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Industry, Extraction and the Natural World (c.1800–c.1870)

> Fog everywhere. Fog up the river where it flows among green airs and meadows; fog down the river, where it rolls defiled among the tiers of shipping, and the waterside pollutions of a great (and dirty) city.
>
> Charles Dickens, *Bleak House* (1853)

Engagement with new parts of the world spurred some to take a deeper interest in what could be learned from geography, from history and from science. Writing in the middle of the eighteenth century, the philosopher David Hume considered what the authors Horace, Juvenal and Diodorus Siculus had said about the weather and climate in Rome as well as elsewhere in the empire. It would have been preferable, he notes, 'had the ancients known the use of thermometers'. Nevertheless, comparing the accounts with the present day, it is reasonable to conclude that 'the winters are now much more temperate at Rome than formerly'.[1]

In Hume's own time, he wrote, the Tiber froze about as often as the River Nile – never, in other words. Likewise, Ovid's description of the Black Sea freezing every year either spoke of a very different climate, or reveals that Ovid was lying. There was only one explanation, concluded Hume. 'Plainly', he said, human activity was responsible for causing the planet to warm. This must have been done, he went on, primarily through deforestation and the cutting down of trees 'which

formerly threw a shade upon the earth, and kept the rays of the sun from penetrating it'.[2]

The question of man-made climate change was one that preoccupied many settlers in the colonies in North America, including several of the Founding Fathers. In the 1760s, Benjamin Franklin wrote to Ezra Stiles, later President of Yale, stating that temperatures were becoming milder as a result of deforestation. 'When a Country is clear'd of Woods,' he said, 'the Sun acts more strongly on the Face of the Earth.' Solar warmth 'melts great Snows sooner than they could be melted if they were shaded by the Trees'. While a 'regular and steady Course of Observations' would be needed across multiple years and taking measurements from several parts of the country to confirm it, Franklin was persuaded that real changes were happening – and that human activity was responsible.[3]

Franklin reported in the same letter that he had recently been in England where he had visited Cambridge to compare notes with John Hadley, the Professor of Chemistry. Contacts such as these were a by-product of fast-expanding global trade networks and a new age of information-gathering from around the world as Europeans began to translate voyages of discovery into extensive commercial contacts and into regional dominance and colonialism. While trade, political and military priorities had led the way, science and scientists had sometimes followed hand in hand and had sometimes done so soon afterwards, supported by rising levels of wealth that funded scholarships and academic institutions and encouraged individual curiosity.

In 1768, for example, Captain James Cook was commissioned by the Admiralty to undertake a voyage to the Pacific Ocean, with the aim of tracking the transit of Venus across the sun the following year. Missions like this were commendable, Samuel Johnson had written two decades earlier, because unlike expeditions which set off with 'intent like merchants' to trade, or had military ambitions, they were motivated solely by the joy of knowledge for knowledge's sake.[4] Such sentiments sounded reassuring, noble even. But they masked the fact that those leading the expeditions, like Cook, often had other motives too: in this case Cook was also given secret orders to search the South Pacific for a southern continent whose existence had been much speculated on and whose discovery was considered a matter of signal strategic importance to Britain and its global interests.[5]

The question of the weather, of climate and of changing conditions dominated the minds of some. Thomas Jefferson had an obsessive interest, starting a diary on 1 July 1776 just as he was drafting the Declaration of Independence, and recording two temperature readings per day for the next fifty years. Indeed, on the morning of 4 July, the day that America's independence from Britain was declared, Jefferson visited Sparhawk's stationery store in Philadelphia to buy himself a new thermometer.[6] We know from his diary that as the Declaration itself was being delivered to Congress, he was busy recording that the ambient temperature was 72.5 °F.[7] As the United States was being born, one of its principal architects was thinking about humidity and atmospheric pressure. He was presumably not entirely happy, at least about the tools at his disposal, for the day after independence he went back to Sparhawk's to buy a barometer so that his findings could be even more accurate.[8]

One of Jefferson's pet theories was about the changing climate in North America in the late eighteenth century. Summarising in a book his 'data for estimating the climate of Virginia', he set out observations about sudden temperature changes, frosts and the impact on plant and animal life. This led him to conclude that 'A change in our climate ... is taking place very sensibly. Both heats and colds are become much more moderate within the memory even of the middle-aged. Snows are less frequent and less deep,' and while 'The elderly inform me the earth used to be covered with snow for about three months in every year,' it no longer was – and nor did rivers freeze often, as they used to.[9]

Jefferson's views chimed with the prevailing wisdom among scholars in North America that the climate was changing rapidly. Hugh Williamson of Harvard had written almost twenty years earlier that 'our winters are not so intensely cold, nor our summers so disagreeably warm'. This was due to land-use change from forest to open fields, which gave the earth a hard smooth surface, and rather as 'the face of a looking glass or any polished metal will reflect more light and heat' the result was a warming of the land and of the temperature. This was good news for the future, he said: 'clearing the country will mitigate the cold of our winters [and] it will also increase the heat of our summers'. As soon as trees had been felled, 'we shall seldom be visited by frosts or snows'.[10] Climate change was 'so rapid and constant', agreed Samuel Williams in 1794, that 'it is the subject of common observation and

experience'. Not only that, he added, but it could be observed 'in every part of the United States'. There was no scope for this to be 'a matter of doubt'; rather, it was a matter of fact.[11]

That was all nonsense, retorted Noah Webster, who is best known for his famous dictionary. Webster took issue both with such statements and with the supporting evidence. 'Mr Jefferson seems to have no authority for his opinions' other than 'the observations of elderly and middle-aged people', he said, adding that there was plenty of evidence to suggest that climates had not changed. The claims by men like Williams that temperatures had risen by ten to twelve degrees in the last century and a half were implausible and should lead any rational commentator to conclude that such views depended on 'insurmountable difficulties' and were quite unreliable.[12]

This was less a case of climate-change denial than a demand for rigorous scholarship to back up claims properly. As it was, competing views had already developed that set out entirely the opposite hypothesis – namely that the earth was cooling. One pioneer was the Comte de Buffon, who looked into questions like the locations of oceans and continents, sea-level changes and the formation of mountains. Widely read in the second half of the eighteenth century, Buffon proposed not only that the earth had been getting colder since its creation, but that it would keep on doing so. Draining marshes, deforestation and urbanisation had certainly helped raise temperatures, but ultimately little would stop an inevitable freeze.[13]

For some, the worry was less about warming and cooling than about the problems of rising populations and the pressure of food shortages, a topic that had generated considerable discussion since the 1770s when the Bengal famine, outbreaks of wheat infestations by the Hessian fly, hurricanes in the Caribbean, the American War of Independence and a run of bad harvests in Britain and Ireland all raised fears about the impact on the poor, about the viability of the colonies and about the potential for disaster in the future.

In 1798, Thomas Malthus published a gloomy tract *On the Principle of Population*. The power of population, he wrote, 'is so superior to the power of the earth to produce subsistence for man, that premature death must in some shape or other visit the human race'. The more people were alive, the greater the difficulty in producing enough food for them all. Fortunately, he went on, such are 'the vices of mankind'

that humans were often the best source of population control, most notably through fighting wars that brought death to many and served as a cap on the number of those consuming resources. Inevitably, however, this would not always work – for 'Man cannot live in the midst of plenty.' As a result, the spectre of 'gigantic inevitable famine' loomed large to resolve competition between the total available 'food of the world' and the number of people living in it.[14]

Such concerns led Sir John Banks, President of the Royal Society, to investigate ways of making warm climate plants and crops frost resistant. This was a task that gained additional urgency in the light of scientists' conviction that the world was going through a pronounced phase of climatic change, although it was a matter of disagreement whether the problem was one of cooling or warming. It was 'unquestionable', wrote the Scottish chemist John Leslie in 1804, 'that the climate, over the whole of Europe, has assumed a milder character'. It was clear, he argued, that 'our earth must grow continually warmer' thanks to the sun's rays. There could be little doubting, he added, that the climate of central and northern Europe 'has gradually become milder', for natural reasons. This had nothing to do with human activities. If it did, then the role was a marginal and peripheral one: anthropogenic activities 'have no influence whatever in altering the average of temperature'.[15]

Scholars like Harvard Professor Samuel Williams were not so sure: Williams suggested that 'the heat of the earth has been gradually increasing' as a result of colonisation and human-inspired ecological change in New England. If this was true, argued others like the influential Buffon, then it was an anomaly that would pass: the clear trend was towards cooling that would eventually cause the planet to freeze.[16]

Hypotheses and disagreements like these were in part a reflection of the awareness and realities of a rapidly changing world. The first decades of the nineteenth century saw a series of profound technological, political, socio-economic and ecological shifts that remoulded geographies, accelerated exchanges of goods and people and transformed landscapes in ways that were both dramatic and rapid. This was an age of scientific discovery and of the dissemination of information, an age of the creation, expansion and enhancement of transport, trade and communication networks, a time when improvements in communication and

transportation were developed and rolled out, a time when productivity shot up as a set of industrial and scientific revolutions bore fruit.

These changes had the greatest impact in Europe, a world that in the late eighteenth century was 'shaped by bereavement, peopled with orphans and widows', where half of all children died before the age of ten and only one in ten people reached the age of sixty. Harvest failure, famine and epidemic disease were commonplace, all aggravated by squalid conditions in towns and cities where mortality rates were so high that there was constant demand for people to migrate from the countryside.[17]

Part of the stimulus for change came from the military revolutions that transformed battlefield tactics as well as from the demand for manpower by states that became increasingly centralised as a result. In the early eighteenth century, the number of casualties in even major battles in Europe amounted to a few hundred, and rarely much more than that. With soldiers carrying enough ammunition for about fifteen or twenty minutes of fire, and at a slow rate of discharge, army sizes were modest, as were levels of training. By the end of the century, however, firefights could last many hours – and the number of dead and wounded typically ran into the tens of thousands.[18] Around 1.7 million men (and a few women) who served in the French armies between 1798 and 1815 died, with a large proportion not killed in battle but dying as a result of injuries, infection or disease.[19]

Britain was able to mass-produce weapons and ammunition – helped by control of the saltpetre of Bengal and Bihar, by far the richest in the world, which produced vast quantities of nitrates, the essential ingredient in gunpowder. In the years 1808–11, during the height of the Napoleonic Wars, the British were able to supply 336,000 muskets, 100,000 pistols and 60 million cartridges to help Spanish guerrillas opposed to Napoleon, to say nothing of the production of weapons, cannon and ordnance for use by British forces in their own campaigns.[20]

The Napoleonic Wars had another curious effect too: the demand for manpower to serve in Britain's armed forces against the French produced labour shortages as men were recruited to fight, with an estimated 350,000 men under arms at the peak of the conflict. Towns and regions where recruitment was heaviest prompted adoption of, investment in and improvement of labour-saving technologies – such as threshing machines. This produced long-term socio-economic benefits, even after peace returned to Europe in 1815.[21]

The enhanced role of the state created demands for higher levels of political participation, a mood that reached crisis point at St Peter's Field in Manchester in August 1819, when a crowd of perhaps 60,000 gathered to protest against the lack of parliamentary representation; this was a time when voting was a right confined to the elites, with just over 10 per cent of adult men (and no women) being allowed to vote in elections, which in some cases were not even held regularly. Magistrates called in troops, who brutally broke up the protests with a cavalry charge that resulted in deaths and many casualties. Soon known as the Peterloo Massacre, the event became notorious for the use of force against unarmed demonstrators.[22]

The demand for reform was driven by a number of factors, including economic stagnation and unemployment stemming from a conclusion to almost two decades of constant warfare after the defeat of Napoleon at the battle of Waterloo four years earlier. But depressed climatic conditions also played a role in disrupting harvests, creating price shocks that led to the cost of grain doubling and to poverty deepening across much of Europe and elsewhere around this time. In the winter of 1816–17, noted a leading newspaper in Manchester not long afterwards, workers in large manufacturing towns were without work and desperately short of food. Parishes gave what they could, but this bore no comparison to what was needed. As one influential newspaper at the time put it, Britain was 'a nation supplicating for bread – a people sinking for want of food'.[23]

This stemmed in part from measures adopted by the government following the end of the Napoleonic Wars which served to benefit landowners and the wealthy. One was the abolition of wartime income tax; another was the introduction of the Corn Laws that imposed a ban on the import of grain, which inevitably drove prices upwards and dragged people deeper into poverty.[24]

Another cause of problems, though, lay on the other side of the world. This was Mount Tambora in what is now Indonesia, whose eruption on the evening of 5 April 1815 is the largest of the last ten thousand years. The effects locally were devastating as tens of cubic kilometres of magma were spewed out and ejected as much as forty-three kilometres into the atmosphere, while the explosions were heard 2,000 kilometres away. A tsunami fanned out, with some reports of waves as high as four metres devastating multiple islands, including Java. As many as 120,000 people lost their lives in South-East Asia as a result of the famine and disease that followed.[25]

In the three years before Tambora erupted, global temperatures had already become distinctly cooler, partly because of the eruptions of Mount Soufrière in the Caribbean and of Mount Mayon in what is now the Philippines in 1812 and 1814 respectively. If these magnified the effects of Tambora, it did not help that 1816 corresponded to an unusually weak maximum in the sunspot cycle, a phenomenon that is known to affect sea surface temperatures. The impacts around the world were so great that 1816 has become popularly known as 'the year without a summer'.[26]

The consequences were dramatic. In July 1816, *The Times* of London warned that dangers lay ahead: 'Should the present wet weather continue', the paper noted, harvests were likely to fail 'and the effects of such a calamity at such a time cannot be otherwise than ruinous to the farmers and even to the people at large.' It was a similar story in many parts of Europe, with 'melancholy accounts' being received 'from all parts of the Continent of the unusual wetness of the season; property in consequence swept away by inundation and irretrievable injuries done to the vine yards and corn crops. In several provinces of Holland, the rich grass lands are all under water, and scarcity and high prices are naturally apprehended and dreaded. In France the interior of the country has suffered greatly from the floods and heavy rains.' Mortality rates in some parts of Europe increased, most notably in Switzerland and Tuscany.[27]

It is perhaps no coincidence that a group of English writers that included Percy and Mary Shelley and Lord Byron, who were spending time in Geneva in the summer of 1816, made repeated reference to dark storms, unusual skies, violent winds and rains in their writings. Indeed, on one evening in June, the group came up with the idea of a ghost-story contest in order to entertain themselves during that long, cold summer; thus it was that Mary Shelley had the idea for *Frankenstein*, one of the most famous novels of all time, and one in which celestial anomalies, lightning strikes, thunder and storms feature prominently.[28]

A collapse in cereal crops in New England led not only to severe food shortages and price surges, but also to large-scale livestock death thanks to lack of animal feed. 'Never were such hard times,' wrote Thomas Jefferson, as people found themselves in a state of 'unparalleled distress'. It was likely, perhaps even inevitable, he wrote, that there would be local insurrections, uprisings and breakdowns of law and order as a result. Newspapers compared the situation to the biblical 'famine of Egypt', though that analogy did not allow for the scale of the financial crisis,

the emotional upheaval or the abandonment of towns. One historian has even argued that Tambora was a 'primary cause of the United States' first major economic depression'.[29]

The eruption devasted other regions, such as the Indian subcontinent, where a shift in monsoon rains, a failure of trade winds and a three-year depression of the thermal cycle of South Asia not only led to major reductions in crop yields and of maritime trade, but also served to change the microbial ecology of the Bay of Bengal. In 1817, unusually early and heavy rains brought about a surge in cases of cholera that caused death on an almost unimaginable scale. The bodies of the dead and dying were gathered together, wrote one eyewitness, with funeral pyres burning non-stop to incinerate the rich and the poor, and other corpses picked over by vultures or jackals. It was 'a scene of woe which completely baffles the power of description to portray'.[30]

More than a million were estimated to have died as a result of what one report of 1820 argued was the 'distempered' state of the weather since 1815. It seems that climatic factors had indeed played a decisive role: changes in water temperature and salinity supported zooplankton that serves as cholera's main aquatic host, while unusual and unseasonal flooding served as the source of the bacterium's nutrients, at the same time delivering the pathogen into the water system of coastal regions. This was almost uniquely dangerous in Bengal because of the low-lying land in the river delta.[31]

While assessing how many people died involves wide margins of error, another indication of the devastation it caused can be seen in the widespread panic within affected communities, with large numbers of towns being depopulated as people fled. Some took to traditional methods of salvation, turning for protection to deities such as Kali and Ola Bibi, whose cult grew quickly around this time. Although climate had a role in the prevalence of cholera, diet, sanitation and hygiene were even more important factors, since cholera was above all a disease of poverty.[32] By the early 1820s, cholera had spread by land and sea through South-East Asia to China and Japan and westwards to Persia and Russia, and then on to Europe, where it took hold at the start of the 1830s.[33]

Disease, poverty and limited employment prospects all played a role in driving waves of migration from Europe. The end of the Napoleonic Wars meant that the job market was inundated with 200,000 demobilised soldiers at a time when massive government contracts to provide

supplies to the military of everything from uniforms to musket balls to ropes to canvas for ships were scaled back or abandoned altogether.[34] Appetites for better futures were ravenous: a British government scheme for settlement in South Africa was set up in a bid to attract 4,000 people willing to move continent to settle in the Albany district of the eastern Cape; more than 80,000 submitted applications.[35]

This was not to say that all greeted the arrival of newcomers with glee. George Washington, the first President of the United States, was scornful of the quality of those who reached the shores of North America in search of better lives. They were nothing more than 'banditti who will bid defiance to all authority', 'worthless fellows' and a bunch of 'savages'.[36] From the point of view of those facing a protracted depression in Europe, the prospect of moving to start a new life elsewhere was an increasingly attractive one, especially in lands where new opportunities were opening up and infrastructure and facilities were constantly being improved, such as in the United States, where more and more steamboats plying the great rivers created new networks, cheaper transportation and the prospect not only of wealth but of freedom too.[37]

The numbers of those leaving the British Isles accelerated sharply. Between 1790 and 1815, around 180,000 emigrated from England, Scotland and Wales.[38] In the three decades that followed, numbers swelled dramatically, followed by a series of surges in the second half of the nineteenth century. In the seventy years after 1850, some 45 million people migrated from the Old to the New World.[39] This proved crucial for the development of the Americas as a whole, with new arrivals not only serving as fresh pools of labour, but bringing with them ideas, knowledge, cultures, genes, institutions and languages that helped promote rapid socio-economic and political development.[40] It spurred change in Europe too, with the mass exodus reducing the size of the workforce, thereby driving up wages and offering further rewards for innovation, mechanisation and industrialisation.[41]

Reports were sent back home that talked not only of opportunities in new lands, but of freedoms. As Joseph Hollingworth, a recent arrival in North America in the 1820s, put it in a letter to his relatives in Huddersfield, 'in this country there are no Lords, nor Dukes, nor Counts, nor Marquises, nor Earls, nor Royal Family to support nor no King'. Not only that, there was no sign of poverty. 'I have never seen in this Country a Beggar such as I used Daily to see in England,' and, perhaps better still, no sign of a

tax collector 'taking the last penny out of the poor Mans Pocket'. It was a wonder too that the President of the United States began speeches by addressing not 'My Lords and Gentlemen' but his 'Fellow Citizens'. This was a place of dreams, remarked Hollingworth, and turning to what he called 'Old English poetry', described his new homeland as 'A land where tyranny is no more / Where we can all be free.'[42]

Underpinning such notions of freedom was a variety of expansive ideas about nature, about ecological transformation, about 'improvement' of virgin lands – and about the displacement of those who already lived there. Indigenous populations, commonly lumped together and referred to as 'Indians', were routinely dismissed as 'citizens of an inferior order' – like Jews, Gypsies, enslaved people and 'free negroes'. Native peoples were 'the very filth of civilized society', opined some, worthy to be 'left to the rapacity of noxious vermin'; it was only a matter of time before they would end in 'total extermination'. In any event, it seemed obvious to many that the lands where they hunted, farmed and subsisted should be taken over by settlers. This would involve displacing existing communities, since, as one commentator claimed, 'if any thing is certain', it is that 'savage and civilised man cannot live together'.[43]

Views like this prompted discussions about mass deportations and in due course led to government policy and legislation that expelled Chickasaw, Choctaw, Muscogee-Creek, Cherokee and other nations, pushing them west into what survivors called 'the Land of Death'. It has 'long been the policy of Government', said President Jackson in his State of the Union address in 1829, to introduce indigenous peoples to 'the arts of civilisation'. Such efforts had failed entirely, he said, as was clear from the fact that they had 'retained their savage habits'. The best solution, therefore, set out in the 1830 Indian Removal Act, was to encourage migration to the west – which in practice led to forcible deportation.[44] It was a 'great pity', wrote former US President Thomas Jefferson, 'and indeed a scandal that we let that race of men disappear without preserving scarcely any trace of their history', although he too argued that deportation would free up land for white labourers.[45]

It was a similar story elsewhere. In Canada, First Nations were pushed into reserves away from the best land, which was taken over by new settlers. In Australia, the 1830s and 1840s saw Europeans move inland into territories that some described with giddy excitement as being 'as

green and fresh as Eden', forcing out the Wurundjeri, Boonwurrung and Walthaurong people who had managed and lived on grasslands for centuries, cutting off their access to water holes and in some cases even accusing them of trespass.[46] New Zealand was presented as a wilderness ready to be tamed and turned into a bucolic idyll by hard work and perseverance, with little or no reference to those who already lived there. New worlds were waiting to be transformed. All they needed were people – or, more precisely, the right kind of people. Europeans, in other words.

Mass migration not only dramatically changed demographics and population distribution but also reshaped the natural world. The number of settlers in Australia grew from 1,000 to 12,000 between 1790 and 1810, before climbing to 1.25 million fifty years later – a rise of more than a hundredfold. The population of Ontario rose by a multiple of twenty-three, from around 60,000 to 1.4 million, in roughly the same period – while those of Ohio, Indiana, Illinois, Michigan and Wisconsin did much the same, from just over 250,000 to 7 million in total. Similar shifts could be found in Alabama, Mississippi, Arkansas plus Missouri, Florida, Louisiana and Texas, which together grew from 150,000 to more than 4.6 million – and in the original thirteen colonies, plus Vermont and Maine, where numbers rose from 3.8 million to 15.9 million between 1791 and 1861.[47] In 1830, Chicago consisted of 'about half a dozen houses'; sixty years later, it had a population of 1.1 million.[48]

This pattern of expansion was not limited to the Americas and to the west. It was mirrored in the steppe region of the European part of the Russian empire, where the population increased more than eightfold between 1700 and 1800, almost trebled again before 1850 and then trebled again before 1914 – rising from around 380,000 to more than 25 million. Moreover, these numbers did not include the seasonal migrant labourers who came to work on farms each year. But it was not only population movements that explain the dramatic rise in numbers; so too did the high fertility levels among new settlers.[49] The abolition of serfdom in the 1860s did much to help loosen ties between the rural peasantry and the land, sending waves of those seeking new opportunities to lands that changed from being exploited as pastoral, partly nomadic economies to settled arable farming.[50]

Colonial expansion did not repeat the pattern in Qing China, where there was little enthusiasm for long-distance migration into Xinjiang,

Inner Mongolia and Manchuria – regions that offered few of the attractions or rewards promised by reshaping agricultural systems. It did not help that the lands conquered by the Qing in the late seventeenth and eighteenth centuries were remote and difficult to reach, or that there were no sea and river routes allowing the transport of bulk materials in both directions to be carried out easily and relatively cheaply. What mattered more, however, was that these lands afforded little by way of commodity frontiers that might render their exploitation attractive in the first place, and no obvious upside of converting challenging terrains into large arable landholdings that could enrich new owners and support large settlements locally. Regressive policies adopted by the Qing, in particular preventing recipients of land grants from buying or selling land, and the practice of tying labour to landholdings, created barriers that offered few incentives and even fewer opportunities.[51]

This acted as a brake on Chinese social, economic and even political development during the heady nineteenth century that saw vast empires take shape in other parts of the world. Past climatic and geological serendipity which created coal reserves were also to prove important at the start of an age of fossil fuels that in some ways is still responsible for the way the world is today. The exploitation of coal, combined with advances in technology that paved the way for the industrial revolution, helped to transform productivity in Europe. Britain in particular was blessed with coal-fields and a scientific community that developed, refined and improved the methods by which enhanced energy resources could be put to use. That included improving coal extraction, which lowered costs further still. The impact was astonishing. By 1850, some 18 million people in Britain used as much energy as 300 million in China.[52] This was a reflection of multiple factors. Most important of these, according to some historians, was rising demand – which in turn reflected new and evolving ways in which energy could be used.[53]

The scale of such demand was impressive. In Britain, coal production doubled between 1815 and 1830.[54] In this sense, the distribution and location of coal deposits proved extremely providential for Britain. Much turned on the location of coal-fields. While China matched Europe in its living standards, its sophisticated and commercialised agriculture, its vibrant scientific community and its advanced print culture, its coal-fields were a long way from population centres in

general, and from the densely populated Yangtze Delta that was the heartland of manufacturing and production in particular.[55]

Coal-fields in Britain – above all in Northumberland and Durham – were far closer to towns and cities, where there were high energy demands. Indeed, the availability of coal spurred the growth of cities which could attract cheap labour and were either connected to new canal systems or located on the coast. Manchester and Birmingham were two obvious beneficiaries; so were Glasgow and Liverpool, whose population rose by nineteen times during the course of the eighteenth century.[56]

Part of the success of provincial cities was because transportation costs for large volumes of bulky coal were high: the cost of coal in Newcastle, for example, was one-eighth of what it was in London. Coal was important not only as a source of cheap energy, however, but also because it spurred immediate and major gains in productivity, most notably thanks to the steam engine and the railway, which combined to connect locations together and to lower the costs of transport and of exchange while increasing their speed.[57] It helped too that there was an enhanced ability and interest in supporting research and the development of new technologies which ensured ever greater efficiency thanks to profits from overseas trade that created a pool of capital looking for returns.[58]

The bondage of other human beings was crucial in this regard: what mattered above all was not the purchase and sale of enslaved peoples, but rather the fruits of their labour in the form of sugar, tobacco, coffee and cotton. As new research shows, not only would Britain have been substantially poorer and more agricultural in the absence of slave wealth, but it also benefited from the proceeds of slavery being invested in other businesses and technology. In other words, it could be argued those who toiled in servitude provided the fuel that accelerated the industrial revolution in Britain.[59]

Taken together, pools of capital, new ideas and technologies helped drive urbanisation and the growth of London in particular, which stimulated the growth of the coal trade and in doing so helped seed towns close to mines that needed manpower and capital, offered financial rewards to investors and encouraged consumption in new locations too. This powered a housebuilding boom that was accompanied by changes in living habits and architectural styles, requiring 'an entirely new style of house' as heating with coal replaced burning of wood.[60]

In China, in contrast, regions with lower resources and worse soils were the ones that saw the most rapid demographic growth – which exacerbated strains on resources rather than alleviating or solving them.[61] This too marked a different trajectory to Europe, where the creation of colonies overseas had created networks of extraction that funnelled resources from one continent to another. As we have seen, some commodities that were highly prized were cash crops, like sugar, cotton and tobacco; but there were real needs for more mundane materials too, including a number that were bulky and expensive to move. For example, by 1650, perhaps as much as 200,000 hectares of forest land had been cut down in Europe – around 40 per cent of the entire area. Almost the same again was cleared between 1750 and 1850. This was a process of land being repurposed for other uses, and also a reflection of unsustainable consumption patterns. The answer was to look to sources abroad.

One key area was the Baltic, which had long serviced the timber needs of western Europe. Mature trees needed for ships and large buildings took a hundred and twenty years to grow; moreover, substantial volumes were required: a single galleon required two thousand oaks, or around twenty hectares of forest. These needs had been instrumental in opening up trade into the Baltic and stimulating the success of the towns of the Hanseatic league that were dotted around the coast of the North and Baltic seas.[62] With industrialisation taking off, demand now rose sharply: imports of wood climbed from 2.5 million cubic metres in 1850 to 15.5 million cubic metres seventy years later, with wood-pulp imports rising even more steeply in the same period.[63]

Fundamental to the extraction of resources were radical ideas about nature, about land and about the right to remodel the environment in whatever way they wished and thought best. The natural world became something to be tamed and defeated, a notion fuelled by the conviction that human ingenuity, hard work and new tools could now shape and repurpose ecologies better and faster than ever before. Many scholars tie these attitudes directly to Europe and European religious, cultural and philosophical sensibilities. Hegel was dismissive about the way that East Asians engaged with nature and suggested that their cosmological frameworks prevented them from thinking in abstract terms or freely. His view of Africans as exemplifying 'natural man in his completely wild and untamed states' also captured the supremacist

sentiment that it was for Europeans to inherit the earth, and that other races were not only inferior but unworthy and incapable of doing so. For Hegel, then, the urge to 'do violence' to nature was an aggressive statement that reflected emerging mainstream ideas, bundling whiteness, power and entitlement into a toxic framework that set Europeans at the apex of humankind and of all living animals and plants.[64]

Nature became something to be not only exploited but defeated as standing in the way of human progress. As one American engineer modestly put it when proposing the construction of a canal between the Black and Caspian seas that would supposedly double the size of the latter, change rainfall patterns and improve the soil fertility of the steppes, schemes such as this would represent 'a great triumph of a nation over Nature' which 'would be far the greatest conquest in the annals of human material progress'.[65] His scheme would restore desert lands to 'their primaeval condition, as the abode of countless millions of men and beasts'. This was important, noted one contemporary commentator, because 'the world is none too large for its present population'. Stopping the advance of nature was essential; anyone who could help do so 'will be a benefactor of his race'.[66]

Not everyone was convinced that human activity was positive and some instead worried about sustainability and about the long-term damage that was done to the environment. Alexander von Humboldt was concerned about the combination of deforestation and the increase in irrigated agriculture that turned plains into deserts. 'By the felling of trees that cover the tops and sides of mountains,' he noted, 'men in every climate prepare at once two calamities for future generations; the want of fuel and a scarcity of water.'[67]

Humboldt was hardly alone in his concern about or his awareness of the link between deforestation and aridity, which was known, as one leading historian puts it, by 'every literate person' in the nineteenth century.[68] New regions brought wealth to some and disappointment to others, observed one English visitor to Australia. Though 'Anglo-Saxon energy at last triumphs over every obstacle', this victory came at a cost: 'Nature, as if offended, withdraws her beauty from the land; the pasture gradually loses its freshness, some of the rivers and lakes run low, others become wholly dry.' Wild animals 'are no more to be found'.[69]

* * *

Anxiety about the effects of deforestation became part of mainstream scholarship – and policy. In Russia, measures to promote the conservation of forests were put in place as early as 1802, with the Ministry of State Domains establishing a forestry corps to oversee protection.[70] In due course, efforts were made to gather information about pre-existing territories and about the large swathes of land in Siberia and Central Asia which were brought under imperial control from the middle of the century. Russian scientists and landowners became increasingly concerned about rising aridity and intense and worryingly regular droughts. Many had read the works being written in the United States and in Europe and picked up on the theme of deforestation as a cause of changing climate. Cutting down trees had exposed the land in southern Russia to the easterly winds, reported a survey in the early 1840s, noting that this 'must be the main cause of the disastrous impact of droughts which have been intensifying recently'.[71]

Although the Valuev Commission, which published its findings in 1873, stated that the climate had become 'more severe and drier' thanks to land being cleared, not everyone was convinced either that this was the case or that human activity could influence climate in the first place. Senior military officers who surveyed the empire's provinces complained that ideas about changing climate were more often than not based on anecdotal evidence and on comments made by members of the local population that were of doubtful reliability.[72] Nevertheless, the common view was that the climate on the steppes was changing, and for the worse; to help understand how and why, networks of weather-measuring stations were set up across the empire, to try to build a coherent picture that relied on data rather than opinions.[73]

Similar concerns were being raised elsewhere. In Mexico, the polymath Michel Chevalier considered how to develop the economy of Mexico after French intervention in the 1860s. One of the principal problems, he argued, was that a place that had once been a veritable Eden had been turned into a 'barren and desolate wasteland' by overexploitation by the Spanish. Deforestation had been catastrophic, he wrote, not only because it led to spells of aridity and changing patterns of precipitation, but because the land had been starved of nutrients, depleting its productivity. This naturally had an impact on the diet and poverty of the local population – and led in turn to falls in productivity and competitiveness, to economic distress and to

political instability. The answer, for Chevalier, was to look at 'the extent to which the country could be reforested'.[74]

Protecting forests and indeed replanting trees became a central part of British colonial policy – starting with India and the Charter of Indian Forestry, which annexed all forests that were not privately owned and declared them to be state property. Similar measures soon followed in Australia, Canada and Africa, where 'large tracts of the country' were said to be drying up as a result of too many trees being felled. Despite the claims of some scholars, the motivations of the authorities in taking control of forests had little to do with conservation: in fact, what was at stake was that colonial authorities insisted on exploiting timber resources that were vital to the extension of political and economic control. The consequences for peoples who lived in the forests – and who had done so for many generations – were disastrous.[75]

Though some raised concerns, the reality was that deforestation continued at a staggering rate in the nineteenth century and beyond. Between 1850 and 1920, around 152 million hectares of the world's tropical forests were converted to grasslands, almost two-thirds of which (some 94 million hectares) were in sub-Saharan Africa and South and South-East Asia – that is to say, in the heartlands of colonial expansion.[76] Ironically, when it came to rationalising change, the standard narrative was that local populations were poor guardians of nature and were primitive in their approach to agriculture and that the development of new landscapes was not only to their benefit but beyond their capabilities. Such claims, of course, were untrue.[77]

From 1750 to 1900, around 600,000 to 800,000 hectares of the world's most fertile arable land were opened up for exploitation. Newly settled regions in the Americas, Australia, New Zealand and southern Africa became important sources of wool, meat and grain and among the largest producing regions in the world. This was not just the result of those hunting for land and scouting for prospects, but also a function of the predatory use of claims to legal possession and land title and by insistence on the importance of 'improvement' of land and nature, which gave incomers the 'right' to take control of territory.[78] In many cases, such as in India, colonial administrations simply asserted – and enshrined that assertion in law – that all uncultivated land belonged to the state. This too was an aspect of the widely held assumptions that indigenous peoples were ignorant and careless and adopted policies

that ruined forests. The British saw themselves as guardians of the environment who needed to protect the natural world from the predations and practices of peoples who had lived there for centuries and even millennia.[79]

In time, ideas like this were carried further still – namely, not only taking control of land but pushing people off it altogether. National parks established at Yellowstone in the United States, Banff in Canada and Tongariro in New Zealand in the 1870s and 1880s were based on the idea that, to protect nature, human beings needed to be excluded entirely, even if that meant forcible displacement.[80] In some cases, this led to violent protest, as in German East Africa where orders to protect forests granted the right to expel inhabitants from newly created reserves.[81]

Colonial expansion cemented the power of the global north by giving access to the best land all over the world, controlling its usage, monopolising the fruits of its production and enshrining the reality of poverty and limited freedoms for those excluded from its resources and from land 'ownership'.[82] Even today, wildlife conservation – whether to do with animals or plants – often involves benefactors with deep pockets or well-funded and well-resourced charities seeking to 'preserve' the natural world by keeping human beings out of conservation areas. In a curiously neo-colonial twist, the wealthy of the developed world protect nature from being spoiled and save it by ring-fencing it, often literally, from indigenous populations: the creation of the Messok Dja protected area in the Republic of Congo by the World Wildlife Fund, without the consent of local Baka communities, or the eviction of more than 70,000 Maasai from their lands in northern Tanzania to create a game reserve are just two examples among many.[83] In fact, creating national parks and protected areas does not necessarily benefit wildlife – and certainly does not do so in predictable, uniform ways.[84]

Ironically, of course, for all the concern about the effects of anthropogenic change on forests and the impact on soil erosion (and therefore on yields), the demand for goods and commodities was not merely ravenous but ecologically catastrophic. As we have seen, animals were hunted for their pelts to the brink of extinction and sometimes beyond in North America; in southern Africa, ivory was the driver of the expansion of resource frontiers. In the late 1870s, British and Boer hunters advanced north into modern Zimbabwe, northern Botswana and eastern Zambia in search of elephants. Export figures show the

shocking scale of slaughter, with thousands of elephants killed each year in the second half of the nineteenth century.[85]

Ivory was highly desirable in Victorian-era Britain and the United States, as well as elsewhere, used for fashion accessories ranging from collar studs, hairbrushes and vanity sets to sewing cases, toothpicks and napkin rings.[86] Major demand came from piano manufacturers, as these instruments became popular in working-class bars and music halls and also as status symbols for the burgeoning middle classes, whether in British homes or newly settled farming communities on the Great Plains. The rise of billiards as a social pastime also increased demand; the ivory used for billiard balls had to come from soft young specimens – and from only part of the tusk at that.[87]

There were attempts to slow the trade down, if not stop it altogether, with Khama, the Tswana King, trying to introduce controls over hunting by sharply raising levies for elephants shot in his territory. This had little effect on consumers living a long way away, whose ideas about nature and the majesty of wild animals and preconceptions about the continent of Africa proved a heady cocktail that glamorised hunting and hunters; indeed big-game hunters like R. G. Cumming became household names and even outsold Charles Dickens when they wrote their memoirs filled with derring-do tales about how supposedly brave (white) men were able to push large animals to the brink of extinction thanks to their proficiency with the rifle.[88]

These were all new developments in the opening up of 'ghost acres' – that is, the colonial powers' exploitation of land, resources and commodities in other parts of the world. The British were by far the best, most organised and most determined at spawning clones in other continents, such as South Africa, North America and Australia. In each, political, legal and religious institutions were created that imitated those at home and were controlled by those who spoke the same language and had strong family ties with the mother country. The growth of the Anglosphere was explosive: the number of English-speakers rose sixteenfold between 1790 and 1930, from 12 to 200 million. It was not that the Spanish, Russians, Chinese or others who expanded into new lands or developed extractive, centralising policies in the same period did not meet with success; but as one leading historian puts it, 'it was the Anglophones who bred like rabbits'. It was the British who met with conspicuous success in creating infrastructure networks that sent

resources, commodities and goods in one direction and people in the other. Despite what conventional wisdom might say, it was only in the nineteenth century that Britain became great.[89]

Of course, success came at the expense of other people, as local populations were displaced or coerced in the Americas, in Africa, in Asia and in Australia either by Europeans directly or by their descendants. Ironically, the push towards independence in the United States was not predominantly caused by the rejection of Britain, or by revulsion towards British rule and British identity; rather it was more because leading Americans felt that they were treated as not being British enough and were accorded second-class status, above all in the lack of representation in the political process in London.[90]

On the face of it, the United States was fiercely republican in character, demeanour and self-identification; in behaviour and practice, however, it proved to be an expansive, militaristic and extractive power in its own right: the Louisiana Purchase in 1803 was followed by the occupation of Florida in 1810, by the expansion of geographic horizons to the west in the decades that followed and in the 1840s by the seizure of about half of Mexico. The gains that came thereby were distributed to elites and to commercial interests, at the expense of those who were conquered, displaced or subjugated.

The processes of acquiring territory and of opening up new commodity frontiers set in motion a chain of other changes, including investment in transportation connections and a rapid period of urbanisation. In the late 1770s, the three principal settlements in Kentucky were home to a combined population of 280 people. By 1782, some 8,000 European settlers had joined them; by 1790, the number had risen to 73,000.[91] Development of bigger and faster steamships brought shipping costs down and prices with it – though not in uniform ways. For example, in the 1820s, the cost of sending freight by river from Philadelphia via New Orleans was a third of what it cost to transport it overland; a few decades later, transatlantic shipping had become so efficient and cheap that it cost less to transport flour from North America to Liverpool than from Dublin across the Irish Sea.[92]

The rise of coal-powered steamships, combined with increases in their size, speed and reliability in difficult seas, stimulated the creation of a global network of refuelling stations and in doing so galvanised the development of new ports and coastal cities where goods could be

loaded and unloaded and which became important in their own right.[93] The opening up of the Suez canal in the late 1860s cut shipping times dramatically, with obvious implications for prices; the massive expansion of railways in Britain and Europe, the United States and Canada and in other continents during the nineteenth century was a similar story.

Cheaper, quicker, more reliable connections did not just boost economic exchange, but brought about dramatic social and cultural revolution too: provincial cities blossomed as they became integrated into networks giving access to ideas about art, music and literature that had previously been the preserve of the wealthy. Literacy levels in France rose by 20 per cent in the 1830s and about the same again in both the 1840s and 1850s; museums opened in the second half of the nineteenth century at great pace in the major cities in Europe, seeding discussions about the past and the present across ever wider sections of society. Not everyone approved: with operators like Thomas Cook capitalising on a booming tourism industry, some complained that visitor numbers spoiled the experience for others. English tourists, ran one complaint, were 'seemingly everywhere; there is no lemon tree without an English lady smelling its perfume, no picture gallery without at least sixty Englishmen, each with a guidebook in their hands checking everything is where it should be'. All these changes transformed connectivity, shrinking distances between regions and widening cultural horizons.[94]

So too did technological breakthroughs: the invention of a concentrated meat extract by Justus von Liebig not only proved commercially lucrative (and spawned many imitators), but also played an important role in the 'meatification' of metropolitan diets, as did mechanical refrigeration, which made the transport of meat highly profitable and much more efficient from the late 1870s.[95] Meat and protein increasingly became a part of working-class diets in London in the later nineteenth and early twentieth centuries, bringing health benefits to adult populations and aiding brain development in young people.[96] Meat consumption likewise grew in parts of Asia, such as in Japan, where the Meiji Restoration of 1868 prompted new attitudes to beef in particular, and in China. China was scouted by the beef baron William Vestey, whose family business had built up a global network that shipped millions of carcasses. He thought China offered enormous long-term potential – although one study in 1912 poured cold water on

the idea of exporting to Asia because the inhabitants, 'where they are not entirely vegetarian, are too poor to buy imported meat'.[97]

There were clear winners and losers in the acceleration and deepening of globalisation that characterised the nineteenth century. The British were prime beneficiaries, above all in terms of rising living standards and availability of goods and commodities. For example, by the 1890s, Britain absorbed 60 per cent of the meat and as much as 40 per cent of the wheat that was traded globally.[98] There was good news too for low-income households, with the repeal of the Corn Laws and the rise of imports from America ensuring that the price of a loaf of bread halved between 1840 and 1880.[99]

Constant improvement of machinery expanded production, improved efficiency and applied pressure on costs. Wheat exports from the United States rose from 5 million hectolitres to 100 million in the thirty years after 1840. The introduction of mechanical reapers doubled productivity, while steam-powered grain elevators meant that 500,000 bushels of grain could be processed in ten hours at a cost of five cents per bushel.[100] Mechanisation reduced the amount of labour required to yield a hectare of wheat from 150 hours to just nine. Breeding techniques doubled milk-fat production per cow and resulted in draught horses becoming 50 per cent bigger (and therefore stronger) in the United States between 1860 and 1890.[101]

The fruits of these gains flowed to those who had capital to invest and to those who could take advantage of mass production – large-scale arable farmers in the United States and livestock owners in Australia and South America, for example, or shareholders in railway companies that paid handsome dividends. They brought despair to those who were squeezed out, however, such as cereal farmers in Britain who could not compete with the flood of imports, and to labourers who were forced to leave the countryside to look for work in towns that had low levels of hygiene and a high incidence of poverty and disease – a way of life epitomised in works such as *Bleak House* by Charles Dickens.

There were similarly few benefits in parts of the world that were either left behind or received little by way of hard infrastructure in the form of roads, schools, hospitals and railways, and little by way of soft investment in institutions, education and local capacity building. States that were notionally free from colonial rule, such as in South America, behaved as classic extractive satellite states, exporting raw materials and

relying on imports for domestic consumption. The changes to the global economy brought mixed blessings for India and South Asia. Between 1810 and 1860, India lost much of its domestic textile market to Britain as prices were driven downwards, which had dramatic consequences because of the relative rise in the price of grain in the same period.

So while Europeans revelled in plentiful and cheap food, others were not so fortunate: as many as 16 million died of hunger in India in the decades between 1875 and the start of the First World War – a prolonged catastrophe that colonial administrators treated as a fact of life and one that had positive side-effects, which included forcing indebted smallholders off the land while serving as a welcome check on the growth of India's population size.[102] Huge numbers died in famines, often during times when massive consignments of wheat from India continued to be exported, especially to Britain. This mattered little, according to one blunt official writing to the Viceroy in the second half of the nineteenth century: 'still they reproduce themselves with sufficient rapidity to overcrowd every employment that is opened to them.'[103]

Problems came too from opportunistic attempts to turn profits. By the end of the 1850s, for example, the United States was the biggest producer of cotton in the world, exporting around 3.5 million bales annually – much of it grown by coerced labour on plantations in the Deep South. The Union blockade of Confederate ports during the civil war dramatically strangled trade, with just 10,000 bales exported in 1861–2, a drop of almost 99 per cent.[104] Although slavery had been banned in Britain by the Abolition Act of 1833, the British economy relied heavily on the textile industry and as such not only benefited from cotton imports but relied on them to keep its factories working. The supply failure raised concerns about shortages of materials and about threats to public order. There were riots in several cotton towns in England, as well as elsewhere in Europe. 'No crisis in modern times has been so anxiously watched,' declared *The Times* in the early 1860s in reference to the US civil war, 'nor has any European war or revolution so seriously threatened the interests of England.'[105]

Anxieties were heightened by the rise of radical ideas that were themselves closely linked to long-term socio-economic problems. Rapid and large-scale urbanisation was transforming the literal and the political landscapes of Europe, which had already been hit by a series of revolutions in 1848. These upheavals were framed by Karl

Marx and Friedrich Engels as expressions of the class struggle by the oppressed against those who controlled the means of production; in fact they owed rather more to serious food shortfalls that had triggered famine and hunger riots, most notably in Ireland, Flanders and Silesia in the mid-1840s. The violence that spread across many parts of the continent resulted in governments cancelling investment programmes and so negatively impacting mining and metal production from the spring of 1847. This contributed to the groundswell of protest and the demands for reform, freedom and greater rights that peaked the following year.[106]

Attention quickly turned to India, therefore, as an alternative source of cotton – perhaps not surprisingly given the repeated attempts to stimulate production, most of which had faltered thanks to the low quality of Indian cotton and to poor transportation networks that added to costs. The invention and widespread adoption of the Whitney gin had prompted a revolution of its own in the United States: in 1801, a cotton picker typically averaged around 28 pounds per day; by the end of the 1820s, this had risen more than fourfold, to just over 132 pounds a day, almost trebling again just over a decade or so later to 341 pounds.[107] The coerced labourers who were forced to work at these staggering rates of productivity benefited factory owners and factory workers (albeit to a much lesser extent) in cities like Manchester on the other side of the Atlantic, as efficiency in weaving mills improved by six to ten times between 1820 and 1860. Ironically, the gains made slavery even more lucrative, ensured that enslavers in the American south became richer still and reinforced their determination to hold on to the source of their wealth – forced labour.[108]

The pressure on supplies caused prices of Indian cotton to rise by almost five times in the early 1860s. A surge in land clearances followed as producers sought to capitalise on the high prices. More than a million hectares were turned over to cotton growing from other subsistence crops. Railway construction dissected Berar, a province in the heart of the Indian subcontinent, where the town of Khangaon quickly became what one contemporary called the 'largest cotton outpost of the British empire'.[109]

Others too tried to grasp the opportunity, including in Central Asia where some Russians in this period hoped the local populations would be 'our Negroes' – an aspiration that leaves little to the imagination.

During the US civil war, cotton production in Central Asia boomed, rising more than fourfold in the period 1861–4.[110] Then there was Lower Egypt where 40 per cent of all fertile land was converted to cotton cultivation, as was much of the substantial personal landholdings of the Ottoman Viceroy, Sa'id Pasha.[111]

All these opportunistic moves paid immediate dividends. However, they came at a high cost. For one thing, the settlement of the American civil war reintroduced large supplies to the market, with improved availability placing downward pressure on prices. For another, the expansion of cotton growing led to the introduction of agricultural slavery in other parts of the world, most notably in the Nile Delta, which became home to large numbers of enslaved people imported from East Africa: efforts to end slavery in one continent brought about just the opposite in another.[112]

The attraction of high returns also led to financial strains and overstretch among those who borrowed money for seeds, tools, food and labour. When prices turned, many found themselves overextended and with debts that they struggled to pay. In Egypt, this produced waves of land abandonment, bankruptcies, a growing body of landless labourers and the polarisation of social relations in the countryside as inequalities rose. Much the same happened in India, where some have argued that indebtedness, displacement and desperation – combined with the tightening suffocation of colonial demands – provide the backdrop to the Deccan riots and to the death of millions from starvation in the 1870s.

Minimal efforts went into investing in irrigation because of mistaken beliefs about the richness of the black soil of Berar and partly because of the incompetence of colonial officials who prioritised cotton over grain. The failure of wages to keep up with prices resulted in malnutrition and higher susceptibility to disease as well as starvation. Famine cycles in the 1890s struck again and again, ruining countless families and enriching those who hoarded food – and even continued to export it during years of acute crisis.[113] That starvation rates were particularly high in Berar tells its own story about attempts to cash in on short-term opportunity.[114] Such were the consequences that flowed from a conjunction of the search for profits, the unsustainable exploitation of the landscape and nature taking revenge when pushed beyond its limits.

20

The Age of Turbulence (c.1870–c.1920)

> A gallant body of Englishmen have fallen victim to their efforts to bring West Africa within the outer fringes at least of civilisation.
>
> *Daily Telegraph* (18 January1897)

If the human consequences of disaster were severe and shocking, so too were the ecological implications of rapid transformations of landscapes that were motivated by the chase for a fast buck. For example, forests were hacked down to create cotton plantations. This had obvious knock-on effects for flora and fauna alike, exacerbated by the practice of paying bounties for tigers, panthers, wolves, bears and hyenas – apex predators whose disappearance produced major environmental change. Worse, land that was cleared often proved to be unsuitable or was exploited so badly that yields dried up, as (literally) did rivers, lakes and water resources as a result of soil erosion or because clearances induced changes to regional rainfall patterns.[1]

The story of cotton was one that was repeated time and again, particularly from the second half of the nineteenth century onwards when global markets became more integrated, transport networks improved and information-sharing accelerated. For example, the demand for rubber shot up as a result of Charles Goodyear's pioneering work in the 1830s on vulcanisation, the chemical process that improves elasticity, hardness and resilience, and then again by the development of the pneumatic tyre, perfected by John Dunlop in 1888.[2]