in some areas to double — until by 1618 China boasted perhaps 150 million inhabitants, India 116 millions and Europe 100 million. In some areas, the number of inhabitants had increased so fast that local resources no longer sufficed to feed them because of another cruel calculus: population increases geometrically while agricultural output grows only arithmetically. Just like 'compound interest', a sustained demographic increase of 1 per cent per year over a century causes a population not merely to double, but to triple; while a 2 per cent increase over a century produces a sevenfold growth. Since crop yields rarely increase at this pace, food shortages can occur very rapidly.

Many people in the early seventeenth century realised that their part of the world possessed more mouths than could be fed, and feared the consequences. China's Lower Yangzi valley known as Jiangnan, boasted a population of about 20 million by 1618, equivalent to almost 1,200 persons per square mile (by way of comparison, the overall population density of the modern Netherlands, the most densely settled part of Europe today, is 1,000 persons per square mile). According to Álvaro Semedo, a Portuguese Jesuit long resident in the region who wrote in the 1630s, Jiangnan was '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, 'settlement is almost continuous.' Indeed, he noted:

'This kingdom is so overpopulated (accruminat popula) that after living there for twenty-two years, I remain almost as much 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,' Semedo concluded, 'there can be no capital sufficient for so many, or money enough to fill so many purses.'

Many of Semedo's contemporaries also considered Europe 'overpopulated.' John Winthrop justified the plantation of New England because England itself 'greweth her inhabitants saw that man, the best of creatures, is held more base then the earth they tread on'; while Sir Ferdinando Gorges also claimed that England's 'peaceable time affords no means of employment to the multitude of people that daily do increase,' and he sent colonists to settle the coast of North America primarily 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. These and other measures enjoyed such success that by the 1630s thousands crossed the Atlantic each year, promoting England's stability because the colonies 'serve for draines 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.'

Scarcely had the ink dried on these words than the global population began to contract sharply. In China, the victorious Qing believed that in the mid-seventeenth-century crisis over half of the population perished. In Suzhoun, people lamented that they did not have a single offspring. In the 1650s, after a decade of sectarian violence and civil war in Ireland, according to one of the English vicar's a man might travel twenty or thirty miles and not see a living creature except for 'very aged men with women and children' whose skin was 'black like an oven because of the terrible famine'; and a generation later, another English eye-witness estimated that over 500,000 Irish men and women had died 'by the sword and famine and other hardships in the troubles. Contemporaries elsewhere made similarly bleak assessments. In southern Germany, one eye-witness of the Thirty Years War believed that there have been so many deaths that the life of it has never been heard in human history, while a Lutheran minister wrote despondently in 1639 that of his 1,046 communicants a decade earlier, barely one-third remained: 'Just in the last five years, 518 of them have been killed by various misfortunes. I have to weep for them, he continued fortunately, because I remain here so important and alone. Out of my whole life scarcely fifteen people remain alive with whom I can claim some trace of friendship. Perhaps most striking of all, in France, ravaged between 1648 and 1653 by war, famine and disease, Abbess Angelique Arnauld of Port-Royal (just outside Paris) estimated that 'a third of the world has died.'
nomination of these judges on 21 August 1647 was at the insistence of the populace during the seditions and tumults: that is what obliged and compelled that decision. Now that these disturbances have ceased, it does not seem appropriate to confirm it. Furthermore, 'when we saw that the appointments failed to include Spaniards, as has always been the case, it caused even greater astonishment,' and so, he thun-
dered, 'it seems that neither the appointments then nor the decision now can be legal. And yet, after rehearsing all these arguments, the king crumbled. 'Considering the zeal with which you serve me, and the need to authorize all your actions,' he concluded merely.

You should govern according to the state of affairs in that city and kingdom, paying chief attention to its peace and relief, which is what matters most and is the goal to which everything we do has to aim. So we remit everything to your prudence, and what I have told you here is for your information only.65

The judges appointed by the revolutionaries retained their offices. Such flexibility, and the desire to preserve concurrence at all costs, helps to explain why, even though catastrophes caused by both human and natural agents continued, the revolt of Messina remained the only serious challenge that the Spanish Habsburgs faced in Italy after 1648. Unfurling the 'red flag as a sign of war' offered too few attractions.

The ‘dark continents’: The Americas, Africa and Australia

Although the human and natural archives from the mid-seventeenth century are abundant, they relate overwhelmingly to only two continents: Europe and Asia. We lack a human archive for much of the Americas and most of Africa, because few indigenous populations left written or pictorial records that can be precisely dated; and although the natural archive (above all tree rings), supplemented by archaeological remains, indicates that global cooling afflicted both these continents, its impact on their human population remains obscure. Thus while many Europeans in North America realized that the indigenous population was declining rapidly – in New Mexico, 'where these Pecos had lived in 1622, only two lived in 1641 and only one in 1694' in New England 'by the 1640s the number of Iroquois (and of their Indian neighbours) had probably already been halved' – none suggested the probable causes.7 In Australia, although only archaeology and the natural archive provide reliable testimony, little of it is currently available, and (as elsewhere) much of it lacks chronological precision. So despite the immense size of these continents (16 million square miles for North and South America, almost 12 million for Africa, and 3 million for Australia), historians can reconstruct the experience of their inhabitants in the seventeenth century only for those areas where literate residents or travellers from other regions – most of them Europeans – compiled written records that have survived.

The Americas

In both North and South America, substantial records exist only for the European colonies that stretched from the tundra of Newfoundland at 49 degrees north, through the rain forests of Brazil, to the tundra of Chile at 39 degrees south; the French settlements along the St Lawrence river and the southern Great Lakes; the English colonies of New England, the Chesapeake and the Caribbean; the Spanish viceregalies of New Spain and Peru; and coastal Brazil. Despite the distance that separated these colonies, and their environmental differences, their histories in the seventeenth century shared five striking similarities:

- From Newfoundland to Patagonia, the Americas experienced notably colder winters and cooler summers in the 1640s and 1660s; while 1675, a year without
a summer', remains the second coldest recorded in North America during the last six centuries.\(^1\)

- Areas normally affected by episodes of El Niño suffered more, because the frequency of these episodes doubled in the mid-seventeenth century: more rain and floods along the Pacific coast and throughout the Caribbean; more droughts in the Pacific Northwest; more cold winters in the Atlantic Northeast. Moreover, both seismic and volcanic activity along America's Pacific shores increased.\(^2\)
- Almost all surviving harvest records show dearth in the 1640s and 1650s.
- In the words of John McNeill, 'From Canada to Chile, the Americas in the seventeenth century served as a playing field for the ambitions of several European statesmen and countless independent warrior-entrepreneurs.' Several regions experienced wars of unequal ferocity: the Pequot War and King Philip's War in New England, the 'Beaver Wars' in New France, and the Dutch-Portuguese struggle in Brazil. As in Europe and China, wars waged at a time of climatic adversity caused extensive damage to both property and people.
- Finally, all the indigenous peoples who came into contact with Europeans, whether directly or indirectly, suffered losses - sometimes catastrophic losses. In New England and New France (but only there), this decline was partially offset by a dramatic growth in the number of settlers, both through strong immigration and because many appear to have lived longer than any other group of humans in the entire early modern world.

Our people must at least be doubled every twenty years':

The Anglo-Atlantic at Peace

According to Benjamin Franklin in 1751, New England's white settlers had never been 'afraid to marry' because:

They see that more land is to be had at rates equally easy, all circumstances considered. Hence marriages in America are more general, and more generally early than in Europe. And if it is reckoned there, that there is but one marriage per annum among one hundred persons, perhaps we may here reckon two; and if in Europe they have but four births to a marriage (many of their marriages being late), we may here reckon eight, of which if one half grow up, and our marriages are made (reckoning one with another) at twenty years of age, our people must at least be doubled every twenty years.\(^3\)

Although Franklin lacked any statistical basis for his estimate, as usual he was right. As early as 1634, John Winthrop had commented on the unusually low mortality among the settlers around Massachusetts Bay, and a few years later English pamphleteers likewise extolled the general good health of the colonists, contrasting it with the situation back home. In public assemblies it is strange to hear a man sneeze or cough as ordinarily they do in Old England', one wrote; while another claimed that 'No man living there [in New England] was ever known to be troubled with a cold or a cough.' Most comprehensive of all, a group of 'New-England men' who had briefly returned to their native land thanked God for 'Blessing us generally with health and strength ... more than ever in our native land; many that were tender and sickly here [in England] are stronger and heartier there!' And they all knew why: 'God has so prospered the climate to us that our bodies are fuller, and children born stronger, whereby our numbers [are] exceedingly increased.'

The church records of seventeenth-century New England confirm this claim: over 90 per cent of all colonists married; most women married young (aged 23 or younger at first marriage); and half of all settlers seem to have survived to age 70. 'Completed marriages' (ones where both parents survived to bring up their children) produced, on average, six children - most of whom, unlike those born in Europe, survived to childbearing age. Thanks to this remarkable fecundity, and to continued immigration, the settler population of New England increased from about 14,000 in 1640 to over 90,000 in 1700 - a sixfold increase in two generations. The experience of British colonists elsewhere in North America was very different. Almost from its foundation in 1607, Virginia experienced (in the words of its first governor) 'a world of miseries', because drought caused its early settlers 'to feel the sharp prick of hunger', forcing some to eat 'dogs, cats, rats and myse' as well as 'bootes, shoes or any other leather'. In desperation, 'many of our men this starveinge tymne did runn away unto the salvages' - but the salvages could offer little help because the years 1607-12 saw the most prolonged drought registered in the Tidewater region near Jamestown in eight centuries, and it affected natives as well as newcomers. Demographic growth therefore remained slow although at least 6,000 English men, women and children had come to Virginia from England since 1607, by 1624 the colony still numbered only 1,200. Several other circumstances contributed to this slow growth. First, although in 1618 the Virginia Company decided to recruit and send out far more colonists than before, it failed to send sufficient provisions to feed them - and the newcomers arrived just as a new drought reduced the local crops. Many soon died, and in 1621 the Company complained petulantly that 'some have beene pleased to write' that their colonial venture was no more than a 'more regulated kind of killing of men'. The following year was far worse, because another severe drought forced natives and newcomers to compete for the scarce food, culminating in a massacre that cost the lives of almost 350 English men, women and children. Then, according to a prominent settler, there followed 'a generall sickness, insomuch as wee have lost I believe few lesse than 500, and not manie of the rest that have not knoc't at the doores of death.' Nevertheless, he continued,

With our small and weakie forces wee have chased the Indians from their abode, burnt their houses, taken their corn and slayne not a few. The great king now sues for peace and offers a restitution for his prisoners; for whose sailes wee seeme to bee inclined to thereunto, and will trie if wee can make them as secure as wee were, that wee may [later] follow their example in destroying them.

The strategy succeeded: by 1670 a combination of wars and diseases had reduced the indigenous population of the Tidewater from perhaps 20,000 to fewer than
2,000. When Benjamin Franklin and others extolled the fruitfulness of 'our people,' they meant only people of European descent like them.4

Even though the English settlers in Virginia 'chose the Indians from their abodes,' they still suffered from the hostile climate. In 1637 a New England pamphleteer gloated that 'many men' had come to Massachusetts 'sick out of Virginia,' but had 'instantly recovered with the help of the purity of that aire;' and that the Bay Colony 'in seven years time could show more children living that have beene born there, then in 37 years could be shewn in Virginia.' Then in winter 1641–2 the entire Chesapeake Bay froze over, while in winter 1657–8 the Delaware river was frozen so hard that a deer could run over it ... an extraordinary case, which the oldest Indians had never known.5 Even in 1650 only 15,000 colono-lives lived in Virginia. Not until the 1680s, when their number had reached 60,000 settlers, did the white population become self-sustaining.

That milestone took even longer to reach in England's Caribbean colonies, thanks largely to tropical diseases – especially two mosquito-borne viruses, malaria and yellow fever, which thrived in the wetter conditions created in the region by increased El Niño activity. Of the 7,000 Englishmen who invaded Jamaica in 1655 as part of Cromwell's 'Western Design,' more than 5,000 perished during the first ten months; and although some 233,000 Europeans came to Barbados, Jamaica and the Leeward Islands in the course of the seventeenth century, their combined white population rose from 34,000 in the 1650s to only 40,000 in the 1690s.6

Mortality in the seventeenth century among the indigenous inhabitants in Anglo-America was also high. In 1621, in one of the first observations made at Plymouth plantation, Reverend Robert Cushman noted how the [Indians] were 'very much wasted of late, by reason of a great mortality that fell amongst them these three years since, which together with their own civil dissensions and bloody wars, hath so wasted them, as I think the twelfth person is scarce left alive.' Archaeologists have found around Massachusetts Bay several Native American mass graves from the early seventeenth century that lack the customary grave goods, suggesting unusually rapid mortality, probably due to smallpox; while Thomas Morton, who arrived in 1632, found piles of 'bones and skulls upon the several places of their habitations.' The copious evidence of sudden deaths 'made such a spectacle' that 'it seemed to me a new-found Golgotha.'7

Morton's chilling image reflects the crucial difference between European and Native American setiology. Although the native peoples of the Americas suffered from a variety of illnesses before they came into contact with Europeans, to many early colonists they seemed robust, healthy and 'unusually free from any apparent physical defects and deformities.'8 In part, this reflected the absence of diseases that produced 'stunting' and disfigurements, such as smallpox and measles; but, unfortunately, this created a Virgin population with no immunity whatsoever when the Europeans arrived. Widespread vulnerability, combined with the probability that several 'Old World' diseases (notably smallpox and yellow fever) became more virulent in the seventeenth century (see chapter 4 above), explains not only why Thomas Morton encountered a 'new-found Golgotha' in Massachusetts, but also why the same uncommonly high mortality among the indigenous population of New England persisted. In Massachusetts, John Winthrop commented on this phenomenon in 1634, noting that 'if God were not pleased with our inheriting these parts, why did he drive out the natives before us? And why does He still make room for us, by diminishing them as we increase?'9

Nevertheless, some early settlers of New England still felt overwhelmed by what Roger Williams of Providence colony called in 1637 the 'ocean of troubles and trials wherein we sail.' Perhaps he had in mind the hurricane that two years earlier 'threw down all the corn to the ground, which never rose more,' followed by a harsh winter that forced many settlers who had recently established farms in Connecticut to return starving to the Bay Colony – where they also encountered a 'great scaccitye of corne' thanks to a combination of drought and the arrival of more settlers than the plantation could support.10 But most of all, Williams referred to the Pequot War.

'It was Captain Hunger that threatened them most', The Anglo-Atlantic at War

Smallpox at first spared the Pequot Nation, whose members occupied some 2,000 square miles of southern New England. Most of them followed a semi-sedentary lifestyle in groups of 10–20 households, although perhaps 70 households lived in a fortified settlement at Mystic (modern Connecticut). Thanks to their numbers and their strategic location, by 1630 the Pequots controlled almost all the trade of the English colonies with the Dutch to the north and east and with other Indian nations to the west – but this increased their exposure to European diseases, and their numbers fell from some 13,000 in 1620 to only 3,000 by 1635. This loss destabilized the entire area and in 1634 John Winthrop noted that the Pequots 'were now in war with the Narragansett whom till this year they had kept under, and likewise with the Dutch,' so that 'by these occasions they could not trade safely anywhere.'11 The number of colonists, by contrast, continually increased and groups in search of viable farmland returned to the Connecticut valley. Since the indigenous inhabitants heavily outnumbered them there, the Governor of Massachusetts engaged Lion Gardiner, an engineer with extensive military experience in Europe, to build a new fort at Saybrook. Gardiner advised caution, because

War is like a three-footed stool: want one foot, and down comes all. And these three feet are men, victuals and munition. Therefore, seeing in peace you are like to be famished, what will or can be done in war? Therefore I think, said I, it will be best only to fight against Captain Hunger, and let fortification alone for a while.'12

Governor Henry Vane, 24 years old and only six weeks in office, did not listen. Instead, early in 1637 he sent a force of colonists, reinforced by Narragansett and other Native Americans opposed to the Pequots, to launch a surprise attack on Mystic. It succeeded far beyond Vane's expectations. His troops penetrated the palisade and set fire to the wigwams within, which 'burned their bowstrings, and made them unserviceable,' allowing the colonists and their native allies to shoot down without risk those who tried to flee. Between four and seven hundred Pequots perished in less
than an hour. Only seven escaped (Plate 19). The scale of the slaughter and the ‘fearful sight’ of human beings ‘thus lying in the fyer and the streams of blood quenching the same’ shocked the ‘young soldiers that never had been in war’. Some asked ‘Why should you be so furious?’ But the colonial veterans reassured them that ‘Sometimes the Scripture declareth women and children must perish with their parents… We had sufficient light from the Word of God for our proceedings’.

As Neal Salisbury has observed, ‘For many settlers, the Pequot slaughter was the ideological as well as military turning point in the war and in their conquest of New England’. Following the massacre at Mystic, the colonists ‘in a short time, pursued through the wilderness, slew and took prisoners about 1,400’ Pequots, ‘even all they could find, to the great terror and amazement of all the Indians to this day’; until in September 1638 representatives of the victorious English and their allies gathered at the Dutch trading post in Hartford to divide up both the vanquished and their assets. The treaty of Hartford forbade the surviving Pequots to use their name and native language, or ‘to live in the country that was formerly theirs but is now the English’s by conquest. It also incorporated the first “fugitive slave law” in North American history: any former Pequot who escaped must be returned to his or her original captor. By 1643, according to the proud boast of a group of Harvard graduates, “the name of the Pequots (as of Nanseocking) is blotted out from under heaven, there being not one that is (at least) dare call himself a Pequot.” The gender ratio among the Pequots after 1640 sank to one male for every 20 females, and the tribe continued to decline until it numbered just 66 people by the beginning of the twentieth century. By contrast, by 1643 the English population of the Connecticut valley and Long Island already exceeded 5,000, with 2,000 settlers in New Haven alone.

The maize seeded from the Pequots during the war helped the colonists in New England to survive another ‘very hard winter’ when ‘the snow lay from November 4th to March 23rd, half a yard deep’ and a drought in 1639; but then in 1641–2 came the second coldest winter in a century, when Massachusetts Bay “was frozen over, so much and so long, as the like, by the Indians’ relation, had not been so these forty years.” After this, drought and cold significantly stunted the harvests throughout New England – just as the English Civil War broke out (see chapter 11). Although in 1640 John Winthrop rejoiced when he heard of the ‘Scots’ invasion of England and the summoning of the Long Parliament, he regretted that ‘some among us began to think of returning back to England’ and others of ‘removal to the south parts [Virginia], supposing they should find better means of subsistence there, and for this end put off their estates here at very low rates.’ Between May and October 1640 the price of grain in Massachusetts fell by almost one-half, and of cattle by three-quarters, which caused,

A sudden and very great abatement of the prices of all our other commodities… whereby it came to pass that men could not pay their debts, for no money or beaver were to be had, and he who last year or but three months before was worth £1,000, could not now if he should sell his whole estate raise £200, whereby God taught us the vanity of all outward things.

Winthrop’s ‘vanity’ received another blow in June 1641, when his joy at the execution of Strafford and the arrest of Archbishop Laud (‘our great enemy’) was tempered by the fact that ‘this caused all men to stay in England in expectation of a new world, so as few coming to us, all foreign commodities grew scarce, and our own of no price’.

The situation of the New England colonies remained perilous throughout the decade. The Massachusetts preacher Increase Mather later claimed that ‘more persons have removed out of New England than have gone thither’. He might have added that those who ‘removed’ to support the parliamentary cause included many of the colony’s elite: 14 of Harvard College’s first 24 graduates (one of them George Downings, who rose to be Oliver Cromwell’s symnaster); Hugh Peter, who became Cromwell’s favourite preacher; and at least seven colonels in the parliamentary army (including Stephen Winthrop, son of John). Two more New Englanders (including Henry Vane, victor over the Pequots) won seats in the Long Parliament, one sat in the Westminster Assembly of Divines and one signed the king’s death warrant. Many of those who remained in New England also became parliamentary warriors – albeit ‘in ambush’, seeking to kill royals with their prayers and sending sermons, poems, letters and treaties of encouragement back to England. Thus early in 1643 Anne Bradstreet of Cambridge, Massachusetts, Anglo-America’s first published poet, composed a verse ‘Dialogue between Old England and New concerning their present troubles’ in which the loyal colonial ‘daughter’ urged her ‘mother’ to show no mercy towards royals:

Go on brave Essex, shew whose son thou art,
Not false to king, nor country in thy heart;
But those that hurt his people and his crown
By force expel, destroy and tread them down:
Let gaels be fild with th’remnant of that pack
And sturdy Tyburn loaded till it crack.

Although New England supported Parliament, Virginia (and several other colonies) remained loyal to King Charles, who denounced Parliament’s efforts to spread ‘this horrible rebellion even unto those remoter parts’. Barbados, by far the most prosperous English settlement in the New World, saw neutrality as the best way to survive, and its freeholders swore ‘not to receive any alteration of government, until God shall be so merciful unto us as to unite the king and Parliament’, and vigorously pursued a policy of free trade. Initially the regicide changed little – only Rhode Island immediately recognized the English Commonwealth as the legitimate government – but in 1652 the young Republic dispatched one fleet to enforce its authority in the Caribbean and another to subdue Virginia. It also created a Council of Trade to promote overseas commerce and passed a Navigation Act that restricted all trade in the Anglo-Atlantic to English merchants. In addition it sent to America thousands of its defeated British and Irish opponents who tolled alongside tens of thousands of slaves imported from Africa; while because (in the words of a group of boastful colonists in 1643) New England enjoyed ‘peace and freedom
from enemies, when almost all the world is on a fire', the migration of freeborn English men and women also rose. In all, the population of the Anglo-American colonies quadrupled from around 50,000 to 200,000 during the 1660s. The British revolution strengthened Anglo-America in other ways. The collapse in local prices and the interruption of transatlantic trade after 1640 forced the colonists to fall back on their own resources. Instead of importing what they needed from Europe, they mined and worked local iron and lead, invested more in fishing and logging and manufactured their own textiles and ships. By 1660 almost 100 ships - many of them built in New England - docked annually in Boston, exchanging goods from Europe, the southern colonies and the West Indies. Distinctive new economic, demographic, social and constitutional structures emerged in Anglo-America, from Newfoundland to Trinidad during the mid-seventeenth century; and the Restored Monarchy in London left what the Republic had wrought alone until 'a concatenation of disasters' in 1676 led to some significant changes. In spring 1676 the Governor of Barbados noted that although his island had suffered some 'misfortunes, by the negroes' [revolt] first, and then by the hurricane', its inhabitants still retain one advantage: They sleep not so uneasily as the rest of their neighbours in America, from whence they receive nothing but ill news of daily devastations by the Indians who increase in strength and success which spread like a contagion over all the continent from New England, where they have burnt some towns and destroyed many people, to Maryland where they have done the same, likewise at Virginia. The daily devastations in New England originated in the Pequot War, which had opened the Connecticut valley to European settlement. The newcomers' increasing demand for land and food alarmed even their most loyal Indian allies and in 1642 Miantonomo, one of the Narragansett leaders who had helped to exterminate the Pequots, called upon his neighbours to unite before it was too late. Just as 'we [are] all Indians as the English are, and say "brother" to one another, so must we be one as they are, or we shall be all gone short', he told the Montauks of Long Island. You know our fathers had plenty of deer and skins, our plains were full of deer, as also our woods, and tucketts, and our coves and rivers were full of fish and fowl. But these Englishmen have gotten our land, they with scythes cut down the grass, and with axes felled the trees. Their cows and hens eat the grass, and their hogs spoil our clam banks, and we shall all be starved. Miantonomo announced that he and 'all the sachems from east to west' had resolved at one appointed day 'to fall on and kill [English] men, women and children - but no cows, for they will serve to eat till our deer be increased again. Miantonomo's appeal backfired. A Montauk favourable to the English betrayed the plot, while the following year a rival Mohigan sachem captured and murdered its author; moreover, fear of a pan-Indian alliance encouraged the various groups of colonists to band together. The preamble to the 'Articles of Confederation of the United Colonies of New England' (1643) noted not only the 'sundry insolence and outrages' committed by 'the natives' but also 'those sad distractions in England, which they have heard of, and by which we know they are hindered' from receiving protection. The new alliance promised general cooperation (including the return of fugitive criminals and indentured servants) and mutual military assistance in case of attack. With a generation, the New England colonists had created precisely the crisis predicted by Miantonomo. As Sir William Berkeley, Governor of Virginia, observed in 1676: All English planters on the main [land] covet more land than they are safely able to hold. This craving, he asserted, was the cause of the New England troubles, the Indians complaining that strangers had left them no land to support and preserve their wives and children from famine. His analysis contained much truth, in that the cultivable land available to the Indians did fall below subsistence level - but it did so for a variety of reasons. First, the rapid growth of the European population (both through immigration and through the natural increase praised by Benjamin Franklin) automatically drove up the number of mouths to feed and the number of fields required to produce the food. Second, the settlers cultivated not only subsistence crops but also cash crops like tobacco, and this diversification, too, reduced the amount of arable land. Third, the settlers' livestock also required space - a lot of space: their cattle trampled down crops as they grazed while their hogs rooted up clams and corn stores, and while the natives begged the newcomers to fence in their pastures, the newcomers retorted that the natives should fence in their crops. Finally, the 'natural archive' of what is now the eastern United States suggests a cooler climate in the mid-seventeenth century that reduced the total yield of crops, and so increased anxiety in both communities about their long-term prospects for survival. On top of all these changes the virtual extinction of the fur-bearing animals of New England, especially beavers, through excessive hunting, meant that the natives had fewer trade goods to offer the settlers. This shortfall in turn meant that, whenever the colonists' courts fined Native Americans for some transgression, land was often the only asset they had left with which to pay. This dynamic precipitated King Philip's War, which almost ended the existence of New England.
critical weaknesses undermined his cause: not only the tensions inherent in any alliance, but also the lack among the New England tribes of any tradition of following a single leader — indeed, several of the traditional enemies of the Wampanoags fought for the United Colonies. So although (to quote Gomme and Berkeley again) Philip ‘made the New England men desert about a hundred miles of ground they had lived years seated and built towns on’, he and his allies suffered some serious defeats.31 Above all, the unusually cold winter of 1675–6 froze the ‘Great Swamp’ that normally protected an important Narragansett fort, allowing a colonial army to march across the ice to the fort and slay all within it. Then early in 1676 the Mohawks, a member of the Iroquois Confederation, assaulted Philip’s winter encampment, forcing him and his followers to disperse. For a while, another poor growing season combined with hostilities to produce dearth in New England, but the colonists received supplies by sea, and from each other, whereas Philip’s supporters starved.32 In addition, the colonists belatedly adopted the ‘skulking way of war’ and conducted joint operations with their Native American allies, until in August 1676 they cornered Philip and killed him. Although the war continued for another 18 months, Indian power east of the Connecticut river was broken forever.

Nevertheless, victory came at a high price. Perhaps, 3,000 Native Americans died through combat, disease and hunger; 2,000 more fled; and another 1,000 were sent in servitude to Bermuda; whereas of the 90 settler towns in New England before the war, Philip’s forces attacked 52, pillaged 25 and razed 17. Some of the smaller outposts perished for ever; and ‘the work of a generation would be required to restore the frontier districts devastated by the conflict’. It was, in proportion to population, ‘the costliest in lives of any American war. Out of a total population of some thirty thousand, one in every sixteen men of military age was killed or died as a result of war; and many men, women, and children were killed, carried into captivity, or died of starvation or exposure as a result of the Indian raids. The war also ‘all but wrecked the colonial economy’, disrupting the trade in furs and commerce with the West Indies, and it ‘eliminated so much of the capital invested in colonization by the two founding generations that per-capita income did not achieve 1675 levels again until 1775’. In addition, Plymouth colony alone spent over £100,000 in the war, and Connecticut £30,000 more. Since human and material losses on this scale threatened New England’s continued prosperity, perhaps even its survival, in April 1676 its leaders appealed to London for assistance.33

Shortly afterwards, another appeal arrived from Virginia. In July 1676 some of the Chesapeake planters demanded that Governor Berkeley sanction attacks on their Indian neighbors. When he refused, malcontents led by the well-connected and newly arrived Nathaniel Bacon issued a ‘Declaration’ in the name of ‘the Commons of Virginia’ that commanded ‘in his Majesty’s name’ the arrest of the governor and his supporters ‘as traitors to the King’. They also garnered support in Maryland. Both sides offered freedom to any servants and slaves of their opponents who agreed to take up arms (an unprecedented step); and in September, Bacon and his supporters subjected Jamestown, the colonial capital, to an artillery bombardment. They then entered and ‘sett fire to townes, church and state house’ so that by dawn,

21 September 1676, property worth £45,000 sterling was destroyed. Not a habitable house was left.34

In the event, the unhealthy environment of the Tidewater nibbled rebellion in the bud — dissenters carried off Bacon and many of the other rebellious planters newly arrived from England — but several commentators linked the events in Virginia and New England in 1676 with those in Ireland in 1641 (‘The tyranny of the natives exceeds that of the rebellion in Ireland, if possible; they have embroiled their hands in the blood of so many of His Majesty’s good subjects’). The government in London therefore dispatched a fleet of 14 warships with 1,300 regular troops, and orders first to pacify Virginia and then to proceed to Boston and restore order there.35

James, duke of York and Albany, the future James II, played a leading role in formulating the new policy. He was already ‘proprietor’ of the North American territories acquired in 1674 from the Dutch (hence their name ‘New York’, as well as the names of the two principal towns); and his governor, Sir Edmund Andros, played a leading role in defeating King Philip by mobilizing the Iroquois against him. In 1677 Andros sealed a lasting agreement, known as the Covenant Chain, with the entire Iroquois Confederation, which brought peace to the Anglo-Indian frontier from Maine to the Carolinas — but at a price: colonial expansion westward ceased for almost a century.36 Charles II and James now took other steps to restrain the colonists. As in England (see chapter 12 above), throughout the 1680s they revoked charters and other royal concessions, while in 1686 James (now king) created the Dominion of New England, with Andros as his first governor-general.

Early in 1689 Sir Edmund was in Boston, consolidating his authority, when news arrived of the Glorious Revolution in England. A group of Massachusetts colonists immediately seized and imprisoned the governor general (and some of his appointed council); then, followed by other New England colonies, they restored the form of government laid down in their confederated charters. The colonial elite in Massachusetts (as well as in Maryland and New York, which also supported the rebellion against James) later proclaimed William and Mary their sovereigns, but their capacity for independent action worried the new rulers: although they dismantled the Dominion created by James, the new rulers also issued new colonial charters that gave the crown far more authority.

The memory of the great Anglo-Indian wars of the mid-seventeenth century — and their outcome — lived on beyond the Appalachians. In 1811, in a vain attempt to unite the Indian Nations of the Midwest, the Shawnee leader Tecumseh asked rhetorically ‘Where today are the Pequot? Where are the Narragansetts, the Mohican, the Pocanet, and other powerful tribes of our people? They have vanished before the avarice and oppression of the white man, as snow before the summer sun . . . Will we let ourselves be destroyed in our turn?’37 It seems curious that Tecumseh omitted from his appeal some other ‘powerful tribes of our people’ destroyed in the mid-seventeenth century, including the Lenape (or Delaware Indians) of New York and New Jersey, and his own forefathers, the Algonquian speakers who lived around Lake Huron. Tecumseh’s ancestors were not directly the victims of ‘the avarice and oppression of the white man’, but of the Iroquois.
New France and the 'Beaver Wars'

The history of the lands along the St Lawrence and around the Great Lakes in the seventeenth century resembled that of neighbouring New England in several respects. Above all, the European population increased very rapidly. Almost 70 per cent of all women who arrived in the colony from France married before they turned 20; while one-half of the married settler families produced four or more children and one-quarter produced ten or more. After 1650, some parishes in Québec registered three or four births for every death. The French metropolitan government rewarded this remarkable fecundity handsomely. After 1669 each French Canadian female who married before the age of 16 received 20 livres (as did each male who married before 20), and each father received an annual pension of 300 livres if he supported 10 children, and 400 livres if he supported 12. Thanks to all these factors, the number of French settlers increased from 800 in 1660 to 15,000 by 1699, the year in which Marshal Vauban (Louis XIV's leading statistical adviser) predicted that the colony's population would double every generation.48

As in New England, even this spectacular increase failed to offset the decline of the Native American population. In part, the decrease was deliberate, because the Iroquois were matrimonial and practised 'inheritance through the female line; female-headed households; pre- and extra-marital sexual relations for women; female-controlled fertility; permissive child-rearing; trial marriages; mother- dictated marriages; divorce on demand; maternal custody of the children in case of divorce; [and] polyandry.' Finally, Iroquois women also sometimes used herbs for abortion (and perhaps also for contraception, since they rarely seem to have had two pregnancies in less than two years). All these practices mitigated the intensity of the mid-seventeenth century crisis by easing the demand for limited or failing food supplies.49 But the Iroquois women could not withstand new European diseases. According to Adriaen van der Donck, a Dutchman who spent the 1640s in the Hudson valley and then wrote a detailed 'Description' of the region, the Native Americans 'affirm that, before the arrival of the Christians, and before the small pox broke out among them, they were ten times as numerous as they now are; and that their population had been melted down by this disease, whereof nine-tenths of them have died.'48 'The Christians' began to arrive in 1669, when Henry Hudson sailed a Dutch ship up the river that today bears his name, reaching the site of the future Albany, while a French party led by Samuel de Champlain advanced from Québec (which he had founded the previous year) up the St Lawrence as far as Crown Point. Both Hudson and Champlain hoped to find a ' northwest passage ' to China and profit from its riches; and although they failed, they did profit from the abundant North American beaver, whose thick pelts made warm, rain-proof hats. In Albany alone, according to van der Donck, 90,000 beavers are annually killed, and he went on to note that 'there are some persons who imagine that the animals of the country will be destroyed in time, but this is unnecessary anxiety. It has already continued many years, and the numbers brought in do not diminish.' But van der Donck, who never went east of the Appalachians, was misinformed. The beaver became 'prey to one of the longest sustained hunts for a single species in world history' and the resulting 'fur rush' drastically reduced not only the number of beavers but also, in due course, the number of native hunters.48

Many Native Americans along the St Lawrence died in the wars of the seventeenth century. At Crown Point in July 1699 Champlain and several hundred Huron and Algonquin allies, who farmed and hunted in the woodlands north of Lake Ontario, encountered a war party of Mohawks, members of the Iroquois Confederation, which controlled the woodlands south of the lake. The French used their firearms to kill all three Mohawk chiefs at the outset, as well as several warriors as they fled, leaving the field to the Franco-Huron allies. This victory marked a turning point in the relations between Europeans and Native Americans in the region: the beginning of the long, slow destruction of a culture and a way of life from which neither side has yet recovered: The defeated Mohawks sought an alliance with other groups of Europeans - but whereas the Hurons exchanged beaver pelts primarily for metal artefacts, above all tools, the Mohawks and other Iroquois groups exchanged them primarily for brandy and firearms. Before long, the Iroquois not only possessed many 'fowling pieces, muskets, pistols etc.' but were also 'far more active in that employment' - firing guns accurately - 'than many of the English, by reason of their swiftness of foot and nimbleness of body.'48

For a time the Hurons continued to prosper, since the metal tools supplied by the French enabled them to increase their maize crops, and their numbers rose to perhaps 25,000; but the Europeans they encountered exposed Huron traders to measles and smallpox in a form to which they apparently possessed no resistance. After a particularly savage epidemic in 1639-40 the Hurons numbered scarcely 12,000 and they now lacked the strength to resist the attacks by Mohawks and other Iroquois groups. Worse, the acquisition of European firearms and ammunition, and the drunken rages induced by consuming European brandy, gave Iroquois warfare a new ferocity. The 'design' of the Iroquois, wrote the Jesuit missionary Isaac Jogues in 1643, 'is to take, if they can, all the Hurons; and, having put to death the most considerable ones and a good part of the others, to make of them both but one people and only one land.'48 Jogues failed to perceive that the Iroquois also fought in order to replace their own losses from disease by integrating prisoners captured from other Indian nations, a form of conflict known as 'mourning-war' in which the women (especially the widows) of the tribe separated the captives suitable for breeding, whom they saved, before torturing and then killing the rest. The Hurons did their best to defend themselves. In 1645 they concluded a peace with the Iroquois; and, lest it should fail, they persuaded the Jesuits and French settlers living among them to provide firearms and teach them how to fortify their villages more effectively. But still the Iroquois burned Huron maize and stole their furs until, during the famine year 1649, they launched an all-out assault. The Hurons had made plans for an orderly withdrawal in case of need, and they now burned their villages and retreated to an island in Lake Huron, accompanied by about 50 French missionaries, artisans and soldiers; but since drought killed the maize planted by the refugees, many of them (especially children) starved to death.
An excavation in 1987 of a fort and the adjacent Huron village revealed a grave filled with the tiny skeletons of malnourished children—victims of the Europeans’ obsession with firearms and fur hats. Their orderly migration plan enabled enough Hurons to survive the ‘Beaver Wars’ and the ensuing famine winter, and thus to preserve their collective identity after they abandoned their homeland; but, as with all migrations, groups who were intimately familiar with the resources, ecology and natural balance of their ancestral lands found it far harder to survive as malnourished refugees in an unfamiliar environment. For example, the Hurons took with them to their new homes, in what is now northern Illinois and Wisconsin, a lifestyle dependent on the staple crops that had sustained them further east. In the words of Nicholas Perrot, a Frenchman who lived among them for two decades: ‘The kinds of food which the savages like best, and which they make the most efforts to obtain are the Indian corn [maize], the kidney bean, and the squash. If they are without these, they think they are fasting, no matter what abundance of meat and fish they have in their stores, the Indian corn being to them what bread is to Frenchmen.’ Unfortunately for the refugees, maize requires a 160-day growing season but, even in periods of benign climate, northern Illinois rarely provides more than 140. In years of late or early frost, or if too much rain or drought, the maize failed. Tree-ring data from Illinois indicate that, as elsewhere in the northern hemisphere, adverse weather occurred more frequently during the mid-seventeenth century, and so no doubt many Hurons starved.

None of these misfortunes affected Europe’s demand for beaver hats, and so in 1665 Nicholas Perrot established a base at Sault Sainte Marie, where Lake Huron joins Lake Superior, and began to exchange furs for guns, alcohol and tools with the Ottawas and other Indian nations around the Great Lakes. From there, together with Louis Joliet, he advanced to what is now Green Bay, and again established a trading post. In 1673 Joliet travelled down the Mississippi to its confluence with the Arkansas river; and a decade later the Chevalier de la Salle canoed all the way down to the Gulf of Mexico. On his odyssey, La Salle met a group of Huron exiles who gave vivid testimony concerning the insupportable hardships of life back home. When asked whether they would like to return north with the French they absolutely refused, because ‘being in the most fertile, healthy, and peaceful country in the world, they would be devoid of sense to leave it and expose themselves to be tomahawked by the Illinois or burnt by the Iroquois on their way to another land where the winter was insufferably cold, the summer without game, and ever in war.’

Perhaps these refugees exaggerated. In his magisterial study, *The Uttering Frontier: An Environmental History of the Early Modern World*, John Richards assessed ‘the effects of the fur trade on those Indian groups caught up in it. Every year,’ he wrote, ‘Europeans enlisted tens of thousands of Indians to serve as hunters, processors, carriers, and traders of huge numbers of furs and skins for export from North America. He discerned ‘three intertwined questions’.

- Did the involvement of Native Americans in the fur trade cause weaknesses, dependence and cultural disintegration among them?
- More specifically, did the glut of European manufactured goods cause the Native Americans to abandon their cultural beliefs, institutions and behaviour?
- Finally, did insatiable European demand also cause the Native Americans to abandon sustainable hunting practices and embark on a policy of indiscriminate slaughter of fur-bearing animals that adversely changed the environment?’

Richards cautiously rejected each of these claims, at least for the seventeenth century. Although European diseases decimated most Indian groups in North America, the acquisition of metal tools, woolen textiles and accurate firearms ‘enabled them to dispose of surplus goods in exchange for the means to live better and more comfortably.’ With the partial exception of alcohol, they were ‘cautious consumers who restrained their wants in both variety and quantity’. And although by the 1660s beavers had been hunted to near extinction in coastal New England and along the lower St Lawrence, Richards noted that the hunters who harvested more than 150,000 pelts every year in the 1690s seemed to have experienced few problems in satisfying European demand.

The experience of other indigenous populations in North America during the seventeenth century, however, remains a mystery. Where European visitors to the central Mississippi valley in the mid-sixteenth century had encountered impressive hierarchical chiefdoms, French explorers in the 1670s did not mention them. Instead they reported widespread desolation. Patrick Galloway, a leading historian of the Choctaw of the Mississippi valley, has speculated that, since the area had limited lands capable of feeding large settlements from maize cultivation, ‘a point came when some of the river valleys could no longer support their population, or when populations right at the edge of need experienced a run of bad years or even climatic change, and the people had to disperse or starve.’ Perhaps the mid-seventeenth century, when tree-ring series from the region show serious drought, formed such a ‘point’? Likewise, dendrochronological data from the Great Plains suggest that a major drought occurred there in the mid-seventeenth century which may correspond with what some Native American oral histories describe as ‘the dog-less period’—that is, a time when all livestock, even dogs, perished—but greater precision seems impossible without a more extensive ‘human archive’. Indeed, the entire period 1530–1650 has been dubbed the ‘black hole’ of Native American history beyond the Appalachians.

Nevertheless, it is worth recalling that, despite the setbacks in the northeast, in 1700 Native Americans still far outnumbered both Europeans and Africans throughout the northern subcontinent; and that, thanks to their growing profiency with both firearms and horses, they controlled most of its territory. The number of native inhabitants of the Mississippi and Arkansas river valleys may have been fewer than before, but they still occupied what Kathleen DeGol has called ‘the Native Ground’ of North America, from which they excluded all European settlers, negotiating with them (if at all) from a position of great strength. To the east of this region, lay a ‘Middle Ground’ where Native American peoples formed new relationships both with each other and with the Europeans. Their value as allies enabled
them for another century both to impose their diplomatic protocols (such as the ‘Covenant Chain’) on their European neighbours and to avoid dependence on a single European group. Given the ravages of lethal diseases and savage wars, such resilience was a remarkable achievement.31

'This land of Brazil'

Although European colonists in the Americas sometimes went to war against each other in the seventeenth century as part of broader conflicts – the English against the Dutch in the 1660s, and against the French in the 1670s and 1690s – they seldom fought for long or deliberately destroyed much European property. The viceregency of Brazil formed a significant exception. By 1630, the Portuguese ‘captains’ of Bahia in the centre, with its capital at Salvador, and of Pernambuco in the north, with its capital at Olinda, each boasted around 12,000 settlers, many of them living on sugar plantations where engenhos (mills) made sugar from cane to sell in Europe; while perhaps 60,000 people inhabited the entire viceregency, roughly half of them Portuguese and the rest African slaves and Native Americans. Then two catastrophes occurred. First, sailors aboard two fleets that arrived from Lisbon introduced yellow fever, picked up from African slaves, which swiftly decimated the unprotected indigenous population of the colony. Second, a Dutch expeditionary force captured Pernambuco and, having destroyed Olinda, gradually expanded its control southwards down the coastal plain, until in 1640 Salvador itself came under siege. A young Jesuit in the city now delivered perhaps the most remarkable sermon of the seventeenth century in the form of a tirade against God modelled on those delivered by Moses and Job in the Old Testament. ‘Consider, Lord, from whom You are taking this land of Brazil and to whom You are giving it,’ Antônio Vieira began sternly: ‘You are taking it from those same Portuguese whom You chose from among all the nations of the world to be conquerors for Your faith.’

How will it look, Supreme Lord and Governor of the Universe, if the sacred ‘five shields’ of Portugal and the insignia and wounds of Christ are replaced by the emblems of the hecatomb from Holland, rebels to their king and to God? If You had decided to give these lands to the Dutch pirates, why did You not give them when they were wild and uncultivated, instead of now?32

Perhaps the tirade (like those of Moses and Job) found its mark, because a few days later a relief force arrived and raised the siege, while in 1641 Salvador celebrated the apparently miraculous news of the ‘restoration’ of Portuguese independence (see chapter 9 above). But any hope that shifting their allegiance from Philip IV to John IV would bring peace and prosperity soon evaporated. In 1641–2 smallpox ‘raged so violently among the Indians that entire aldeias [villages] were almost totally extin- guished. The survivors retreated into the forests since they no longer dared to remain in their homes.’33

By contrast, Dutch Brazil prospered until, by 1644, some 15,000 settlers inhabited the fertile coastal plain that stretched from the Amazon delta to the Sáo Francisco river. Almost half the newcomers lived in the handsome new capital Mauritstad (now the heart of Recife), built with bricks and tiles shipped out from Holland and boasting a fine palace for the governor, numerous churches and the first Jewish synagogue in the New World. Meanwhile, an expeditionary force captured Iranduba, the capital of Portuguese Angola and the principal source of slaves required to produce sugar, thus apparently securing the economic future of the new colony. Everything changed in 1645 when the Portuguese settlers mounted a counter-attack that drove the Dutch back into a few coastal fortresses. For the next nine years, civil war between the Dutch and Portuguese colonists and their Native American allies caused widespread devastation. The Dutch seized hundreds of Portuguese ships carrying sugar to Europe, while in 1648 their warships entered the Bay of All Saints, the heart of the Portuguese colony, and torched the engenhos around its shores. The Portuguese retaliated in kind, burning so many engenhos in Pernambuco that the province lost for ever its position as the colony’s leading exporter of sugar. Human casualties were also high. ‘The Heavenly Court had decreed, wrote the rabbi of Mauritstad, that the marauding bands should spread out and invade forest and field. Some of them looked for plunder, others hunted human beings, for the enemy came with the intention to destroy everything.’34

The rabbi had good cause to know: the Portuguese treated captured Jews with especial cruelty, either killing them in cold blood or surrendering them to the Inquisition for trial and eventual execution. In all, at least 20,000 Dutch settlers perished in Brazil, and at the fall of Mauritstad in 1654 the survivors – perhaps 6,000 in number, including at least 600 Jews – lost almost all their assets. Some of the Gentiles sailed on the next fleet to Batavia, intending to make their fortunes in Dutch Indonesia, while many of the Jews migrated to England, hoping that the belligerent Republic might provide them with another chance to settle legally in America.35 Meanwhile Portuguese Brazil prospered, especially after the discovery of massive gold deposits in the interior in the 1600s, expanding until it covered (as it does today) almost half of South America.

'Panic in the Indies'

In the rest of Latin America, news of the revolt of Portugal ignited what Stuart Schwartz has called a ‘panic in the Indies’. According to Don Juan de Palacios y Mendoza, bishop of Puebla and inspector general of the vicerealty of New Spain in July 1641, ‘the whole monarchy trembled and shook, since Portugal, Catalonia, the East Indies, the Azores and Brazil had rebelled’. Rumours spread that rebels had murdered the Spanish garrison in Salvador and that the settlers had made common cause with the Dutch to bring down Spanish power. Both stories proved false, but when an agent from Lisbon arrived in Cartagena and attempted to seize the treasure galleons (which assembled in the port every year), according to Palacios ‘apprehension and hysteria’ gripped the capital, whose 6,000 Portuguese residents were (he claimed) armed to the teeth and likely to enjoy the support of their numerous African slaves in any rebellion.36
The adverse climate, probably related to the unusually frequent El Niño events, made the situation even more volatile. The valley of Mexico normally receives copious rain from May to August, with little precipitation in the other months; but an intensive irrigation system would have required a year-round flow of water. However, the climate patterns and the availability of water in the area were such that the valley could sustain a relatively high population density. In 1639, however, the entire valley suffered the first of five years of drought, during which the price of maize quintupled, leaving the granaries without food and the citizens without water.37 Blame for these disasters gradually shifted to the viceroy, the marquis of Escalona—who, although a member of one of the oldest aristocratic families in Castile, was not only married to the duke of Bрагanza’s sister (which might tempt him to transfer New Spain to Portuguese hands) but also had Jewish ancestors (which, some thought, led him to protect the local New Christians).

In June 1641 Palafox wrote a secret letter suggesting to the king that Escalona would be better employed elsewhere, preferably in Europe. Philip IV took no chances: he signed three distinct secret orders, authorizing Palafox to use whichever one he judged appropriate: one invited Escalona to return to Spain where the king wanted his advice; a second censured the duke’s conduct and ordered him to transfer his authority to Palafox; the third authorized the bishop to have Escalona killed. In each scenario, Palafox would become both archbishop of Mexico and interim viceroy. In June 1642, as soon as he received the package containing these remarkable letters, Palafox entered Mexico City to take up his new ecclesiastical position. Four days later, in a dawn raid, his agents arrested Escalona and confined him in a convent outside the town under guard until he could be shipped back to Spain.

Amid the resulting chaos emerged the remarkable figure of William Lamport, better known as Don Guillén Lombardo de Guzmán, an Irish protégé of the count-duc de Olivares (whose surname he took). Having arrived from Spain with the same fleet as Palafox, Don Guillén worked hard in 1641 to win support from the Creoles (the American-born descendants of Spaniards) for Palafox’s plan to overthrow Escalona, but the following year he claimed to be the natural son of Philip III and shared with his Creole allies a plot to liberate Mexico ‘from Spanish captivity’ and declare himself ‘king of New Spain’. By the time a neighbour denounced him to the Inquisition in October 1642, Don Guillén had prepared a declaration of Mexican independence that included the abolition of slavery and forced labour; the establishment of free trade with China and Europe and the manufacture of goods without regulation from Spain; and the creation of a representative assembly in which ‘Indians and freedmen would have the same voice and vote as Spaniards’. He had arranged for a militia of 500 Indians and African slaves to take over the viceregal palace, and waited only for one of the visions induced by the hallucinogens he ingested to reveal the most auspicious moment to launch his revolution. Rumours spread far and wide that Don Guillén was plotting to make himself king, until the Inquisition suddenly seized him and his papers.38

Other parts of Spanish America also saw plots, both real and imagined. In Panama, the entrepôt for all goods travelling between Peru and the rest of the Spanish world, just as news arrived that a Dutch expeditionsary force had sailed round Cape Horn and fortified a base at Valdivia in Chile, a fire broke out that gutted 100 homes and much of the cathedral, followed by another blaze three days later. Once again the Spanish authorities blamed Portuguese nationals and rounded them up—only to find that they numbered just 17. Further south, when the viceroy of Peru, the marquis of Mancera, first received news of the Lisbon revolt, he did not believe it; only on receiving confirmation from Buenos Aires, together with a plea for help, did Mancera send troops across the Andes to secure the settlement.39 Conscious that he was ’500 leagues from the Caribbean and 800 leagues from Buenos Aires’, Mancera also fretted that the Portuguese residents of Lima might persuade the African slaves to revolt, because ‘the first religious instruction that these slaves receive is from the Portuguese, and they maintain love toward them’, so Mancera rounded up and disarmed some 500 Portuguese residents in the capital, forcibly moving the younger males inland.40

Spanish America was thus safe again from political danger, but not from natural disasters. Earthquakes destroyed churches, houses and fortifications in Santiago de Chile (1647), Concepción de Chile (1657), and Lima and Callao, Peru (1687). Frequent storms reflect the unusual frequency of both El Niño events and volcanic activity in the mid-seventeenth century which, then as now, caused extreme weather throughout Spanish America. In Argentina, serious floods of the Paraná river in 1643, 1651 and 1657–8 inundated one-third of the regional capital, Santa Fé, and persuaded the magistrates to abandon the city, despite its splendid public buildings, and relocate to higher ground. Meanwhile, the vulnerability of New Spain continued to suffer repeated droughts. In 1642 the northern town of Monterrey experienced ‘such a shortage’ that the inhabitants sold rotten maize that could no longer be eaten—something neither heard nor seen [before] in New Spain, even in time of greater famine’ and between 1641 and 1668 local officials authorized eight public provisions of Our Lady of Guadalupe, a statue reputed to possess a miraculous ability to produce rain, and sponsored books to reassure readers of the statue’s powers (one in Spanish and the other in Náhuatl).41

The prolonged droughts also decapitated the northern frontier of New Spain. In 1658 the Jesuit Provincial of New Spain, who had served in the missions of Sinaloa and Sonora in New Mexico, wrote that ‘of the 300,000 Indians who had been baptized by the Jesuits, only one-third were still alive’. Shortly after that, prolonged drought forced the Christian communities on the Salinas plains to use their own urine both to irrigate their crops and to make bricks for the lavish mission churches, while Apache bands (no doubt also suffering from the extreme drought) launched repeated attacks. By 1678, every mission had been abandoned.42 Meanwhile, in the valley of Río Grande, between 1629 and 1641 a particularly lethal smallpox epidemic and repeated raids by Apaches killed two-thirds of the population and destroyed half of the Christian pueblos. According to Daniel T. Reif, ‘The Pueblo population, in effect, declined by over 80 per cent between 1608 and 1680, much as populations did in north-western Mexico’.43

In the Caribbean, the torrential rains associated with the increased frequency of El Niño created optimal breeding and feeding conditions for the vector of both...
malaria and yellow fever: the mosquito. The first yellow fever pandemic in the New World began in 1647, a year that saw a ‘strong’ El Niño. In Barbados, attracted both by the sugar and by population densities above 200 per square mile, mosquitoes spread the disease, killing one in every seven Europeans on the island as well as decimating other Caribbean islands and then Yucatán. The Mayan chronicler Chilam Balam de Chumayel reported that in 1648 there was ‘bloody vomit and we began to die’ – a clear reference to yellow fever, to which (unlike many Africans) neither Europeans nor Native Americans possessed inherited immunity. The rains were followed by such a hard and extraordinary drought that it rendered the land sterile and produced such intense heat that wildfires raged throughout Yucatán, destroying all crops left by the drought. The local chronicler Diego López Cogolludo claimed that ‘Almost half the Indians perished with the mortality caused by the plague, famine and smallpox which since the year 1648 until the present one of 1656, in which I am writing this down, have so exhausted this land.’

Two demographic strategies intensified the deleterious impact of these natural disasters on the human population of the Americas. First, according to María Sibylla Merian, a botanist who toured the Caribbean in the later seventeenth century, both African and Native American women frequently aborted their offspring to spare them a life of servitude and humiliation. Merian provided a detailed description of the ‘peacock flower’ (Poinciana palustris), one of over a dozen abortifacients that she and other European observers found in use in the colonial West Indies, asserting that ‘The black slaves from Guinea and Angola have demanded to be well treated, threatening to refuse to have children. In fact, they sometimes take their own lives because they are treated so badly.’ Perhaps realizing that some readers would find this difficult to believe, Merian added ‘They told me this themselves.’ Second, many women had no children because they entered convents. As in Europe, the number of nuns (which included many cloistered against their will in times of economic hardship) reached astonishing proportions: in Lima, popularly known as the City of Kings, the number of women in convents rose from 16 per cent of the total female population in 1614 to 21 per cent in 1700. By then, there were three Spanish and mestiza females for every Spanish and mestizo male living in Lima, as well as three mulatto and black females for every mulatto and black male. As Nancy van Deusen wittily observed, ‘the City of Kings had become a city of women.’

**Revolt and Resistance in Spanish America**

Seventeenth-century Latin America differed from Europe in one important respect: it experienced relatively few revolts. The most serious exception broke out in New Mexico, where (as already noted) prolonged drought produced famines that reduced the population and induced many Pueblo Indians to return to their traditional faith in the hope of bringing rain. Punitive measures by the authorities, both secular and religious, produced a major revolt in August 1680 that drove the Spaniards out of Santa Fé, the regional capital, for a decade – but the continuing drought eventually weakened the victorious (but disunited) Pueblos, and by the end of the century the Spaniards had regained control of the region. In the valley of Mexico, despite the prolonged drought of the 1640s and 1650s, and the activities of Don Guillermo Lombardo de Guzmán, no rebellion occurred; and Spanish South America likewise experienced few serious revolts. In 1656 Pedro Boborquez Gómez, a Spaniard of Morisco descent who grew up in Cádiz and then migrated to America, appeared in the remote city of San Miguel de Tucumán (now in northwest Argentina) and proclaimed that he was the grandson of the last Inca ruler and therefore true king of the region. This was not the first insurrection by the settlers of Peru during the seventeenth century (others occurred in 1613, 1623 and 1644), but Boborquez boasted dangerous military skills (including the ability to found light artillery) and won considerable support from the indigenous population. After two years of defiance, Spanish forces defeated and captured him and sent him to Lima for trial on charges of rebellion. He was still there, pending the outcome of an appeal to Spain, when another insurrection broke out in Upper Peru.

The fleets that brought most European settlers to the Americas left from Seville and, not surprisingly, many of the newcomers (like Boborquez) came from Andalucía. Nevertheless, a substantial number came to America from elsewhere, and some preserved their regional identity – none more so than men and women from Spain’s Basque provinces, many of whom communicated in their native language. Although the Basques always remained a minority, the rest of the Spanish community envied their expertise and success in mining. The most serious rivalry occurred in Laicaoca, a silver-mining region in the Altiplano region of the Andes. Two Andalusian prospectors discovered silver there in 1657 and founded a town that soon became the fourth largest in the region, with perhaps 1,500 inhabitants, many of them Basques. Almost immediately, the region experienced a series of natural disasters: both the maize and coca harvests failed between 1659 and 1662, while epidemic diseases struck in 1660–1. Rioting broke out that pitted not only Basques but also native miners (both Indian and mestizo) against the Andalusian mine owners. Although government forces restored order, in 1665 the Basque insurgents, supported by sympathetic magistrates, seized control of Laicaoca and its rich mines. The following year, however, the Andalusian mine owners, aided by a militia of Indians and mestizos, counter-attacked, chased out the magistrates, and sacked the town to shouts of ‘death to the Basques.’

No sooner did news of this open defiance of royal authority, and of the alliance between Spaniards and Indians, arrive in Lima than the vicecy died. In Arequipa, the town council discussed cancelling religious processions, for fear that discontented elements might exploit the crowded streets to begin a riot (as had happened in both Barcelona and Naples: see chapters 9 and 14 above). Rumours circulated that some Indians in Lima intended to flood the city while other groups throughout the viceroyalty would rise up at Ephesians 1667 to kill all the Spaniards and restore Inca rule; but the authorities acted promptly and executed potential ringleaders. Basque fugitives from Laicaoca in the capital convinced the new viceroy, the count of Lemos, that ‘the kingdom had come within an ace of a great disaster’ and persuaded him to lead a punitive expedition into the Altiplano – the first vicecy to visit the area
for a century. Lemos executed over sixty insurgents (including Pedro Bohorques for good measure), imprisoned many more and razed the rebel strongholds. When the government in Madrid undertook a formal inquiry into the troubles at Tacaca, however, having collected and considered 35,000 pages of testimony, it concluded that Lemos had overreacted. There had been no risk of a ‘great disaster’, only manipulation of power by factions: claims that Lima ‘rotted’ to the verge of insurrection had no more substance than those of Pedro Bohorques to be an Inca, of Don Guillermo Lombardo de Guzmán to be Philip III’s illegitimate son, or of Palafox and Mancera that Portuguese residents were poised to seize Spain’s colonial capitals.

Why did Spanish America largely escape the political upheavals that afflicted so much of the planet in the mid-seventeenth century — especially since both climatic adversity and epidemic diseases caused widespread mortality and economic dislocation? Admittedly, in some areas, such as the isthmus of Panama, the pool of available Native American labour fell so drastically that by the 1630s many towns lacked sufficient food and the colonists’ country estates lacked enough hands to bring in cash crops (above all cacao and indigo). The economy of the entire area entered a half-century of depression. Elsewhere, however, the European settlers found other ways of compensating for labour shortages: they imported more African slaves; and they also increased the labour required from the Native Americans who worked in their mining, farming and textile production — creating appalling conditions that probably led to overall population decline.

Many towns also failed to thrive. An acute shortage of potential brides not only inhibited population growth but also led to some of the highest illegitimacy rates recorded in the Western world. Thus in the largest parish of Lima, over half of all registered births in the seventeenth century were illegitimate and about half of those were born to slaves — indeed, 80 per cent of all registered births to slave mothers were illegitimate: yet another tragic consequence of the abusive power relations that prevailed. As in Europe, a crisis of the future awaited most bastards. The devoted staff of the Foundling Hospital of Lima ‘walked day and night through the streets, corrals, stables, [and by] rivers and waterways to see if desperate people had given birth there, and carried those they found either to the hospital, where most of them died, or to a convent, where the survivors eventually became the celibate servants of the nuns’.

Taken together, these various limits on human reproduction may have averted the ‘overpopulation’ found elsewhere and thus shielded Spanish America from the ‘General Crisis’, but the diversification of the colonial economy also brought relief. The records of the House of Trade, in Seville, which show a sharp fall in official commerce between Europe and Spanish America from 1623 to 1650, have led many historians to suppose that all long-distance trade in the Hispanic world stagnated; but, although disastrous for the Spanish government, the decline brought tangible benefits to America (Fig. 42). Transatlantic trade tied up capital for at least a year — several years in the case of Peruvian merchants, because of the greater distances involved — while Philip IV frequently confiscated goods aboard the fleets as soon as they arrived in Seville in order to fund his wars. To avoid such disasters, American
The search continues for the word "confections" in the dictionary. The word is not found and the search is repeated. After several attempts, the word is finally found. The dictionary is then closed and the search is completed.

The office worker looks out the window at the street. The sun is shining and the temperature is comfortable. The worker then looks back at the dictionary and begins to write something in a notebook. The notebook is then closed and the worker looks out the window again.

The worker then leaves the office and walks down the street. The worker looks at a few shops and then enters one. The worker looks around the store and then walks out. The worker takes a taxi and is then dropped off at the office. The worker then sits at a desk and begins to work.

The worker spends the rest of the day working and then leaves the office at 5:00pm. The worker then takes a taxi home and is dropped off at the door. The worker enters the house and then begins to relax.

The sun sets and the worker looks out the window. The worker then begins to read a book and the night goes by.

The worker wakes up the next day and repeats the same cycle.
arrived, and that this scarcely contributed to the confrontation between them and the native inhabitants — but without a 'natural archive' for the period to reveal the prevailing climate, no such connection can be drawn. In addition, generalization would be doubly hazardous because in three important respects the Cape was not typical of Africa. First, the Dutch newcomers found the sole concentration of temperate land in an almost entirely tropical continent. Second, they encountered only herders and gatherers who (unlike other indigenous peoples in the region) lacked iron, and above all iron weapons, and who could therefore be either expelled or enslaved with relative ease. Finally, the Cape boasts a safe anchorage (except in winter) and relatively easy access to the interior, whereas most of sub-Saharan Africa lacks both the profusion of natural harbours and navigable rivers leading far inland that mark other continents. Instead, less than 100 miles inland, most African rivers descend precipitately from the central plateau to the sea over powerful waterfalls virtually impenetrable to ships.

East Africa

Ethiopia and some adjacent regions normally suffer drought during episodes of El Niño — and the increased frequency of episodes in the mid-seventeenth century is reflected in the flood waters of the Nile in Egypt, which in 1641–3, in 1650 and again in 1694–5 fell to some of the lowest levels ever recorded. This suggests that severe drought periodically afflicted the Ethiopian highlands, where the Nile rises, in the seventeenth century; yet the surviving records of the area, and of other regions of East Africa, mention no political unrest, social upheavals, or economic depression. Of course, this may merely reflect absence of evidence. Attempts to reconstruct the experience of the Illoso (or Teso) people, whose hereditary lands lie between the great lakes of East Africa, have so far failed because (according to James R. Webster, a modern researcher) the Illoso are a people whose ethnic identity and community depend on the act of forgetting. He continued sourly: 'The field researcher has listened to a coherent and detailed account of an historical episode with exciting analytical possibilities. The elders have stopped speaking. There is a pause pregnant with expectation'.

Researcher: 'When did this happen?'
Elder: 'No!'
Interpreter: 'Long ago.'
Researcher: 'How long ago?'
Elder: 'No! No!'
Interpreter: 'Long, long ago.'

'During research into Illoso history "No! No!" becomes the most often heard and, to the researcher, most depressing expression in the language. It is the one he learns first and forgets last.' Nevertheless the silence of seventeenth-century sources from East Africa may constitute evidence of absence rather than absence of evidence, because two factors probably rendered the region 'underpopulated' when the Little Ice Age struck. First, in modern Uganda (the Illoso homeland), a protracted rainfall deficit in the late sixteenth and seventeenth centuries culminated in a total crop failure and famine between 1617 and 1622, which apparently caused mass migration and (presumably) heavy mortality. This may have created a more sustainable balance between food supply and demand a generation later, despite climatic adversity. Second, throughout the seventeenth century, two slave caravans assembled in Sudan, one in the city of Senaar on the Nile and the other in Darfur, which brought at least 5,000 men and women every year to Cairo, to be sold as slaves to toil in various parts of the Ottoman empire. This forced migration may also have relieved the demographic pressure at times of climatic adversity.

West Africa

In West Africa, for which somewhat better records survive, water dominates both the ecology and the economy: climatic change is therefore registered primarily in changes in the rainfall regime. Sahel means 'wilderness' or 'desert' in Arabic, and even on its southern margins in most years only 4 inches of rain falls. This meagre precipitation in the Sahel, the semi-arid tropical savannah belt south of the Sahara that stretches from the Atlantic Ocean to the Red Sea, is sufficient to sustain only small nomadic groups that herd camels, sheep and goats on seasonal grasslands and other hardy vegetation. Just south of the Sahel, the land receives between 4 and 16 inches of rain per year, which make it possible to breed and raise cattle, sheep and goats — provided the herders move south in winter (the dry season) and north in summer (the rainy season) to find water for themselves and their herds. Further south still, annual precipitation of between 16 and 24 inches allows the cultivation of millet, the hardest of cereal crops; and where annual rainfall exceeds 24 inches and produces the rolling tropical grassland known as savannas, farmers can grow sorghum and other rain-dependent crops. The majority of West Africa's people lived in these 'savannas', which stretch from latitude 15° North to latitude 30° South.

It is important to note both the vulnerability and the incompatibility of these three farming strategies. Small variations in rainfall can produce major consequences. If the rains fail in an area that normally receives 16 inches of precipitation, all agriculture ceases and its cultivators must either migrate or become pastoralists — and those who opt for the latter course will soon encounter nomads forced by the same desiccation to migrate south in search of grazing for their herds and flocks. Farmers and herders who previously traded grain and textiles for milk, meat and animals, therefore begin to compete directly for land that has become marginal, and to this end both sides may deploy either force or the threat of force. It is also important to note that all these rainfall levels are averages. Thus at Poder, in northern Senegal, between 1887 and 1927 the annual rainfall averaged 12.5 inches, but this included one year with over 20 inches and another with only 5; while at Ziguinchor in southern Senegal over the same period the annual rainfall averaged 60 inches, which included one year with over 80 inches and another with scarcely 28. These
43. The southeast advance of the Sahara from 1630.

Rainfall patterns in West Africa range from an annual average of 4 inches in the 'Sahel' on the fringe of the Sahara desert to almost 80 inches in the rain forests along the coast, with several critical thresholds that determine what types of agricultural endeavour are viable. After about 1630, each of these thresholds moved southwards, forcing farmers to migrate.
44. Drought and disease in west-central Africa, 1560–1710. Although the surviving records show that several droughts afflicted the areas occupied today by Congo and Angola, the mid-seventeenth century saw an unparalleled combination of natural catastrophes, with drought, locusts, and epidemics.

45. Famine and drought in Chad, Senegambia, and the Niger Bend, 1500–1710. After a period of general prosperity in the sixteenth century, the states of Saharan Africa experienced frequent famines and droughts in the 1640s and, even more severely, in the 1660s - when Lake Chad fell to the lowest level ever recorded.
Louis Maheu de Chabonneau, a French trader in Senegal, attributed the famine of 1674–6 largely to a civil war caused by a charismatic Muslim shi':i, aged about 30, who 'claimed that he was sent by God' and who attracted many adherents in the area. The kings ordered an expedition along the Senegal river by 'proaching' the country. They were entirely naked, disdaining clothes, with his head entirely shaved. He spoke only of the law of God and of welfare and freedom.'64 While Chabonneau called the sheikh Touba (from the Arab word tawba, meaning 'Convert to Islam'), and Arabic sources called him Nairi al-Din (and claimed he came from Mauritania), everyone agreed that 'the war of the Marabout' targeted those whom the sheikhs deemed insufficiently Islamized. Chabonneau reported that in 1674 the new French base at St. Louis, at the mouth of the Senegal river, already suffered a 'scarcity of foodstuffs because of these wars,' but the situation soon became far worse when one of the Wolof rulers counter-attacked, and 'for the entire year 1676 he did nothing but kill, take captives, pillage and burn the countryside belonging to Muslim zealots, destroying the millet harvest and cutting it down while still green, forcing the local population to eat boiled grass.' When Chabonneau sailed up the river to trade, 'whole families offered themselves to me as prisoners, provided they were fed, having reached the extremity of killing each other in order to steal some food.'65

Weiser followed. Nairi al-Din's version of Islam enroiled, among other things, a shift from agriculture to herding, and he therefore required his disciples to cease sowing crops. This shift left them totally unprepared when severe drought returned in the 1680s. Desperate for food, Touba (al's converts killed their animals to stay alive, but having done so, they neither bred or sold them. The number of slaves known to have been transported by sea from the states of Senegambia reflect these changes, almost doubling from over 8,000 in the 1670s, the decade of the 'war of the Marabouts,' to over 14,000 in the 1680s. Even a century later, visitors found no farmers at all in the region.66

Similar instability, caused by a combination of human and natural agency, prevailed further south. After visiting the Bights of Benin and Biafra in 1678–9 and 1681–2, Jean Barbot asserted that the local states were 'ruined by the continual wars which have caused continual famines.' According to historian John Thornton, 'probably more than half of the people of Atlantic Africa lived in polities that measured around 50 kilometres (30 miles) across and had only a few thousand inhabitants, comparable in size to an American county or perhaps a parish' in western Europe. Unlike Americans and Europeans, however, African states did not engage in their 'continual wars' for land, but for people: African legal systems did not regard land as private property, so that ownership of slaves in Africa was virtually equivalent to owning land in western Europe or China.67 Until the mid-seventeenth century, when the ITCZ region migrated southwards and the climate of West Africa deteriorated, most of these conflicts for slaves remained small scale and involved elite warriors who fought with javelins and clubs; but thereafter, rulers began to create much larger armies of slaves and mercenaries, armed first with bows and then with muskets, who fought over far larger areas and took far more captives. This change, seen by some subsequent historians as a 'military revolution,' triggered an arms race in which rulers eager to acquire firearms for their defence traded them for slaves, feeding the dramatic expansion in the transatlantic slave trade as European demand for slaves to work their American sugar plantations escalated.

**Forced Migration: The African Slave Trade**

African slavery, which existed long before the Europeans arrived, took two forms. First, rulers used enslavement to remove troublesome makers from society; those found guilty of (for example) adultery, witchcraft or theft might be fined more than they could pay and, if their kin-group would not help them, the offenders were sold as slaves (the sale price paid their fine). Second, men and women captured during wars or raids also became slaves. 'The distinction between these two processes was crucial,' Robert Harms reminds us. 'Slaves in the former category [criminals], were unlikely to run away because they had no place to go and so often remained in the area; whereas a captured slave had quickly to be taken from the point of capture so that he [or she] could not return home.' The demand of both European and Arab traders for cheap labour increased both forms of slavery, but especially the second. According to an eighteenth-century missionary who interviewed slaves in the Caribbean about their background, 'most of them were captured in open warfare.' The same was no doubt also true earlier.68

The fate of the two million or more men, women and children forcibly deported from Africa to the Americas during the seventeenth century has recently become better known thanks to the remarkable database constructed from almost 35,000 documented slave voyages (roughly 80 per cent of the total) by David Eltis and his colleagues. Almost one-half of the slaves came from West Central Africa (the 500 miles of coast on either side of the Congo estuary); almost one-quarter came from the Bights of Benin and Biafra (the coastal areas on either side of the Niger Delta); and almost one-tenth from Senegambia. Until 1664, ships from Spain and Portugal accounted for 97 per cent of the slave trade organized in Europe, but the separation of the two crowns and the ensuing war between them (see chapter 9 above) opened the way for French, Dutch and British ships to deport slaves to work on their rapidly expanding sugar plantations in the Caribbean. Of 169,000 slaves who disembarked in the Americas during the 1680s, over 141,000 went to the Caribbean (Fig. 46).69

The Little Ice Age played its part in increasing the slave trade, not only via the political, social and economic disruption caused by the southern shift of the ITCZ in the hinterland of Senegambia and the Bights of Benin and Biafra (see above), but also via an increase in droughts, epidemics and wars in West Central Africa. Of an estimated 12,569 slaves deported to the Americas in 1639, all but 285 came from West Central Africa. That year saw the beginnings of a severe drought in the region that lasted until 1645, while the simultaneous Luso-Dutch struggle to control Angola profoundly affected the neighbouring native states, especially Kongo, one of the few large states of Atlantic Africa.70 The kings of Congo, with perhaps 500,000 subjects, had long maintained an ambiguous relationship with the Portuguese, converting to Catholicism but otherwise striving to remain independent, while the
Portuguese constantly sought to impose economic and political as well as spiritual control. The Dutch capture of Angola in 1641 changed this situation. According to Bento Teixeira de Saldanha, a Portuguese resident, the Dutch let the indigenous inhabitants 'live in their own lands, allowing them to produce in their own way everything they needed to live, without permitting a single white man to disturb them in their homes' as the Portuguese have always done, and still do, molesting them and robbing them.99

Teixeira wrote just after an expeditionary force from Portuguese Brazil regained Angola in 1648 and immediately recommenced 'molesting' the native population, and just as a new episode of drought, locusts and disease disrupted life in the interior and led to a succession dispute in Kongo. After a few years of restless coexistence, in 1665 a Portuguese force from Luanda invaded and routed the main army of Kongo at Ambuila (Mwila), killing the king and ending the existence of his realm as a coherent kingdom. Henceforth, regional chiefs maintained themselves by fighting wars to secure slaves, whom they sold to European traders in return for guns and ammunition.99 The decennial total of slaves exported from West Central Africa jumped from almost 60,000 in the 1650s to almost 100,000 in the 1660s and to over 120,000 in the 1670s. Right up to abolition of the slave trade, the region continued to export more slaves than any other part of the continent.

Did this high level of forced migration perhaps mitigate the impact of the Little Ice Age on those humans who remained in sub-Saharan Africa? After all, migration from a community normally reduces its food requirements, and certain areas near to the principal ports of deportation experienced significant out-migration — especially when we include not only the deportees who reached America, but also those who succumbed to disease as their captors took them from drier inland areas to the coast, where they lacked immunity to new disease environments, and those who perished in the overcrowded and insanitary coastal holding pens or on the voyage. Malnutrition, ill treatment and despair all took their toll: many of the logs kept by the slaving ships record the cause of death of their precious cargo, and they included 'stubbornness' and 'lethargy' as well as 'dysentery', 'scrofulous' and a violent blow to the head. Not for nothing did the Portuguese call the ships that carried slaves from Africa to America 'tumbrels' — 'coffins'.

If we include all forced migrations from East, Southeast and West Africa, seventeenth-century European and Arab traders between them apparently deported some 50,000 slaves annually from a continent with perhaps 100 million inhabitants — which at first sight makes the overall impact seem marginal (except, of course, for the victims). But the slaves did not come from all parts of the continent: on the contrary, most of them seem to have lived within 150 miles of coast – and, within that restricted area, often in specific regions. Although we currently lack data on the exact origin of seventeenth-century slaves, those from the eighteenth century show a remarkable degree of geographic concentration. For example, the 'profile of slaves' that embarked on vessels leaving the Bight of Biafra reveals that 'most captives originated in the small Cameroon Highlands area'. In addition, over half the slaves exported to the Caribbean from the Bight of Biafra in the seventeenth century were
female and one-tenth were children; while almost one-fifth of those deported from West Central Africa were children and over one-third were female. Deporting women and children intensified the impact of emigration by removing (in effect) the next generation.83

Yet even with all these exacerbating factors, it seems unlikely that even the areas of Africa most involved in the slave trade lost more than 10 per cent of their population through forced migration — whereas a drought, and drought-induced epidemic, could wipe out three times as many people. So, to return to the earlier question — did forced migration mitigate the disruptive impact of the Little Ice Age on those humans who remained in sub-Saharan Africa? The answer may well be affirmative. If we add famine and disease mortality to the high level of forced migration in coastal regions, the synergy of human and natural agency in sub-Saharan Africa may have removed one-third of the total population, as it did in much of Asia and Europe, and these disasters may have assisted those who remained to survive even prolonged climatic adversity.

Australia

Australia, the driest inhabited continent, covers 5 per cent of the planet's land mass and yet it has (and has probably always had) one of the lowest population densities in the world. The reason for this disparity lies in a combination of climate and isolation. Only the southeastern and southwestern corners of Australia boast both a temperate climate and fertile land, but since they lie farthest away from the other continents, until the late eighteenth century they remained almost entirely isolated from the rest of the world, both demographically and economically. Deserts and semi-arid lands, known as 'the outback', cover more than two-thirds of Australia, and the annual rainfall in some locations there can vary from under 4 inches to over 36 inches. As in sub-Saharan Africa, the critical variable is not the average annual rainfall but its seasonal variability. Even in the temperate zone, drought and the threat of drought are constant concerns.

Two factors preclude precision about the experience of Australia's population in the seventeenth century: the paucity of the 'natural archive', especially the rarity of tree species that produce distinct annual growth rings; and the complete absence of a 'human archive'. Although several groups of Europeans visited after 1606, none of them described climatic conditions; while although the indigenous inhabitants probably referred to catastrophes in their rich oral traditions, attempts to date these events have so far failed. Nevertheless, some generalizations can be offered. Australia, in the words of the pioneering historian of climate Richard Grove, has 'above all other places a claim on the epithet, 'the El Niño continent'.'84 This means that the same droughts that afflict China, Southeast Asia, Indonesia and India in El Niño years also afflict Australia — and therefore that the doubled frequency of El Niño events in the mid-seventeenth century would have struck Australia with unusual force. In particular, the continent presumably experienced the same major drought registered in nearby Indonesia between 1643 and 1671, with particularly intense episodes between 1659 and 1664 (see chapter 13 above.) Reconstructed tree-ring sequences from the island of Tasmania in the south appear to confirm this surmise, showing a succession of poor growing seasons in the mid- and late seventeenth century, a period that saw the 'most prolonged cool period in the past 700 years'.

How much would these climatic events have affected the population of Australia in the seventeenth century? To survive the extreme climate even in 'normal' times, native Australians needed adaptive strategies in much the same way as many of the unique flora and fauna of the continent. Many Australian plants survive because they have developed deeper roots and an enhanced resistance to fire, while some Bankia species produce cones that release seeds only after experiencing both a bushfire and the subsequent onset of rains — precisely the environment most favourable to germination and seedling survival. Likewise the red kangaroo has evolved uniquely efficient mechanisms to cope with the unpredictable extremes of rainfall: it eats vegetation high in moisture, and so can go for long periods without drinking; it hops, which enables higher speeds of travel with no increase in energy expended; and its reproductive cycle, known as embryonic diapause, supports three babies at different stages of development at the same time, which allows a rapid increase in population as soon as a drought ends.85

The annual life cycle of the aboriginal population of Australia's Western Desert in the mid-twentieth century suggests that its human population also adopted unique strategies in order to survive in some of the harshest environments on earth. The annual cycle began with the 'wet season' between December and February, when huge thunderstorms unleash torrential rains, which provide abundant water but do not immediately produce food. Family groups therefore moved around, foraging in areas neglected since the last wet season until seeds, root crops and fruit began to appear in March; then they settled down, living for two months or so by waterholes on the plains and harvesting crops (although often amid periodic droughts and temperatures that fall to 6°C at night). This 'cold time' ended in August as temperatures rose rapidly and the landscape gradually dried out. Men now set fire to vegetation on the plains, both to trap game and to improve the yield of seeds and tubers the following year, while women prepared and stored the vegetables that would sustain the group through the rest of the year. Eventually in the 'hot time' or 'hungry time', as temperatures rose to 50°C, the waterholes on the plains dried up, forcing people to retreat to rock holes for the rest of the year. There they reduced their daily activities and tried to make their food and water last as long as possible, but since drought and heat stress limited foraging to areas near the rocks, the average calorific daily intake might fall as low as 800 person — roughly half of what is necessary to sustain even someone of small stature. Sometimes the weak drank blood drained from the stronger members of the group in order to get through the last few weeks until the torrential rains returned and allowed them to leave their rock holes and spread out on the plains once more.

Although the environment of the Western Desert is harsh, its human inhabitants found and used 120 plants to satisfy their needs. Of these, 70 yield edible parts and
over 40 produce seeds, which the women of the group would laboriously hank, winnow, grind and turn into a paste to be either baked in the campfire or eaten raw. Tubers and bulbs were far easier to turn into food - they were simply pulled up and roasted - while large game (such as kangaroos), once caught, would be gutted and grilled, and small game (birds, lizards and snakes) would be baked.

Since both the seasons and the availability of each resource followed the same pattern each year, the aboriginal populations of the Western Desert survived through their intimate environmental expertise, combined with knowledge of when each source of nutriment would become available as the seasons changed, and the use of fire to trap game and stimulate future crops. The one unpredictable variable was the precise duration of the 'hungry time', which determined whether or not there would be sufficient water and food to sustain the group from one annual cycle to the next, and thus who would die (either from thirst or starvation) and who would be born (because famine amenorrhoea would prevent conception).

Scott Cane, whose research on aboriginal subsistence strategies in the Western Desert is summarized above, noted one other feature of life in the 'hungry time': 'If the rains fail to come, tensions run high and fights are common.' All Aboriginal groups carried weapons - some of them offensive: spears, often used with speare-throwers which produced a velocity of 100 miles per hour and accuracy up to 164 feet; boomerangs; and clubs, sometimes with sharp shells attached to the head. Clearly these weapons were used against people, as well as game, because warfare features in many Aboriginal oral traditions, while when the British arrived in Sydney in 1788, they 'found Aborigines with wounds that could only have [been] caused by fighting with other Aborigines.' It seems probable that wars between rival groups - like fights between group members - became more common in years when the 'hungry time' dragged on and reduced essential resources. It therefore also seems probable that a fatal synergy between natural and human factors prevailed in Australia, and that its population shrank in the seventeenth century until the reduced resources available sufficed to satisfy its minimum demands.

Scott Cane believed that his study of the Aborigines of the Western Desert presented 'the last reliable data on hunter-gatherer subsistence economies from arid environments anywhere in the world' because the way of life he described ended in the 1950s when the hunter-gatherers 'moved from the [Western] Desert onto cattle stations, missions and government settlements, scattered around the desert fringe.' Nevertheless, a modern aboriginal bark painting shows a keen awareness of the destructive power of the weather. It depicts Bumerangun, the 'Lightning Spirit', holding in his hands conduits of power that run from his large testes, while his knees contain stone axes: both serve to remind viewers of how bolts of lightning destroy trees and start wildfires - and thus of the need to complete all activities, both farming and social, before the season of powerful storms begins.

In the seventeenth century, hundreds of thousands - if not millions - of hunter-gatherers' populated the various 'arid environments' of the planet. In large parts of Africa and the Americas, in Central Asia and in the far north of Europe, human populations must have evolved coping strategies similar to those of the aboriginal population of Australia, allowing them to survive; and, as in Australia, those strategies no doubt proved only partially adequate whenever the annual 'hungry time' grew longer. Although the absence of a 'human archive' for these various groups precludes certainty, it is possible that in arid environments, too, 'one-third of the world died' in the seventeenth century. If so, it means that the only large area to register rapid and sustained population growth in this period, apart from New France and New England, was Japan.
the increase in volcanic and El Niño activity, the environmental deterioration has few parallels; while the frequency of wars and state breakdown created unprecedented political, social, and economic instability.

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 because they became slaves; while millions more in Russia and eastern Europe also lost their liberty because they became serfs. Whether free or unfree, women also suffered disproportionately in most parts of the world. Women killed themselves because they had been raped and otherwise humiliated and could not ‘live with the shame’; because they were destitute and could not face a life of hunger and deprivation; or because they did not wish to survive the death or disappearance of their loved ones. Many of the survivors faced a ‘bitter living’ (in the memorable words of a poor woman with only a small field or so to her name’ in Germany): she and her sisters had to work harder and longer just to stay alive. Their desperate situation helps to explain why so many women around the seventeenth-century world aborted, killed or abandoned their infant children.7

Admittedly, some European women could use the ‘weapond of the weak’ to retaliate against their oppressors. Female workers and servants abused by their employers could seek revenge not only through foot-dragging, pillaging and plunder but also (in extreme cases) through arson and murder. Wives could not only plead with their abusive husbands in private: they could 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 16-year-old servant. After tears, reproaches and ‘ranting’, she threatened to tell their neighbours, to leave him, and even to join the Catholic Church. She also struck Samuel, attacked him 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’: she refused to sleep with him. Three weeks after his disgrace, Pepys confided in his diary that he was ‘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 power 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 runs ‘prisoners’ and wives ‘slaves’.’8

Queen Christina would no doubt have felt the same about her female contemporaries in much of Asia, where ‘respectable’ women lived in seclusion from puberty to menopause (a seclusion reinforced in China by the practice of foot-binding: see chapter 4 above). The only exceptions in the Muslim world were the mothers, wives and concubines of Mughal, Ottoman and Safavid rulers, especially during succession disputes. Thus Shah Jahan, who was absent from the Mughal court when his father Jahangir died in 1627, gained the throne only because his female relatives
at court took control and outmanoeuvred those who supported other claimants. In the Ottoman empire Kösem, mother of Sultans Osman, Murad and Ibrahim, over-threw several Grand Viziers and even conspired in the regicide of 1648, becoming the most powerful person in the state, a power rarely lasted long; in 1654 Kösem was murdered at the behest of the mother of the new sultan, just as a generation earlier, in Iran, Shah Saf murdered scores of his female relatives because he feared they might try to overthrow him. Wars and revolutions killed, maimed and ruined large numbers of people, both directly through brutality and indirectly through forced migration and destruction of property. Deaths among young men rose with especial rapidity 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 soldiers, as well as for thousands of civilians — Protestants and Catholics in Ireland, Jews and Poles in Ukraine, and Ming Clansmen in China — the World Crisis proved a terminal event. Taken together, these tragedies claimed the lives of so many millions, including so many members of the elite, that one might speak of a "lost generation." In some areas, a whole way of life disappeared. The violence of the Ming-Qing transition permanently destroyed sericulture in the province of Shanxi, and the Gujrat famine of the 1628–31 did the same to one of India’s premier cotton- and indigo-producing areas (see chapters 5 and 13 above). 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 similar cities (see Fig. 13), 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 (see chapters 1 and 15 above) also prevailed in the seventeenth century, then many communities and countless families must have crossed a threshold of outrightness and perished, leaving no trace. Admittedly, the turmoil produced winners as well as losers. In East Asia, both Nurhaci and Togukawa Ieyasu were revered as gods soon after their deaths and bequeathed to their numerous descendants a luxurious lifestyle that would endure for more than two centuries. Indeed, the numerous Toshogu shrines in Japan still honour the divinity of the first shogun, making him by far the most successful denizen of the seventeenth-century world. The descendants of Michael Romanov also prospered from the political, economic and social balance created by the crisis of 1648–9, 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 almost three centuries. Many followers of these rulers also profited from the upheaval. In East Asia, tens of thousands of Manchu Baratmen and their families exchanged a precarious existence on the steppe for a life of plenty in one of the ‘Tartar towns of China. Likewise, most of the military and civilian officials who swiftly transferred their allegiance from Ming to Qing prospered: of 125 senior officials who received the ambiguous title Er chan (‘ministers who served both dynasties’), 49 became the president or vice-president of a department of state after the conquest. In Japan, the Tokugawa clansmen and most of their daimyo allies enjoyed more than two centuries of peace and plenty following the proclamation of the ‘Genna armistice’ in 1615. In Russia, the boyars and their descendants who in 1649 won control over their serfs through the Uchenchina, maintained their advantage for over two centuries. In India, the leaders who supported Aurangzeb when he challenged his father and brothers during the Mughal Civil War of 1657–9 shared some of the wealth of 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; while Jean-Baptiste Colbert, who at school ‘was so dull that he was always bottom of the class,’ thanks to the favour first of Cardinal Mazarin and then of Louis XIV, died a millionaire and 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 Sköllstorp near Stockholm testifies even today to the bounty brought home by General Karl Gustav Wrangel, while his colleague Hans Chrétifft Königsmarck, who began as a common soldier, died a nobleman with assets worth two million thalers. In England luck and good judgement during the Civil War allowed George Monck, the younger son of a squire (and fortunate as a young man to escape hanging for murdering 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. Often, soldiers gained at the expense of civilians. A Brandenburg lawyer and tax official, Johann Georg Maul, kept a diary between 1631 and 1645 in which he obsessively catalogued the descent of his family from prosperity to virtual destitution at the hands of soldiers who either robbed them, lodged with them, or demanded contributions from them. Maul’s first experience of war cost him 230 thalers: a cavalry sergeant, three troopers and their lackey ate their way through 55 thalers in food over 11 weeks; ‘there was also 115 thalers . . . for 22 barrels of beer, which the aforementioned boosted away with his guests every night.’ Maul also had to provide wine for some visiting officers, hay and straw for their guests, oats for the troopers’ horses and, to add insult to injury, ‘ten thaler for a horse which the major took as a mount for his Pool, who was called Pointynose.’ Most subsequent years brought similar billeting demands, sometimes several times, which Maul grimly itemized along with robberies by troops living in his house, as well as endless demands for contributions to sustain troops billeted elsewhere. By 1640 Maul had enriched so many soldiers (and their camp-followers, like Pointynose) that he had virtually nothing left: when he defaulted on his contributions, the three troopers sent to extract payment ‘saw for themselves that I had no money,’ so after drinking beer worth three thalers ‘they agreed to leave, taking a handskerchief each which my wife gave them, worth a thaler, and some bread.’
The upheavals of the age brought some women fame. Queen Christina said and did things after her abdication in 1654 that would have led other women to the gallows — making fun of religion; dressing, speaking and behaving as a man; ostensibly kissing and sleeping with other women — but, as a prestigious convert to Catholicism as well as a former queen, she enjoyed unique freedoms. Between 1649 and 1653, Madeleine de Scudery published The Great Cyrus, the longest French novel ever written (2 million words; 13,000 pages; 10 volumes), which achieved enormous success because its protagonists were thinly disguised caricatures of Paris socialites and Frondeurs (Cyrus himself was obviously the prince of Condé, and so on). Yet Mlle de Scudéry was also a radical feminist. Her novels implicitly attacked the prevailing idea of love as something rational, calculated and possessive; instead, her characters insist that love springs from the heart, not the head; and that love is only real when a man is overcome by a force stronger than himself and becomes totally submissive to a woman. Despite their enormous length, her books also appeared in English translation and reached a wide public. Elizabeth Pepys, who was not normally an avid reader, enjoyed Scudery’s books so much that one night she angered Samuel, as they travelled in the coach, in her long stories out of Grand Cyrus, which she would tell, though nothing to the purpose nor in any good manner. (Did Samuel perhaps recognize the threat to his philandering ways posed by the book’s feminist views?)

Mlle de Scudéry also presided over a literary salon every Saturday, attended by the leading French intellectuals. One of its numerous female members was Mme de Lafayette, one of those of the Rococo age (1678) who has been hailed as the first modern novel in French, since it offers both historical verisimilitude (it takes place at the French court a century earlier) and psychological analysis. It also reveals a noblewoman wrestling with the temptation to commit adultery with another courtier – a subject scarcely conceivable for a pre-Crime novel, especially one written by a woman. The Prince is currently available in numerous printed editions, as a film, a ‘Kindle’ book, and a book-on-tape (duration: 5 hours 46 minutes); it forms part of France’s National School Curriculum; and in 2008 Nicholas Sarzely, then President of France, complained how much he had suffered from being forced to read it at school. Fane indeed. Both Scudery and de Lafayette appear to have passed unscathed through the human and natural disasters of the mid-seventeenth century. Few women enjoyed such luck. Although there was no ‘typical’ experience of the global crisis, the lives of two other remarkable female survivors, and of their families, may be more representative. Wang Dangkou (c. 1621–1701) was the daughter of a scholar-official in China’s once wealthy Jiangnan region. Too old to fight the Qing, when their soldiers arrived in his town in 1654 his father posted on his door a sign that read ‘NO SURRENDER’ and refused to shave his head in the prescribed Manchu fashion. Instead, he fled to the mountains where he starved himself to death. Meanwhile his learned daughter, who had married an official who also refused to bow to the new regime, supported him as long as she could, through her teaching, writing and painting, but ‘when the chill and hunger became unbearable’ they left home together, taking turns at ‘pushing a cart. Desolate while on the road, they sold her calligraphy, painting and writing for a living’. That same year, 1654, Margaret Lucas, a lady-in-waiting to Queen Henrietta Maria of England who had followed her mistress into continental exile, married William Cavendish, marquis of Newcastle, the defeated royalist general at Marston Moor, 30 years her senior. The couple remained in exile until the Restoration of 1660, renting the exquisite town house that Peter Paul Rubens had used as his studio, where Margaret entertained literary luminaries and wrote books. In 1656 she presented the Antwerp City Library with a five-volume set of her own works; 11 years later she was the first woman to be allowed to visit the Royal Society (where she watched an ‘experiment’ performed by Robert Boyle); and by the time of her death in 1676 she had published over 20 books on subjects as diverse as natural philosophy, poetry, love (in verse and prose), and science fiction. She also composed an autobiography that, although expressing satisfaction with her social and literary successes, devoted far more attention to the loss of almost £1 million because Parliament had sequestered all her lands and revenues, and to the pain she felt at the death of her older brother Thomas from a head wound sustained while fighting for the king in Ireland, and the execution of her younger brother Charles by firing squad after the surrender of the royalist garrison of Colchester. Both died in 1648, and the following year her sister died of ‘consumption’ (no doubt tuberculosis), followed by her mother. Margaret wrote that her mother’s death was, ‘I believe, hastened through grief’ at having ‘lived to see the ruin of her children. She concluded sadly: ‘I shall lament the loss so long as I live’. Despite her literary eminence, in her own eyes the balance sheet of her life, which ended before she was 50, was decidedly negative. The balance sheet of many states likewise showed both losses and gains. Thus although Qing China and Romanov Russia topped the list of successful dynasties, 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 Raine 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, including the permanent loss of most of the Lusitanian empire in Asia (and 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 sultans of Mactan; 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, while Scotland and Ireland (the first states to rebel) temporarily lost their independence. The weakness of the Ottoman empire allowed the Austrian Habsburgs to conquer most of Hungary; while the weakness of the Spanish Habsburgs allowed Louis XIV
to advance the frontiers of France – albeit, in both cases, at the cost of hundreds of thousands of lives.

Other states suffered grave political losses in the mid-seventeenth century and gained little or nothing. The kingdom of Kongoj in Africa, and the Indian nations of New England, all perished; while 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 short-lived Shun dynasty founded by Li Zicheng in China disappeared without trace; while the fall of the Ming forced a reconstruction of Korean identity, because it 'shattered the premise concerning the world order of which the Koreaes felt they were a part' (just as it required Han Chinese intellectuals to refashion themselves). Around the Great Lakes of North America, the Hurons and their allies escaped famine, disease and the Iroquois by moving west where, as Daniel Richter noted, they 'recombined and reinvented themselves' to create a 'Middle Ground' between New England and New Mexico that lasted until the late eighteenth century – but they nevertheless lost all their ancestral lands.12

Above all, 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 – Qing China; Romanov 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. Apart from the loss of his former vassals in Portugal and its empire, and along the French frontier, war devastated Catalonia, the areas of Castile along the Portuguese frontier, the Netherlands and Lombardy; while plague, recruiting and taxation depopulated large parts of the Spanish Mediterranean. Finally, in France, famines, epidemics and the civil war unleashed by the Fronde, 'the climax of the Little Ice Age' and the losses caused by his repeated wars meant that Louis XIV probably ruled over fewer subjects at his death in 1715 than when he began his personal rule in 1661.

In Search of Common Denominators

According to political scientist Mark Hagopian's book, The Phenomenon of Revolution, even

When we have enumerated adequate sets of antecedent conditions with their respective empirical generalizations, [t]he resulting explanation or prognosis is bound to be highly complex, but those seeking simplicity should study something else than the causes of revolution. In addition, there is good reason to doubt the 'completeness' that any explanation of revolution could possibly attain.

Thus inspired, let us begin with the 11 'antecedent conditions' (or, as a historian might call them, 'causes') offered by Francis Bacon in his celebrated essay 'Of seditions and troubles', first published in 1612.

The causes and motives of seditions are: innovation in religion; taxes; alteration of laws and customs; breaking of privileges; general oppression; advancement of unworthy persons; strangers; deserts; disbanded soldiers; factions grown desperate; and whatsoever, in offending people, joyous and knitteth them in a common cause.14

Most of these categories can be broken down into components. Thus, in his lectures to the Statistical Society of London in 1787 on 'The famines of the world: past and present', Correllius Walford proposed 13 distinct causes for just one of Bacon's categories: 'deserts'. Walford discerned six natural precipitants of harvest failure, including excessive rain, frosts, droughts, 'plagues of insects and vermin' and sunspot cycles, and seven more 'artificial' (read: human) precipitants, including war, 'defective agriculture', insufficient transport, legislative interference, currency manipulation, hoarding, and diverting grain from making bread to other purposes (such as brewing or distilling).19

Nevertheless although Walford relied mostly on nineteenth-century data from England and British India, the same combination of 'natural' and 'artificial causes' he identified also prevailed in the seventeenth century. Famines caused by unfavourable weather were often exacerbated by 'defective agriculture' (farmers who refused to cultivate maize and other crops more resistant to a harsher climate); by a shortage of vessels and carts to transport food from areas with a surplus to those in deficit; by grain merchants who withheld or diverted supplies in order to increase their profits while people around them starved; and by governments that promoted economic chaos by tampering with the currency, squandered resources that might have fed the starving, and refused to make peace in order to reduce demands for troops and taxes. The seventeenth century also witnessed an 'enigma', noted by Walford, 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 often included rebellion and sometimes revolution. Nevertheless, Walford remained convinced that extreme climatic events normally played a greater role than human action in creating catastrophe.24

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, 1657–8 and 1694–6). 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, and two 'years without a summer' (1628 and 1675); and an unequalled series of extreme climatic events – the freezing over of both the Bosphorus (1620) and the
Baltic (1658); the drying up of China’s Grand Canal (1641); the maximum advance of the Alpine glaciers in 1642–4. In 1641 the river Nile at Cairo fell to the lowest level ever recorded, while Scandinavia experienced its coldest winter on record. These various climatic aberrations accompanied a major episode of global cooling that lasted at least two generations: something without parallel in the past 12,000 years. The famines caused by this change in the global climate caused what would today be called a ‘humanitarian crisis’ in which millions of people starved to death.

These same years of death also saw rebellions and revolutions, with two distinct ‘peaks’: Normandy, Catalonia, Portugal and its overseas empire, Mexico, Andalusia, Ireland and England in 1639–42; and Naples and Sicily, France, England (again) and Scotland, Russia, the Ottoman empire and Ukraine in 1647–8. Sometimes a link between rebellion and climate change is manifest. Thus, in Scotland, the summer of 1637 (in which Charles I sought to impose his new liturgy) was the driest in two decades, while 1638 (when he refused to make concessions to his Scottish opponents) was the driest in a century. Government innovation and inefficiency at a time of unprecedented climatic adversity led many Scots to join the Covenanting revolt. 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, his lordship did not ‘run away’. He had already signed the formal protest against the new Prayer Book; six months later he signed the National Covenant. In 1640 Lothian led a regiment in the invasion of England, declaring that ‘necessitie made us come from home’ and ‘in our laudable defence WE DARE DIE’. 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; and 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. Likewise, in East Asia, the repeated harvest failures caused by adverse weather in the early 1640s had two dramatic political effects. First, the famines and popular rebellions in Jiangnan fatally weakened the Ming as they struggled against the inroads of ‘roving bandits’ from the north-west. Second, 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 death also 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 the privations inflicted by climate change in the mid-seventeenth century were an exception. The revolts in Ivrea in 1637, Palermo in 1647, Ferrara in 1648, and the ‘Green Banner’ revolts of Andalusia in 1652, began in just the same way as the greatest rebellion of the twentieth century in Petrograd in 1917: when adverse weather ruined a harvest and thereby created a food shortage that brought hungry people onto the streets shouting ‘bread’. In such a tense situation, even a small increase in government pressure could produce an apparently disproportionate popular reaction. The revolt of the towns of Sicily in 1647 began when the government decreed an end to the subsidy that had kept down the price of bread; while the Naples revolution a month later began when the viceroy reimposed 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 also 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 the churches in villages that defied them had the same effect in Catalonia in 1649; as did the decision of the Qing regent Dorgon to enforce the head-shaving edict on all males in China in 1645. The revolt of the Catalans would last for 18 years; the resistance of Ming loyalists would last for 38 years. Ineptitude by rulers could also encourage resistance. In Naples the inability of the ‘lettro del popolo to settle a squabble over who should pay the ‘fruit excise’ on the morning of 7 July 1647 allowed Masaniello and his ‘boys’ to galvanizeariate 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 regent bolstered an attempt to arrest his leading opponents as they left a service in Notre Dame cathedral. The ineffective use of force by governments in the initial stages of a rebellion could also prove disastrous. In Barcelona in 1640, in Naples at 1647 and in Messina in 1674, rebellions began just after the galleys squadrons based in each port city departed to fight elsewhere.

The most 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 climatic change and to government abuse. The major revolts against Charles I and Philip IV all began in a political capital (in Edinburgh, Dublin and London against the former; in Barcelona, Lisbon, Palermo and Naples against the latter), as did other insurrections that rocked and sometimes toppled seventeenth-century regimes: Prague in 1618; Stettin in 1622, 1648 and 1651; Manila in 1639; Paris in 1648; Moscow in 1648 and 1662; Edo in 1651.

Popular protests alone rarely brought down 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, Chars 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; while in the Ottoman empire the Chief Muhl (the Seybiliyam) 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; while seven years later the duke of Guise established the short-lived 'Royal Republic of Naples.' In the Mughal, Ottoman and Chinese empires, in contrast, the hereditary nobility played virtually no part because their fortunes were too closely linked to the state. Most of the remaining leaders of the major mid-seventeenth 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 Founding 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 the 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 an earlier state of affairs which they considered preferable. Thus the rebels in Palermo and Naples demanded a return to the Charters granted by Charles V a century before; the Catalans called for respect for their ancient 'constitutions'; the Portuguese wanted a return to the relationship with the king created at the union of 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 merely for a return to the past. In England, they demanded government by the crown-in-Parliament, as created by his predecessors; in Ireland the Catholics sought implementation of the 'Graces,' which would end the recent trend in Protestant expansion at Catholic expense; in Scotland, the Covenanters insisted on retaining their traditional liturgy. In France, the judges wanted a return to the constitutional 'balance of power' that they believed had prevailed in the Middle Ages; while the 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 crown 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 past 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, Kadirzade Mehmet 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 Swiss in Entlebuch and the Norman No-Pieds, demanded a return to a Golden Age when 'justice' had prevailed. To quote Crane Brinton once more: 'Revolutions cannot do without the word 'justice' and the sentiments it arouses.'

Attempts to gain 'justice' drew strength, at least in Europe, when supported by legal institutions of unquestioned legitimacy, such as the law courts or Parliament. To this end the rebel leaders in Scotland, Catalonia and Portugal immediately summoned the 'Estates of the Realm' 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, the Catholic leaders created their own General Assembly and Supreme Council at Kilkenny, which served for a decade as the government of an independent Ireland (it even boasted its own corps of resident foreign diplomats: an achievement not repeated until the twentieth century). 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 House of Commons (the 'Rump') tried and executed him, and then proclaimed England a Republic with themselves as its sole sovereign body. Meanwhile, in the Dutch Republic, the States-General exploited the death in 1650 of William II of Orange to gain control over the executive functions that he had exercised. In Ukraine, finally, 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 30 years. The revolt of Portugal against Habsburg authority in 1640 began a conflict that lasted 28 years; while the Catalan Diputació's rebellion of Philip IV the following year turned the principality into a battleground for 19 years. In Ukraine, the Cossacks' rejection of the authority of the Polish crown in 1648 also led to 19 years of war. The execution of Charles I by his English subjects in 1649, and the proclamation of a Republic, inevitably led to hostilities against the Scots, the Irish and several American colonies (which proclaimed Charles II as their sovereign), and the former Stuart monarchy remained on a war footing, with a large army and navy even in peacetime, right up to the Restoration in 1660.

Longevity, however, 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 of those who begin a war, not being able to foresee where it will end. None of the Five Members 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 whose actions
demonstrated their ability to lead. Likewise, in Naples, the constitutional lawyers Gennaro and Arpaja replaced the illiterate demagogues Cassiano, only to lose their places to Gennaro Annone and the duke of Guise, who possessed military experience. The rise of a 'second generation' of more militarized leaders, like Cromwell and Annone, helps to explain why revolutions became more violent the longer they lasted. The experience of resistance habituates leaders to actions that would earlier have seemed intolerable. Moreover, any government, whether established or insurgent, needs to take drastic measures when faced with climatic extremes, famine and war (and in the mid-seventeenth century such challenges occurred with unusual frequency), but regimes that lacked legitimacy (and experience) might resort to more extreme measures to enforce their policies.

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, the Catalan opponents of Philip IV appealed for French assistance; and although French troops and military advisors 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 spectacular of all, in China, the Ming commander Wu Sangui appealed to his northern neighbours for military assistance against the 'movable bandits', and allowed the Manchu Grand Army to pass through the Great Wall to destroy Li's forces; but once this mission had been accomplished, the Manchus claimed that their victory conferred 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. Thus immediately after his 'acclamation', King John IV of Portugal sent envos to Barcelona to make common cause with the Catalan rebels; and somewhat later his principal adviser, the Jesuit António Vieira, went to Rome to invite the Pope to invest John's son as king of Naples (a papal 'title'). In 1645 in Castile, Don Carlos de Padilla, lynchpin of the 'conspiracy of the dukes of Hijar', looked to John IV of Portugal for support; and government agents found the name of Don Miguel de Ibarbide, who had recently spearheaded a successful opposition to royal policies in Navarre, among his papers (see chapter 9). Most striking of all, as soon as news arrived that riots in Palermo against excessive duties in 1647 had secured their abolition, the citizens of Naples began to 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'. One of these 'Palermitani' was Giuseppe d'Alesi, who returned to lead the movement in his native city that secured the same concessions as those granted the previous month to the rebels of Naples. In addition, in both kingdoms, revolt in the capital provoked copycat uprisings in numerous other towns (see 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. Thus some Scottish ministers in northern Ireland found the hostility of the earl of Stratford'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 defence of the tsar (see chapter 6). Finally, the peasants of Enghelbuch who began the 'Swiss revolution' in 1653 sent envoys to mobilize support elsewhere in Canton Luzern and its neighbours (see chapter 8).

Despite the unparalleled frequency of revolts in the mid-seventeenth century, it is possible to imagine a more peaceful world - even with the litany of 'unsounded conditions' listed above. 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.' Accidents - totally unpredictable developments - could crucially affect the outbreak or outcome of a rebellion: the election by lot of two talented but intrinsically Catalan patriots, Pau Claris and Francesc de Tamamit, as the senior Diputats of Catalonia, in 1638 (see 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 (see chapter 6); the death from smallpox of William II of Orange without an adult heir just after he had defeated his domestic opponents in 1650 (see chapter 8).

Some 'accidents' were more predictable - especially those caused by distance, which was (in Fernand Braudel's adage) 'Public Enemy Number One'. 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 it meant that 'I cannot 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. 
Likewise, the central government in Madrid received the first reports of the Portuguese revolution that occurred in Lisbon on 1 December 1640 just one week later than was refused to believe them. 'It is impossible that the 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.' The king 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.18

Conversely, 'accidents' could also unexpectedly derail rebellions. Thus Lord Maguire's plot to seize Dublin Castle in 1641 failed only because 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 so sent him away. He 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). 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.20 In each of these cases (and no doubt in many others) a minor 'reversal' of the historical record would thus 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 only 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 revisionary) counterfactuals: the possibility that rewriting the short-term historical record, as in the examples above, might still not alter the long-term outcome. Revisionary counterfactuals take two forms: one positive (an 'accident' could delay but not permanently derail 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', 22 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; just as Charles II regained virtually all of his father's powers in all his dominions 11 years after the regicide in 1649. Turning to the 'natural archive', since some parts of the planet could only feed their inhabitants in 'good years', then even a few volcanic eruptions and El Niño episodes occurred in the 1640s, sooner or later 'bad years' would come, and they would still cause heavy mortality.

M. de Bellèvre, the French resident in London, provided a good example of a negative 'revisionary counterfactual' as he contemplated the situation in Ireland in 1648. He informed Cardinal 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.19

The English conquest began the following year, and within three years Confederate Ireland was no more – but, in Bellèvre's view, even if the London government had delayed its campaign of repression, internal dissent still doomed the Catholic cause to ultimate defeat. Historian Julius Goodare has proposed a similar negative 'revisionary counterfactual' for Scotland; given the character of both Charles I and the leading Covenanters, 'the Scottish crisis of 1657–8, 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.21

Many of Charles's fellow rulers – Qog Regent Dorgon, Tsar Alexei Romanov, Gustavus Adolphus of Sweden and Christian IV of Denmark – displayed a similar inflexibility; and so did their principal ministers. None of them seemed prepared to contemplate alternatives to the policies they had adopted. Thus 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.22 Although Philip IV's ministers never gave their political programme a boastful name like 'Thorough, they blindly pursued policies that were equally ambitious and equally unrealistic. However desperate the political situation seemed, introducing innovations and imposing additional burdens during the adverse economic and social situation caused by the Little Ice Age was sooner or later likely to provoke resistance and rebellion.

The Two Worlds of Robinson Crusoe

Robinson Crusoe, one of the most famous fictional inhabitants of seventeenth-century Britain, grew up during the Civil War and left home in 1651, just after the execution of Charles I, and after being marooned on a remote island he returned to his native land in 1687, just in time to witness the flight of James II and the Glorious Revolution. Yet Crusoe's 'Strange and surprising 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 grew 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 (see chapter 20 above); 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. He 'allow'd liberty of conscience throughout my dominions' to Catholics, Protestants and pagans alike, and he considered 'all the disputes, wranglings, strife and contention, which has happen'd in the world about religion, whether niceties in doctrines or schemes of church government, they were all perfectly useless to us, as for ought I can yet see, they have been to all the rest of the world'. Crusoe's enthusiasm for religious toleration did not stem from a desire to attract religious refugees (as under Cromwell) but because it was essential for profitable international trade (which Crusoe pursued with great success). Finally, Crusoe successfully practised the 'new philosophy' (see chapter 22 above). 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 suitable'. 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 Native American, from cannibals and immediately set him to work on his 'colony' (Crusoe's term), where the first English word he had to learn was 'Master'. So although Crusoe 'had never handled a tool in all my life' yet 'I improv'd myself in this time in all the mechanic exercises, which my necessities put me upon applying myself to.' A clearer example of the impact of the new 'experimental philosophy' would be hard to find.

The world of 1719 differed from the world of 1651 in one other important respect: the frequency and violence both of volcanic eruptions and El Niño events diminished, the current 11-year sunspot cycle resumed, and the long episode of global cooling came to an end. The benign climate, coinciding with a more systematic exploitation of the environment, allowed the supply of goods to increase faster than demand for them, and so 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 complained — just like his predecessors a century before — about the increase in the number of 'unproductive consumers', singling out intellectuals, merchants and clerics. A few years later, a senior official in Fujian estimated that 'the population had doubled' during the previous six decades. He also complained that 'while the population increases daily, the amount of land under cultivation does not'. The following year, the central government launched a drive to bring more land under cultivation because 'population has increased of late, so how can [the people] obtain their livelihood? Land reclamation is the only solution.' Thanks to such measures, by the mid-eighteenth century both East Asia and western Europe boasted a far denser population than ever before — but this time without a decline in life expectancies or standards of living. Equally important, the new equilibrium of population and resources made the demands of the fiscal-military state more bearable. The return of a warmer climate had broken the 'fatal synergy'.

Nevertheless, the same dynamic of subsistence prevailed, and continues to prevail. Societies in which the demand for food exceeds the supply must either increase supply (by adopting technological changes that improve crop yields per acre, by mobilizing a new source of energy, or by securing food elsewhere by trade or by force); or else they must reduce demand (by eating less, or by reducing the number of mouths to be fed through fewer births, increased migration, or more deaths). All these strategies played their part in coping with the problems caused by the fatal synergy of human and natural factors in the seventeenth century. Many starved and many more went hungry; while more abortions and infanticides, more delayed or forgone marriages, and more migration (both forced and voluntary) reduced the number of mouths to feed. Yet, since all these adaptive measures took effect only slowly, in most societies around the world food supply and demand only came back into equilibrium after 'enough' people had died.

Although blind, and confined to his house, John Milton understood this dynamic as clearly as any contemporary. He began to compose *Paradise Lost* in London during the landmark winter of 1658, and continued through the years of death that accompanied the Restoration of Charles II, so it is hardly surprising that unpredictable and unforgiving changes in the climate are central to his story. Milton's fictional world, like the real one in which he lived, was (as he termed it) a 'universe of death' at the mercy of extremes of heat and cold.

At certain revolts all the damned
Are brought: and feel by turns the bitter change
Of fierce extremes, extremes by change more fierce,
From beds of raging fire to starve in ice
Their soft eternal warmth; and there to pine
Immovable, infixed, and frozen round
Periods of time; thence hurried back to fire.'
Epilogue: 'It's the climate, stupid'

Once upon a time, the history of climate was a 'hot topic'. In 1979 the World Meteorological Organization, the United Nations Environmental Programme, the National Science Foundation, the Ford Foundation and the Rockefeller Foundation paid for 250 historians, geographers, archaeologists and climatologists from 30 countries to attend 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. Cambridge University Press later published a volume containing the most innovative of the conference papers. That same year, the World Meteorological Organization created the 'World Climate Program' with a mandate to 'insert climatic considerations into the formulation of rational policy alternatives. No one doubted then either that global climate had undergone dramatic changes in the past or that, sooner or later, it would undergo equally dramatic changes in the future.'

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 USSR, themselves a reflection of the strong El Nino episode of 1971–2 which suggested that a system of teleconnections might explain how the global climate 'worked'. The United Nations therefore convened a 'World Food Conference' in 1974, which made the solemn 'Declaration' that: 'As it is the common responsibility of the entire international community to ensure the availability at all times of adequate world supplies of basic food-stuffs by way of appropriate reserves, all countries should co-operate in the establishment of an effective world system of food security.' The Conference's equally solemn 'Resolutions' included:

- 'Achievement of a desirable balance between population and food supply.'
- 'Reduction of military expenditure for the purpose of increasing food production'; and
- 'Creating a global information and early warning system on food and agriculture.'

Before governments had time to enact these resolutions, however, the shadow of a world food crisis disappeared thanks to the 'Green Revolution': new high-yielding varieties of wheat, maize and rice, combined with the increased use of irrigation, fertilizers, pesticides and herbicides, dramatically increased food production. Incomes virtually disappeared from the headlines and climate change virtually disappeared from the research agenda of historians.

Then in 1990 the 'Intergovernmental Panel on Climate Change' (IPCC), another United Nations initiative, issued its first Assessment Report, summarizing the research of several hundred working scientists from 25 countries. The document claimed that 'emissions resulting from human activities are substantially increasing the atmospheric concentrations of greenhouse gases', and that without immediate action to reduce greenhouse gas emissions, 'additional warming of the Earth's surface' was inevitable. To clarify the scale of the problem, the Report called on colleagues to 'further investigate changes which took place in the past'. The response of the scholarly community, including many historians, has been magnificent: since 1990 they have compiled thousands of data-sets and published hundreds of articles about past climate change, revealing a series of significant shifts that culminated in an unprecedented trend of global warming.

Unlike the research presented in the 1970s, these new findings have been ignored, rejected and belittled, while suggestions that states should 'insert climatic considerations into the formulation of rational policy alternatives' also provoke passionate opposition. Just after he became Chairman of the Environment and Public Works Committee of the United States Senate in 2003, Senator James Inhofe declared global warming to be the 'greatest hoax ever perpetrated on the American people' (a 2011 Senator Inhofe co-sponsored legislation (the Upton-Inhofe bill) that would prevent the federal government from 'promulgating any regulation concerning,) taking action relating to, or taking into consideration the emission of a greenhouse gas to address climate change'); while later that year the United States House of Representatives defeated by 240 votes to 184 a motion known as the 'Waxman Amendment' stating that 'climate change is occurring, is caused largely by human activities, and poses significant risks for public health and welfare'.

The Waxman Amendment conflated two distinct issues: determining whether 'human activities' (notably, the emission of greenhouse gases and deforestation) can produce climate change is not the same as proving that 'climate change' occurs. More may perhaps be residual doubts about the first proposition, just as some still deny that smoking tobacco increases the risk of lung cancer, but the historical record leaves no doubt that climatic change occurs, and that it can have catastrophic consequences for 'public health and welfare'. Although humans appear to have played no part in precipitating the climate changes of the seventeenth century, they suffered and died from its consequences all the same.

The surviving human and natural archives reveal epics of major climate change in the fourteenth century and in 1816, as well as in the seventeenth century. A series of articles by economic historian Bruce Campbell demonstrates that the 1160s and 1340s saw both 'extreme instability' in the climate and lethal disease (influenza in 1316–25 and bubonic plague 1346–53), at a time when both the naive and human populations had reached unprecedented densities. England's
excellent surviving records suggest these natural disasters 'more than halved the population.' The climate-induced catastrophe in 1816, another 'year without a summer,' occurred when sunspots were few (the 'Dalton Minimum,' 1795-1824), and just after the most powerful volcanic eruption recorded in the past 10,000 years, at Tambora in Indonesia, a combination that appears to have reduced average temperatures on earth by between 1° and 2°C — exactly the same variations as in the mid-seventeenth century. This sufficed to produce not only global cooling but also extreme climatic events. In North America, throughout the summer, fronts of Arctic air dumped snow north of a line stretching from British Columbia to Georgia, producing temperature oscillations from 35°C to freezing in a single day; and in September 1816, New Hampshire experienced 'the four greatest snows known... at this season by any man living.' Across the Atlantic, intense cold prevailed for most of the summer from Finland to Morocco; rain fell in Ireland for 142 out of 153 days between May and September; England experienced the third coldest summer since continuous records began in 1659; and grapes in all French and Swiss vineyards ripened later than in any other year since continuous records began in 1437. In Asia, the monsoon failed in India, while snow fell in Jiangnan and Taiwan. In 1817 at Barnstead, New Hampshire, St Valentine's Day was 'the coldest day [that] has been for forty years'; while at Salem, Massachusetts, the Reverend William Bentley spent 'the first [day] in my life in which I kept house upon account of the cold. The extreme weather also generated both disease and famine: a severe epidemic of typhus broke out in Europe while cholera ravaged India; scarcity of broad provided widespread food riots in Europe; while 'throughout' New England scarcely a tenth part of the usual crop of sound corn will be gathered. The price of wheat in New York City in 1816 would not be surpassed until 1973.09

The 'Yankee Chills' (as survivors in North America called their miserable summer) produced massive emigration from New England to the Midwest. 'The lands to the westward are luxuriant, and the climate mild and salubrious,' crooned a land promoter, and thousands of families believed him and abandoned their farms for the 'golden Ohio country'; between 1817 and 1820 the population of the state of Ohio rose by 50 per cent, taking it above 500,000 for the first time. Most of the newcomers were New Englanders fleeing the sudden climate change.10

Two centuries later, flight to Ohio would offer little relief. If 'Yankee Chills' (or any other natural disaster) should strike New England, in the words of the 2011 version of the state of Ohio's Strategic Plan: '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 also feed 50 per cent more in an emergency.11 Admittedly, if the 'chills' killed only corn, or only affected New England; if transport and distribution infrastructure that has developed in Ohio since 1816 could probably import sufficient emergency food rations from unaffected (or less affected) areas, this might prove impossible in the wake of a natural disaster closer to home. In 2003 it took almost a week to get vital supplies of food and water to New Orleans after Hurricane Katrina struck, because the storm that flooded the city also severed road and rail links and disabled both landline and cellular telephones; while the evacuation of over one million people from areas of the Gulf Coast affected by the hurricane created a 'hollowed economy,' with an infrastructure no longer capable of satisfying basic food, water and health needs.12

Although Katrina was the costliest natural disaster in the history of the United States, it was only one among 432 reported natural disasters of 2005 around the world, causing between them $176 billion of economic damage. That figure surpassed the record until 2011 when, although the total of reported natural disasters fell to 302, the economic damage they caused exceeded $350 billion. This sum included $2 billion caused by a tornado that struck Tuscaloosa, Alabama; $1.1 billion caused by the earthquake that struck Christchurch, New Zealand; $2.5 billion caused by another tornado that hit Joplin, Missouri; and $310 billion caused by the Tohoku earthquake and tsunami in Japan. Between them, those four natural disasters killed well over 20,000 men, women and children. In addition, in 2011, over 106 million people around the world were affected by floods almost 60 million were by drought; and a further 40 million by storms.13

No human intervention could have prevented these natural catastrophes — although a better early-warning system, better popular education about evasive actions, and faster and more effective emergency responses would surely have mitigated the consequences. Likewise, no human intervention can prevent volcanic eruptions, half an El Niño episode, or delay the onset of another no-tropos minimum. Despite the certainty that each will affect the climate, reduce harvest yields, and induce starvation, economic dislocation, political instability and death. So what can be done to mitigate the consequences? The disastrous hurricanes seasons of 2004 and 2005 (which included not only Katrina but 'seven of the nine costliest storms to strike the United States') led the National Hurricane Center, a division of the National Weather Service, at Miami, Florida, to pose just this question. The Center concluded sadly that another "disastrous loss of life is inevitable in the future, mainly because the majority of those living in areas at risk have never experienced a direct hit by a major hurricane" and seem incapable of envisaging what one is like, even while the rest 'only remember the worst effects of a hurricane for about five years.' For the National Hurricane Center, the problem lay less in the frequency of hurricanes than in the failures of humans to learn from them: those areas along the United States Gulf and Atlantic coasts, where most of this country's hurricane-related fatalities have occurred are also experiencing the country's most significant growth in population — striking testimony to the strong failure of discern that prevails.14

Nevertheless, as the social psychologist Paul Slovic pointed out, 'The ability to cope and avoid harmful environmental conditions is necessary for the survival of all living organisms,' while 'survival is also aided by an ability to codify and learn from past experience.' Moreover, Slovic continued, 'Humans have an additional capability that allows them to alter their environment as well as respond to it.' This ability to 'alter' our environment presupposes 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). History offers numerous examples of both in action. Repeated floods in the lands around the North Sea in the Middle Ages led to the evolution not only of preventive measures and coping strategies but also of permanent cadres of ‘experts’ and an unusually resilient entrepreneurial culture: all underpinned the rise of the Dutch Republic as a world power. Likewise, the crescendo of urban fires in the mid-seventeenth century gave rise in one city after another to both better fire-fighting measures and (at least in Europe) to the development of a system of specialist insurance companies that now form some of the most powerful business enterprises in the modern world.16

Nevertheless, in order to activate our ‘additional capability to alter [our] environment’, it seems that humans 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’.17 Effective measures to prevent and to mitigate floods and fires therefore only seem to evolve after repeated disasters of unprecedented severity strike a community. Perhaps this defect in human cognition explains why, despite the fact that 2010 saw the warmest global surface temperatures ever recorded, and was the 34th consecutive year with global temperatures above the twentieth-century average, the Washington Post proclaimed in 2011 that global warming had become ‘a second-tier issue’18

This strange disconnect prompted a team of researchers to ask over 67,000 people in 47 different countries to answer the question: ‘How serious do you consider global warming?’ The findings, published in the Journal of Peace Research in 2012, supported the assertion of the Washington Post: ‘Global warming is not considered as an especially important environmental problem by the public. The data also suggested five broad explanations:

• Concern about climate change correlates with education level, but not with age: those younger than 30 and those older than 60 both seem less concerned than those who are middle-aged.

• As countries become affluent, its citizens shift their concern from issues related to economic conditions and personal security to ‘issues related to political and individual freedom and environmental protection’.

• A statistically significant negative correlation exists between Biblical Fundamentalism and ‘concern for the environment’, particularly among Christians in the United States, for many of whom natural disasters are divine punishments for sins and so must be accepted.

• Respondents in rich countries, and in countries with high carbon dioxide emission levels, showed less concern about global warming than those in poor countries, or in countries with low greenhouse gas emissions (perhaps because it is harder to accept global warming as a problem when it is not recognized that it is partly your fault: a relationship that has been labeled ‘uncomfortable truth’).

Finally, the level of concern about global warming is negatively correlated with concern for climate-related natural disasters: that is, people living in countries highly exposed to natural disasters (such as droughts or earthquakes) are less concerned about global warming, either because they perceive the other environmental problems they face as more acute, or because prolonged exposure to natural adversity has taught them to live with it - or, in the words of a study entitled The Culture of Disaster: ‘For the greater part of humanity, hazard and disaster are simply just accepted aspects of daily life’.21

Until recently, the fact that almost all people killed and most people affected by natural disasters lived outside North America and Europe fostered two assumptions in the West: that such things only happened ‘somewhere else’ (an assumption reinforced by terms such as ‘Typhoon Alley’, ‘The ring of fire’ or ‘El Niño-prone’); and that certain groups are particularly ‘vulnerable’ not just because of where they live but also how they live (such as people who live in overpopulated cities or at marginal lands). Such views are not unfounded: for example, the Philippine government really does experience more disasters than any other comparable area of the world, with 220 volcanoes (at least 12 of them active), 5 earthquakes a day, and 30 typhoons a year; while the Haitian earthquake of 2010 reminded the world that urban overcrowding and poverty magnify the impact of disasters.22 But now, natural disasters are also striking North America and Europe, where each one becomes ‘an insurance event’. According to a White Paper prepared for the European Commission, almost one-third of all ‘loss events’ between 1980 and 2007 were ‘directly attributable to weather and climate events (storms, floods and heat-waves)’ while a further quarter was attributable to wild fires, cold spells, landslides and avalanches, which may also be linked to weather and climate. Therefore, ‘95% of the overall losses of catastrophic events result from these weather and climate related events’. According to the same White Paper, ‘overall losses caused by weather and climate related events live increased during the period 1980–2007 from a decadal average of less than €2 billion (1980–1989) to about €13.7 billion (1999–2007). The central European floods of 2002, alone, resulted in overall losses of €16.8 billion and insured losses of about €3.4 billion’.23

These striking data have not escaped the attention of the world’s insurance companies – indeed, their own estimate in 2009 was that ‘losses from weather events are growing at an annual 6 per cent, thus doubling every 12 years’ - and, in response, they have made some dramatic changes in coverage and premiums. Thus in the Netherlands, where over one-third of the country would be under water without artificial barriers, flood insurance is now unavailable; while in Great Britain it is currently available only for properties built before 2009, and for them only until a government re-insurance system expires at the end of 2012.24 In Florida, when in 1992 Hurricane Andrew caused more than $15 billion in insurance losses and bankrupted 12 insurance companies, the State government created a public alternative to the private market. Then came the hurricanes of 2004 and 2005,
which forced private insurers to pay out a further $39 billion to rebuild Florida, yet when those insurers asked the State’s permission to raise premiums to cover the increased risk, the State refused. Several private companies therefore refused to insure property in Florida, creating an ‘insurance crisis’ that has yet to be resolved. In the Bahamas, finally, where government declined to introduce a publicly guaranteed alternative to private insurance, after three major hurricanes between 1999 and 2004 flood insurance (and consequently mortgage lending) became withdrawn [by private companies] for some low-lying areas, and, without any State-backed alternative, houses have become abandoned as their value collapsed.25

These developments led the International Association for the Study of Insurance Economics, also known as the Geneva Association, to conclude that ‘Insurers need to emphasize that climate change brings societal problems to which insurance can only provide solutions in partnership with government and business.’ This is easier said than done. Not every one believes insurers companies, even when their message takes the form of dramatically higher premiums (if they did, no one would smoke tobacco because smokers pay so much more for life and health insurance.) Moreover, as the European Commission White Paper points out, in a number of regions, less populated and economically less performing, often located in areas that are particularly sensitive to climate change risks (coastal, mountainous), the costs to cover adaptation needs will be so huge that they exceed the capacity of public funding. In these areas, losses can take such massive dimensions also for the private sector that they rise eventually beyond the financial capacity of individual companies and businesses.24

The impact of the 2004 and 2005 hurricane seasons on the Florida property market demonstrates why neither insurers nor ‘market forces’ nor local government are likely to cope with all the consequences of climate change. In 2009 the Florida Chamber of Commerce composed a report entitled Into the Storm, warning that the state’s entry into the insurance business had created a $2 trillion exposure in property risks, so that taxpayers face ruin when the next major hurricane strikes. The report recommended two obvious steps: offering incentives to owners who improved their properties to minimize storm damage (and thus reduce the cost of compensation and repair); and allowing the state insurance scheme to ‘let risk determine rates’ (that is, in the pungent phrase of former Representative Dennis Ross, ‘The risk of living in high-risk areas should be borne by the people who choose to live in those areas’). The authors of Into the Storm envisaged only two other proposals: either to attract private insurers back by allowing them to set premiums to levels that reflect the risks that property owners actually take, or else to ‘Push the Fed’s’; because without private insurers ‘We need a federal backstop for a Florida catastrophe. The Chamber of Commerce recognized that neither proposal had much chance of success: allowing the free market to determine property insurance premiums would result in rates that few owners could afford, while any national legislation that might serve as a back-up to Florida’s
In the twenty-first century, as in the seventeenth, coping with catastrophes on this scale requires resources that only central governments 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 Whitehall being drowned'; and proposed to erect a barrier to prevent similar catastrophes. A century later - but also the opposite of the London merchants, whose trade would suffer if ships could not sail up the Thames, and disagreements among competing jurisdictions over the costs thwarted them all. Then in 1953 a tidal surge in the North Sea flooded some 150,000 acres of eastern England and drowned more than 300 people. A government inquiry assured the British House of Commons that 'We have had a sharp lesson, and we shall have only ourselves to blame if we fail to profit from it, and we set up a committee to propose remedies, which recommended the immediate construction in the Thames estuary of a suitable structure, capable of being closed. The government eventually considered two types of barrier but, once again, pressure from shipping interests and cash-strapped local authorities prevented action.29

Then in 1966 a new government asked its Chief Scientific Adviser, Professor 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 three feet between 1791 (when records began) and 1933, and he predicted that this trend would continue. Bondi compared the risk of another storm tide with other risks, such as a meteorite falling on central London - which would also cause immense damage - but, he noted, the probability was very low and there was no way to take evasive action. By contrast, a major surge flood in London would be a disaster of the singular and immense kind; given the rising level of the North Sea, it was inevitable; and 'It would be indeed a knock-out blow to the nerve centre of the country'. Bondi therefore unequivocally recommended the construction of a Thames barrier, and although shipping interests and fragmented local government once again caused delay, in 1972 Parliament passed the Thames Barrier and Flood Protection Act, which authorized the project and promised to fund it. By 1980, when the barrier was complete, it had cost a stunning £334 million - but the value of the property it protected now exceeds £200 billion, including 40,000 commercial and industrial properties and 500,000 homes with 1½ million residents. All would be inundated if another flood 'drowned' Whitehall, the heart of government now as it was in the time of Samuel Pepys, containing both Houses of Parliament and the office where 7,000 members of the central administration work. It would also destroy the new Docklands economic development, and disable 16 hospitals, 8 power stations and many of the fire stations, police stations, shops and suppliers needed to supply and replace items damaged in the flood, as well as 200 miles of roads, 100 miles of subway, 51 rail stations and 35 Underground stations. Londoners would thus lose not only their homes and jobs but also the essential means of support and recovery. In short, without the Thames Barrier, London would be like

Oslo-Oslo in 2005: vulnerable to a natural disaster that, like Katrina, is sooner or later inevitable.30

Completion of the Thames barrier came just in time - it had to be activated between 1983 and 2000, and 75 times between 2001 and 2010 - and its success, combined with the increased frequency of extreme weather, has encouraged a more proactive attitude towards climate change on the part of the British government. The 2004 Report by its Chief Scientific Officer, summarizing the research of nearly 90 experts on the risks of flooding, expressed the choice with surprising simplicity: 'We must either invest more in sustainable approaches to flood and coastal management or learn to live with increased flooding.' A similar choice exists for other climate-related risks (such as hurricanes), and indeed for other types of risk (such as the spread of diseases, perhaps accentuated by bio-terrorism, or, for that matter, "cyber-terror"): societies can either 'pay to prepare', and commit substantial resources now to avoid far greater costs later, or else 'learn to live with increased risks'.

Despite the many differences between the seventeenth and the twenty-first centuries, governments during the Little Ice Age faced the same dilemmas - although here needed more reminders than others of the need to choose. In Japan, at one point, the famine, rural revolts and urban riots of the Kan'ei era sufficed to present Tokugawa Iemitsu and his advisers of the need to create more granaries, to upgrade the communications infrastructure, to issue detailed economic legislation, and to avoid foreign wars in order to accumulate sufficient reserves to cope with the probable return of extreme weather. England took somewhat longer. Despite the subsistence crises of the 1590s, 1629–31 and 1647–9, only in the 1690s did property owners accept the central government's argument that, in the long run, it was economically cheaper and more efficient (as well as more humane) to support the poor who became old, widowed, ill, disabled or unemployed, thus creating the first welfare state in the world. Other societies endured even more disasters before they reached the same conclusion that welfare formed an essential and necessary part of effective risk management, but by the nineteenth century the 'welfare state' had become a hallmark of all economically advanced states.

Climatic adversity is a great leveller, because the human population in advanced societies shares many of the needs of the human population elsewhere. 'The hungry 1% 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 (see chapter 15)' stands relatively simple for groups of hunters in another hemisphere, but climate changes can create a 'hungry time' for those living in even the most advanced societies. Of course, the total human population in the seventeenth century was far less than the three billion in 1950, let alone the seven billions today, but the geographical distribution of the present population is changing in ways that increase the resemblance between the world today and that of the seventeenth century. Thus in 1500 Venice had three times the population of Africa, but in 2012 the population of Africa is 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 total population that spends a high proportion of its disposable income on
basic needs such as food, energy and housing, often in areas where even central governments lack the effective means of dealing with big disasters, making them more vulnerable to the effects of climate change. Thus Hurricane Katrina in 2005 caused damage equivalent to 1 per cent of the Gross Domestic Product of the United States, but drought in 1999 caused damage equivalent to 16 per cent of the Gross Domestic Product of Kenya.

It is impossible to measure the human suffering caused by natural disasters. We cannot compare the misery of the women who went to the New Orleans Convention Center in 2005, expecting to find food, water, medical care and shelter in the aftermath of Katrina, but were instead raped, robbed and left to die, with the Australian women who starved as they watched their children die of hunger during an unusually long "hungry time"; or with the poor women of Shanghai who found in 1642 that "the only currency that could buy rice was children," and that the price of enough rice to feed one person for a week was two children. Nor can we measure the true human cost of any of these catastrophes via some sort of "body count." Although some contemporaries speculated that "a third of the world's people" died in the mid-seventeenth century, and although the surviving data confirm that some communities lost up to half of their populations, while others disappeared altogether, it is impossible to calculate a world-wide total. Certainly, the Global Crisis ended prematurely the lives of millions of people, just as a natural catastrophe of similar proportions today would end prematurely the lives of billions of people.

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"—Haggardian, to use the dismissive phrase in Secondo Lancellotti's book Nowadays. Yet the Haggardians are not always wrong. Some natural disasters occur so suddenly that, without advanced preparation, no escape is possible. George Gordon, Lord Byron, discovered this in 1816. He fled England to escape accusations of incest, adultery, wife-beating and sodomy, planning to spend a pleasant summer in a villa near Lake Geneva with a former mistress, his personal physician (and, perhaps, catamite) 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 best-seller, while Polidori wrote The Vampyre, the progenitor of the Dracula genre of fiction. Byron himself composed a poem which he called "Darkness." All three works reflect the disorientation and desperation that even a few weeks of abrupt climate change can cause. Since the question today is not whether climate change will strike some part of our planet again, but when, we might re-read Byron's poem as we choose whether it is better to invest more resources in preparation today or live with the consequences of inaction tomorrow. After all, unlike our ancestors in 1816, and in the seventeenth century, we possess both the resources and the technology to make that choice.