THE ANTHROPOCENE AND THE GLOBAL ENVIRONMENTAL CRISIS

Rethinking modernity in a new epoch

Clive Hamilton, Christophe Bonneuil and François Gemenne

#3.

Routledge
Taylor & Francis Group
LONDON AND NEW YORK

6

LOSING THE EARTH KNOWINGLY

Six environmental grammars around 1800

Jean-Baptiste Fressoz

The promoters of the Anthropocene have not only coined a name for a new geological era; they have also proposed a very peculiar history of the last two hundred and fifty years. It goes like this: since 1800, and more intensely since 1945, humanity, taken as an undifferentiated whole, has inadvertently altered the Earth system through population growth and economic development, both supported by an exponential use of fossil fuels. Fortunately, at the end of the twentieth century, on the brink of a global disaster, a small group of Earth system scientists has opened our eyes to the danger. Thanks to them, 'We are the first generation with the knowledge of how our activities influence the Earth System, and thus the first generation with the power and the responsibility to change our relationship with the planet' (Steffen et al. 2011, 749).

The concept of the Anthropocene and its wide, yet critical reception among social scientists could trigger serious historical reflection on the origins of the environmental disaster we live in. Indeed, compared to 'global change' or 'environmental crisis', its greatest merit is to put humanity, time and history at the centre.

'Historicising the Anthropocene' can refer to various intellectual projects. The most obvious and politically urgent is to write a proper history of the new epoch, replacing the rather vague 'anthropos' with the nations and companies, institutions and imaginaries, technologies and ideologies that are the true drivers of the Anthropocene. When confronted with contemporary global issues, the specificity of historical reasoning and the construction of explanatory narratives tend to disappear in favour of a quantitative vision. Global statistics, so central to the Anthropocene thesis, create the image of a global humanity united by carbon dioxide, thereby erasing the incommensurability of responsibilities. Indeed, a quick glance at carbon emissions data reveals that, up to 1980, the *anthropos* of the Anthropocene seems to have a very strong English accent. In cumulative terms

from 1800 to 1950, 65 per cent of carbon emissions were emitted by Great Britain and the United States alone. Historically speaking, the Anthropocene could well have been called the Anglocene.

Global statistics are also secondary in the causal order. They only measure and reflect the end results of historical processes that are the true causes of the crisis. History is already well equipped for our new geological era, as many classical objects of the discipline play a prominent role in the advent of the Anthropocene. In disorder and without completeness: the industrial revolution, capital accumulation, world-systems, formal and informal imperialism, wars and the military, unequal exchange, Fordism, consumption, energy transitions, science and reductionism, agnotology, and so on. We need to connect these topics to the quantitative history of the Anthropocene.

Beyond replacing the consensual 'anthropos' with a historically grounded narrative, a second, subtler challenge for history is to refute the narrative of a blind humanity transforming its environment unknowingly. On this point, the official story of the Anthropocene actually rehearses what sociologists of risk and postmodernity explained in the 1980s. Thirty years ago 'we' were already the first generation to understand the threat of the environmental crisis and the dead end of development. Thirty years ago, 'risk society and 'reflexive modernity', like the Anthropocene today, were conceived of as a momentous break in the history of civilisation (Beck 1986; Giddens 1991). Because it distinguishes between a blind past and a present on the way to illumination, the Anthropocene could have the same effect as 'reflexive modernity' in the 1980s: the geological sublime replaces the historically grandiloquent, but in the end produces a similar arrow of time based on the presumed progress of our reflexivity. The Anthropocene could well be one of the last reincarnations of the discourse of progress, which it reformulates as the teleology of humanity becoming reflexive as geological agent. The problem with any prophetic narrative centred on a sudden ecological awareness is that by obliterating the reflexivity of past societies, it tends to depoliticise the long history of environmental destruction. And, conversely, by concentrating on our own reflexivity, it tends to naturalise our ecological concern.

As an antidote, this chapter provides a possible typology of the 'environmental grammars' existing at the dawn of the Anthropocene. These grammars are deeply connected to specific disciplines, from natural history to chemistry and thermodynamics, but, more importantly, they provide rules of conduct towards nature. They discriminate between pure and impure, nature and artifice, safety and danger, sustainability and unsustainability; they blame historical processes and valorise certain modes of life.

I distinguish six of them: *circumfusa*/environment, climate, nature's economy, human–nature metabolisms, thermodynamics and exhaustion. The list is not limiting and other classifications are possible. The aim is less historical than to infuse a bit of modesty in the Anthropocene revelation. While it would be a modernist projection to characterise early Anthropocene societies as 'green', conversely it would be self-indulgent to judge our current environmental concerns and

theoretical categories (ecosystem, biodiversity, global warming, biogeochemical cycles, etc.) as the only way to be 'environmentally conscious'. It is also unlikely that the naming of a geological epoch or the advent of a geologically reflexive agent make a revolution in the history human–nature relationship, and even less so in the history of environmental destruction.

Circumfusa/environment

At first glance, the history of the word 'environment' in the public space seems to confirm the thesis of a recent environmental awakening. 'The environment' was institutionalised only in the 1970s with the creation of the US Environmental Protection Agency, ministries of environment in various OECD countries and the United Nations Environment Program (1972). But two points need to be made. First, these new agencies and new departments are responsible for enforcing laws and regulations (such as clean air acts) that have a much longer history (Thorsheim 2006; Massard Guilbaud 2010; Le Roux 2011). Second, the genealogy of the word 'environment' shows that the form of reflexivity it names is actually much older.

In the 1850s 'environment' was used as a synonym for 'surroundings' or 'exterior'. If the environment affects living beings and humans (as stated, for instance, in Carlyle, 1837), the word is not yet used to underline the fragility of nature. In *Man and Nature*, the great American environmentalist book of the 1860s, George Perkins Marsh does not use the word; nor does Eugene Huzar in *The End of the World by Science* (1855), the first catastrophic philosophy of technology. It was Herbert Spencer in *Principles of Psychology* (1855) and *Principles of Biology* (1864) who coined a scientific use for 'environment'. In Spencer's works, environment describes the 'surrounding circumstances' of an organism, that is to say, all the physical influences that affect and transform it.[1] In fact, Spencer, probably getting his inspiration from Lamarck and his notion of *circonstances influentes*, inherits from and gives new life to a fundamental concept of eighteenth-century hygiene, that of *circumfusa* (the 'surrounding things' in Latin). Under this category, doctors included the air, water and places (central to the etiology of neo-Hippocratic medicine) and all the various factors influencing health in general (Fressoz 2009). This *circumfusa*–environment filiation is important to keep in mind because it refutes the common opposition between the old 'environment', as an exteriority out of reach, and the environment of the 1970s, malleable, fragile and therefore eminently political.

In fact, in the eighteenth century, the *circumfusa* are already understood as both in danger and dangerous. Seemingly benign alterations could have dire consequences. For example, Abbé Dubos' explanation for the degeneration of the Romans in antiquity is that the medical constitution of Rome had been altered by the destruction of the sewage system (*cloaca maxima*) and by the multiplication of alum mines in the Latium plain (Dubos 1714). According to the medical and philosophical thought of the eighteenth century, human societies evolve in relation to the atmospheric envelopes they inhabit and help to create. Human action reverberates in the *circumfusa*, which in return change human constitutions (Fressoz 2012).

Given this sanitary sensibility, the fumes, smells and vapours emitted by urban workshops could be extremely threatening. During the eighteenth century and well into the nineteenth, populous and industrious cities were generally considered to be unwholesome places, just like swamps, prisons and ships.

So we have the environmental concerns of eighteenth-century urban institutions. The police were in charge of the good management of urban atmospheres, and the *circumfusa* were some of the main objects of their daily work. In his famous treatise *De la Police* (1699–1704), Nicolas Delamare, a commissaire of Paris, referred to the Hippocratic *Airs, Waters, Places* so as to justify the rule of the police over the city. The threats posed by the *circumfusa* and the preservation of citizens' health legitimated the extension of police powers over almost everything pertaining to urban life – streets and buildings, food supply and quality, waters, airs and workshops.

The crucial point to bear in mind is that industrialisation took place not in a cognitive void, but in spite of prevailing medical theories emphasising the importance of a wholesome environment and the dangers of pollution. In France, industrialisation entailed a profound theoretical and political shift around 1800. First, in 1810, the government passed a decree protecting industrialists from their neighbours' complaints. Factories were submitted to a stringent authorisation procedure, but in exchange could no longer be prohibited or displaced by mere police order. Neighbours who could not hope to see the factories removed, received financial compensation for the environmental damages they suffered.

This financial regulation of environment entailed a second major transformation. A small group of chemists and doctors (in France the first *hygienists* were in charge of granting authorisations to factories) justified the presence of manufacturing by studying statistically the causes of mortality and longevity. They emphasised the importance of social factors over environmental ones. Rejecting neo-Hippocratic environmental medicine, social hygiene allowed *hygienists* and the administration to disregard the medical arguments against industrial pollution.

The frail climate of modernity

Closely related to the notion of *circumfusa*, the idea of climate is also central to understanding early Anthropocene societies. Originally defined as a purely topographical notion (a zone between two latitudes), climate acquires its contemporary meaning (the average conditions of temperature and precipitation in a given place) in the eighteenth century. As meteorologists charted local variations in humidity, winds and temperatures, they also understood the impact of locality upon climates and discovered their transformations over time. The comparison between widely different climates at the same latitude across the Atlantic reinforced the idea that civilisation and deforestation transform the meteorology of entire countries. As climate retains its ability to determine human and political constitutions, what determines the health of populations and social organisations is no longer just the position on the globe, but mundane things – forests and marshes, but also fumes and urban forms – on which society can act for good or ill. Climate thus became in

the eighteenth century a crucial epistemic category to reflect upon the consequences of human action on the environment and vice versa (Fressoz and Locher 2012).

Take, for example, the 'epochs of nature' of Georges-Louis Leclerc Buffon (1778). Buffon's seventh and last epoch of the world's history is aptly named 'the epoch of Man'. It is characterised by the advent of humankind as a global force. At the beginning of the Anthropocene, Buffon explained that 'the whole face of the earth today bears the imprint of the power of man' (Buffon 1778, 244). And this influence is even being exerted upon the climate because, by tinkering with the environment, humankind will be able to 'alter the influence of its own climate, thus setting the temperature that suits it best'. For Buffon, humanity's impact on nature is generally positive. He contrasts the fertility of the 'civilised nature' of Europe with the savage, hostile and neglected nature of South America.

This then-common view of climate–society co-production did not only give way to optimistic and demiurgic dreams of nature improvement and climate control. Many early-nineteenth-century authors developed nightmarish visions of anthropogenic climate catastrophe. The issue of deforestation in particular transforms Buffon's optimism into climatic angst. Meteorologists and agronomists refer to plant physiology to incriminate deforestation for all sorts of weather events – harsh winters, droughts, storms and excessive rainfall. Trees and forests, by their constant relationships with the atmosphere, moderate climate – they dry damp locations and moisten dry places and they prevent storms, erosion and flooding. The massive deforestation of the seventeenth and eighteenth centuries, both in colonial settings (Grove 1995) and in Western Europe – the forest cover in France seems to have fallen from 18 million hectares in 1550 to 9 million in 1789 (Pomeranz 2000, 308) – is perceived as a break in the natural and providential order that keeps in balance the water cycle linking the soil and the atmosphere.

Concern about climate change was widespread in European scientific cycles. For instance, after the eruption of the Tambora volcano in Indonesia in April 1815, Europe experienced a series of anomalous seasons and bad harvests. In consequence, learned societies in France, Switzerland and Britain fostered research on climate change, pointing to the possibility of its anthropogenic origin. In France, the debate on climate change is particularly acute as it is blamed by the Restoration government on the Revolution through its sale of aristocrats' woods and the short-sighted exploitation of forests by a new bourgeoisie. In 1821, the Minister for the Interior ordered a national inquiry on climate change and deforestation. In Britain, the enclosures are discussed in relation to climate change. According to the renowned horticulturalist John Williams, the multiplication of hedges, and pastures for animal feed rendered the British climate colder and wetter than in the past (Williams 1806).

Several remarks are in order. First, what is at stake in the first quarter of the nineteenth century is not local anomalies but the global climate. For important commentators, such as Joseph Banks', Secretary of the Royal Society of London, deforestation is altering a global water cycle that connects the tropical seas to the polar ice caps. Secondly, climate change is also conceived of as an irreversible phenomenon

questioning civilisation itself. As population growth and the expansion of manufactures entail deforestation, climate changes and the rain stops, thus undermining the possibility of future reforestation. Civilisation is caught in a vicious circle of deforestation and climatic change. In the 1820s, foresters develop a theory about the collapse of the ancient civilisations of the Middle East relying on the climatic effect of deforestation. In the engraving of Figure 6.1, François-Antoine Rauch, a prominent French advocate of forest conservation in the 1820s, depicts the ruins of Babylon now lying in the middle of a desert. It serves as a cautionary tale for the French government; this could be Paris's future if deforestation is not stopped.

Thirdly, in the political and scientific spheres of the early nineteenth century, climate change was not a marginal topic. Because wood remains the main source of energy, climate change interferes with a fundamental choice in land use between forests (and thus wood and factories) and fields (and thus food and population). Climate change was discussed in the French National Assembly in 1791, 1821 and 1836. Anthropogenic climate change was also studied by scientific bodies, ranging from provincial literary societies to the Académie des Sciences in Paris and the Royal Society in London (Fressoz and Locher 2012).

Several processes progressively relaxed these climatic anxieties after 1850. First, the shift from wood to coal as the main source of energy made forests much less central to western European economies and their conservation a less vital issue. Secondly, in the second half of the nineteenth century, as geologists

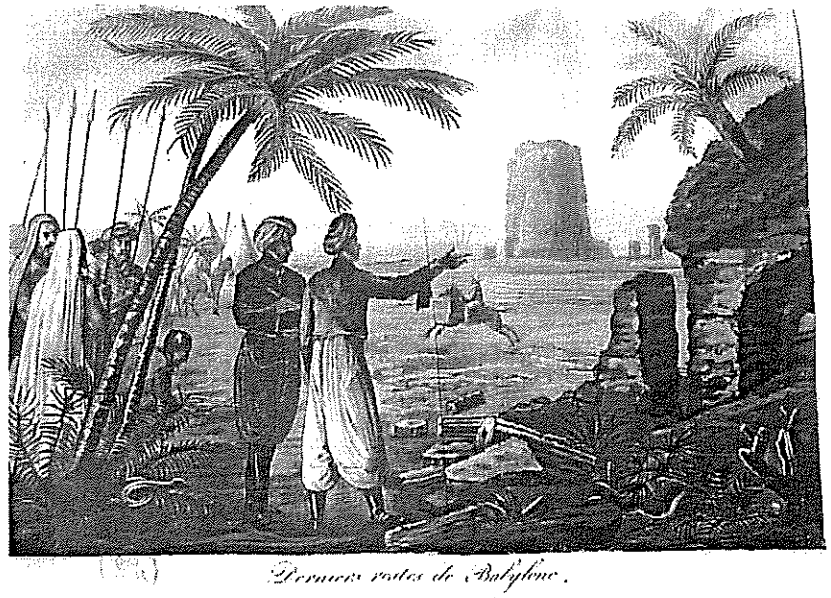

FIGURE 6.1 François-Antoine Rauch, The Ruins of Babylon *Annales Européennes*, 1824, vol. 4, 17

and astronomers gradually accepted the ice age theory, humanity appeared to be trapped in immense cycles of geological time triggered mainly by astronomical phenomena, without human action having any impact whatsoever. And, thirdly, climate itself lost much of its importance as a determinant of social forms and cultures. At the end of the nineteenth century, sociology and economics were careful to distance themselves from the old climatic determinisms and replace them by their own systems of causality (Fressoz and Locher 2012).

Nature's economy

Historians of scientific ecology have identified the concept of 'nature's economy' as the origin of the contemporary notion of ecosystem. They have also demonstrated its centrality in eighteenth- and nineteenth-century natural history (Worster 1977; Drouin 1997). From Linnaeus to Thoreau, naturalists marveled at the systemic relationships weaving all beings together into a coherent whole designed by God. One objective of natural history was to discover networks of interdependency and to demonstrate the 'symphonic precision of nature'. According to natural theology, every being played a precise function in the maintenance of the natural order. Gilbert White, in his *Natural History of Selborne* (1789), explained that 'the most insignificant insects . . . have much more influence in the economy of nature than the incurious are aware of . . . Earthworms, though in appearance a small and despicable link in the chain of nature, yet, if lost would make a lamentable chasm' (White 1789, 216). In this fully connected world, criss-crossed by chains of dependence and reciprocity, disaster is always looming. In face of nature's infinite complexity, there emerged a feeling of dread and modesty. For Jean-Baptiste Robinet: 'We [humans] and other large animals are vermin of the largest animal that we call Earth' (Robinet 1766).

The concept of nature's economy also led to a renewal of the organic vision of the Earth. Carolyn Merchant argues that in antiquity, the Renaissance and up to the scientific revolution, our planet was conceived of as a living body with its veins and its fluids, its shivering and its diseases. The Earth was a mother that had to be respected. The scientific revolution and the emergence of capitalism led to an inexorable decline of organic cosmology. Nature became a vast mechanism to be explained, mastered and exploited (Merchant 1980). In fact, the vision of a living planet persists long after the scientific revolution. In 1795, Felix Nogaret, a courtesan philosopher, published a popular essay depicting the Earth as an animal (Nogaret 1795). The renowned geologists Eugène Patrin and Philippe Bertrand criticised these direct analogies, but nevertheless advocated the introduction of organic explanations. Considering the Earth as having 'organic functions' helped one grasp the 'intimate connexity of all the phenomena of the globe'. The Earth and other planets in the universe formed a third kind of organism, distinct from plants and animals (Patrin 1806, 315). In 1821, the socialist thinker Charles Fourier took on board organic cosmologies so as to criticise individualism in its relation to nature. Climate change, torrents, silting of rivers, erosion and deforestation were testimonies to a planetary disease caused by individualistic societies unable to

regulate their relation with the planet (Schérer 2001). Inspired by Fourier, the French catastrophist philosopher Eugene Huzar also constructed the image of a planet as a living and fragile organism. Man's actions were like wounds inflicted on the Earth-as-body (Fressoz 2007a).

Nature's economy is profoundly reconfigured by the emergence of Darwin's theory of evolution and the refutation of a divine order structuring the natural world. Nevertheless, Darwinism, with the law of evolution and coevolution, and the Malthusian law of the geometric increase of populations produced the image of a fully inhabited nature in which all possible resources were exploited by all the different species. In a preparatory manuscript for the *Origin of Species* Darwin compared nature 'to a surface covered with ten thousand sharp wedges, many of the same shape, and many of different shapes representing different species, all packed closely together and all driven in by incessant blows . . . often transmitted very far to other wedges in many lines of direction' (quoted in Staufer 1987, 208).

The word ecology (*Öekologie*), proposed by Ernst Haeckel in 1867, did not point to a *terra incognita*, but rather renamed and reorganised old traditions in natural history. With the word *Öekologie*, Haeckel wanted to achieve two objectives. First, to suggest that living beings struggled for life, as demonstrated by Darwin, but also that they composed a home, an *oikos*, prospering on symbiosis and mutual help. Secondly, his aim was to integrate in a single discipline two fields of inquiry: the study of the interactions between living organisms (Darwin's theory of natural selection) and the older study of the influence of physical conditions on living beings (climate, soil, and so on). The slow diffusion of the term (one must wait for the International Botanical Congress in 1893 to find the contemporary spelling of ecology) is not a sign of a particular difficulty of supposedly reductionist natural sciences to understand the systemic aspect of nature but was due to the existence of the concept of natural economy which remained very much alive until the late nineteenth century (Worster 1977, 191–5).

Once again, the history of environmental reflexivity is not one of a rising awareness culminating in the Anthropocene revelation. The theme of nature's economy regularly surfaced in socio-environmental struggles of the eighteenth century. For example, in the 1770s in Normandy fishermen complained about glassmakers harvesting kelp (whose ashes, used to produce soda, were highly valued in glassmaking), specifically citing kelp's role in the survival of young fish and the natural economy of the marine world. In a memorandum sent to the Academy of Sciences, they explained that fish spawn in kelp because kelp retained fish eggs, increased the chances of fertilisation and protected the young fish from waves and predators (Fressoz 2012). In the 1950s, such ecological connections were 'forgotten' in the management of fisheries. The principle of the maximum sustainable yield, implemented in international treaties, envisages fish populations as a crop to be harvested. Overfishing is understood as a reversible phenomenon; if catches decrease, the reduction of fishing pressure would quickly re-establish the stocks. Systemic interactions between species and the role of the marine environment were neglected and thus the issue of exhaustion marginalised (Finley 2011).

The metabolic rift

The exchange of matter between human society and nature constitutes a fourth grammar of environmental reflexivity. In the late eighteenth century, a chemical vision of agriculture emerged: as each harvest removed minerals from the soil, soil fertility depended on the return of excreta to the fields. In his *Rural Economy* (1770), Arthur Young reflected upon the right balance between pasture and tillage and the best way to move organic nutrients between plants and animals. The task was momentous: 'if one of the proportions is broken,' Young wrote, 'the whole chain would be affected' (quoted in Warde 2011, 166). The development of a chemical theory of agriculture with Liebig, Dumas and Boussingault increased the complexity of the problem. Liebig's 'law of the minimum' fueled a pessimistic view of soils' future, whose fertility was henceforth determined by the subtle balance of various chemical elements (N, P, K, Ca, Mg, S, Fe, and so on).

Strong concerns were voiced in the nineteenth century about the metabolic rift between city and countryside. Urbanisation, that is to say, the concentration of people, animals and their *excreta*, prevented the return to the land of minerals indispensible to its fertility. Great materialist thinkers, from Liebig to Marx, agronomists, hygienists and chemists warned against both soil depletion and urban pollution. For Liebig, urbanisation and the failure to recycle organic matter would lead inexorably to the collapse of European societies. From his analysis of agricultural metabolism, he formulated a scathing critique of modern agriculture and capitalist globalisation. In a famous angry passage he blamed Great Britain, the major importer of guano and mineral fertilisers, of plundering fertilisers from other countries: 'Great Britain deprives all countries of the conditions of their fertility. . . Like a vampire it hangs on the breast of Europe, and even the world, sucking its lifeblood' (quoted in Brock 1997, 178).

Many socialist thinkers of the mid-nineteenth century discovered the work of Liebig and the whole issue of the metabolic rift. In 1843, Pierre Leroux, an early socialist writer (famous for coining the word 'socialism'), used Liebig's arguments to theorise a social utopia he called the 'Circulus' in which society would live in homeostasis, actively occupied to maintain the cycle of nutrients with land and to minimise material losses in the production process. In the third volume of *Capital*, Marx also criticised the environmental consequences of capitalist agriculture with its large farms breaking up the material cycle between society and nature. According to Marx, there was no possible emancipation from nature, whatever the modes of production; human societies remained dependent on a historically determined metabolic regime, the peculiarity of capitalist metabolism being its unsustainability (Foster 2000).

The fate of excrement was thus at the heart of nineteenth-century debates. Excrement was linked to the social question because impoverished soil fomented famines, pauperism and revolution. It was related to the wholesomeness of urban environments and thus to the question of degeneracy. It involved geopolitical issues as Great Britain and the United States competed for the monopoly of Peru's guano. And it was even related to the fate of civilisations; Rome, according to Liebig, had fallen for failing to manage its excrement properly.

Entropy

With chemistry, thermodynamics (the study of energy's properties and transformations) furnished parallel conceptual tools to study the relationships between human society and nature. Since its inception, the concept of energy has been used to explain economic and social problems (Wise 1990). In the late nineteenth century, it was already possible to construct a quantitative view of the energy fluxes intercepted by plants or extracted from coal and to trace its circulation in the economy. One of the first to conduct such an analysis was the Ukrainian socialist Sergei Podolinsky. Comparing pasture with wheat cultivation he demonstrated that the energy efficiency of agriculture increased with the proportion of animal or human labour input and decreased with the use of machines using coal (Martinez-Alier 1987).

Many authors at the turn of the nineteenth and twentieth centuries proposed a reform of economics and of the economy itself based on the study of energy – Eduard Sacher, *Foundations of Mechanics of Society* (1881), Patrick Geddes, *John Ruskin Economist* (1884), Rudolf Clausius, *On the Energy Stocks and Their Valuation in Nature for the Benefit of Humankind* (1885), and Frederick Soddy, *Cartesian Economics* (1921). These authors shared a very critical view of political economy, which merely considered the monetary value of things. Merely 'chrematistic' (focused purely on monetary wealth) political economy obscured the real problem of economy, namely the material and energy supply of human societies. They also pointed out the discrepancy between the appearance of growing financial wealth and the reality of energy's inexorable dissipation. Geddes, for example, noted that economics accounts only for the energy generated by a steam engine, ignoring the other 90 per cent that is dissipated and forever lost. In *Cartesian Economics*, Frederick Soddy, Oxford professor and Nobel laureate in chemistry, explained that the interest rate was a contingent human convention, which could not contradict for very long the entropy principle to which the capital is subjected. According to him, industrial investment, far from increasing wealth, accelerated the depletion of fossil resources (Martinez-Alier 1987).

Depletion

The historical shift from an organic economy based on wood to a mineral one fueled by coal occurred despite deep concerns about the non-renewability of fossil energy. In 1784 Frederic II (who encouraged the shift from wood to coal) ordered a report on the probable duration of Berlin's coal supply (Sieferle 2001, 185). In 1819, Jean-Antoine Chaptal, a major figure of French industrialisation, estimated that national coal reserves were too limited to be wasted on gas lighting. It was wiser to conserve it for steel production and national defense (Fressoz 2007b). In England in the 1820s, the depletion of certain mines, coupled with parliamentary

debates on the export of coal, prompted the first evaluations of national reserves. The House of Lords established commissions on the question in 1822 and 1829. Stanley Jevons' famous treatise, *The Coal Question*, published in 1866, is thus to be read as part of a long-running controversy.

However, two inflections occurred after its publication. First, the debate on exhaustion moved from a geological problem (centred on measuring the reserves) to an economic one concerning estimates of future consumption. Should geometric growth be assumed (as Jevons did) or is it simply arithmetic growth? Secondly, the period is marked by a general anxiety concerning the exhaustion of natural resources. We already mentioned the concerns about the metabolic rift. In 1898, the president of the British Society for the Advancement of Science, William Crookes, warned against depletion of nitrate and guano and the risk of a global crisis in agriculture, which had become dependent on non-renewable resources (Smil 2001, 58). At the same time, US conservationists started a crusade against deforestation and wasteful uses of natural resources more generally, in the context of the end of the frontier (Hays 1999). Geologists also warned about the scarcity of copper, zinc and tin, warnings arising from the beginning of electrification.

The transition from an organic to a mineral economy, the disruption of metabolic cycles and the reliance on non-renewable sources of energy took place despite acute awareness of the future and clear warnings of the unsustainability of the new material regime that had emerged at the end of the nineteenth century.

This troubling fact is well illustrated by the brutal shortening of the time horizon of political actors. In 1860, in the House of Commons, Benjamin Disraeli, an opponent of a free trade treaty with France, argued that the British reserves of coal covered only three or four centuries of national consumption, so it was imperative to put a heavy export duty on coal to maintain British world hegemony in the long term. A probable scarcity in three centuries seemed to justify an economically harmful measure in the present. Conversely, William Gladstone, then Chancellor of the Exchequer and a supporter of free trade, referred to other geological studies estimating that British coal reserves could last for over 1,000 years. British politicians of the era, steeped in classical references and tasked with managing the empire, could see a thousand years into the future!

Compared to coal, the first debates on oil reserves were marked by dramatically shorter time horizons. In the United States, the consumption boom associated with the development of the automobile and the First World War took place despite warnings of the imminent exhaustion of national reserves. In 1918, a report of the Smithsonian Institution explained that it was unlikely that geologists would find new major oilfields in the United States. During the First World War, the director of the US Fuel Administration anticipated US military decline due to the scarcity of oil. In 1921, the US Geological Survey estimated the duration of economically exploitable oil at twenty years at the most (Dennis 1985).

How can we explain the marginalisation of both the 'limits to growth' debate and entropic thinking in the late nineteenth century? On the one hand, concerns about the depletion of mineral resources were circumvented by the globalisation of geological surveying. For instance, in 1913, the international geological Congress of Toronto led to the first quantification of the global reserves of coal. The rather vague definition of 'probable reserves' and the extension of economically recoverable coal at a depth of 4,000 feet (instead of 2,200 previously) allowed a massive overstatement of the resource (six times higher than contemporary estimates!) (Madureira 2012).

More profoundly, the intellectual world gradually lost interest in the material conditions of production. The case of economics, which became the dominant mode of formation of the social elite, is exemplary in this regard. With the marginalist paradigm, economists shifted their focus from the study of productive factors (labour, capital and land) to the subjective states of consumers and producers seeking to maximise their individual utility. From 1870 to 1970, the study of natural resources was confined to a sub-branch of the discipline, resource economics. In 1931, in the fundamental article of this field, Harold Hotelling analysed the situation of a mine owner who seeks to maximise its revenue across time. The problem is no longer that of the secular evolution of a national economy (the problem that Jevons tackled), but more modestly to determine the optimal extraction path of an exhaustible resource at a microeconomic level. The mine is considered as an abstract entity, disconnected from the rest of the production system, a mere store of value, obeying to the same type of economic calculation as a stock portfolio.

At the same time, in the context of the 1930s crisis of overproduction, economic growth was conceptualised not in material terms but as the intensification of monetary exchanges in a given territory. The abandonment of the gold standard in 1930 (that is, the end of the idea that banknotes represent gold) and the invention of gross domestic product by the system of national accounts, completed the dematerialisation of economic thought. After the Second World War, economics had conceived the economy as a closed system, a circular flow of value between production and consumption, cut off from its natural ties.

Conclusion

When thinking historically about the Anthropocene and the mess we are in, we need to bear in mind that the destruction of the environment has occurred not as if nature counted for nothing; on the contrary, it proceeded despite an understanding of its consequences. In the late eighteenth century, industrial pollution darkened the atmosphere in spite of neo-Hippocratic environmental medicine's focus on air. In the early nineteenth century, deforestation continued in spite of the fear of climate change. Later in the century, the use of natural resources intensified in spite of the awareness of their limits and the idea of nature's economy.

The history of the Anthropocene is not the emergence of an 'environmental consciousness', but rather the opposite. The historical problem is to understand how modernity became 'disinhibited' in its relation to nature. This modern disinhibition (Fressoz 2012) is not the result of some fundamental fractures in the Western mind (Christianism and man's mastery over nature, the divide between

nature and culture, the mechanistic ontology of the scientific revolution, and so on) but is produced by many strategic devices that emerged during the Anthropocene, many of which are still operating (Bonneuil and Fressoz 2013). We need to take on board the disturbing fact that we entered the Anthropocene knowingly and we need to think the contemporary situation in continuity with the past, less as a threshold in environmental awareness and rather as the culmination of a history of two centuries of conscious destruction.

Note

1 I owe this point to Paul Warde.

References

Beck U 1992 *Risk Society: Towards a new modernity* Sage, London [1986]

Bonneuil C and Fressoz J-B 2013 *L'événement anthropocène* Editions du Seuil, Paris

Brock H 1997 *Justus von Liebig: The chemical gate keeper* Cambridge University Press, Cambridge

Buffon G L L 1778 *Histoire Naturelle Générale et Particulière. Des époques de la Nature* Imprimerie Royale, Paris

Carlyle T 1837 *Sartor Resartus* James Munroe, Boston

Dennis A 1985 Drilling for dollars: The making of US petroleum reserve estimates 1921–25 *Social Studies of Science* 15 (2) 241–65

Drouin J M 1997 *L'Écologie et Son Histoire* Flammarion, Paris

Dubos J B 1714 *Réflexions Critiques sur la Poésie et sur la Peinture* Mariette, Paris

Finley C 2011 *All the Fish in the Sea: Maximum Sustainable Yield and the Failure of Fisheries Management* Chicago University Press, Chicago

Foster J B 2000 *Marx's Ecology. Materialism and Nature* Monthly Review Press, New York

Fressoz J-B 2007a Beck back in the 19th century: Towards a genealogy of risk society *History and Technology* 23(4) 333–50

Fressoz J-B 2007b The gas lighting controversy: Technological risk, expertise and regulation in 19th century Paris and London *Journal of Urban History* 33 729–55

Fressoz J-B 2009 Circonvenir les circumfusa *Revue d'histoire moderne et contemporaine* 56(4) 39–76

Fressoz J-B 2012 *L'apocalypse Joyeuse. Une histoire du risque technologique* Editions du Seuil, Paris

Fressoz J-B and Fabien L 2012 Modernity's frail climate: A climate history of environmental reflexivity *Critical Inquiry* 38 579–98

Fressoz J-B and Locher F 2012 Modernity's Frail Climate: A Climate History of Environmental Reflexivity *Critical Inquiry* 38(3) 579–98 Spring

Giddens A 1990 *The Consequences of Modernity* Polity Press, Cambridge

Grove A T 1995 *Green Imperialism: Colonial Expansion, Tropical Island Edens and the Origins of Environmentalism 1600–1860* Cambridge University Press, Cambridge

Grove A T 1996 The historical context: Before 1850, in Brandt J and Thornes J eds *Mediterranean Desertification and Land Use* Wiley, Chichester 13–28

Hays S P 1999 *Conservation and the Gospel of Efficiency: The Progressive Conservation Movement 1890–1920* University of Pittsburgh Press, Pittsburgh

Le Roux T 2011 *Le Laboratoire des Pollutions Industrielles Paris, 1770–1830* Albin Michel, Paris

Madureira N L 2012 The anxiety of abundance. William Stanley Jevons and Coal Scarcity in the 19th Century *Environment and History* 18 395–421

Martinez-Alier J 1987 *Ecological Economics: Energy, Environment and Society* Blackwell, Oxford

Massard-Guilbaud G 2010, Histoire de la Pollution Industrielle en France, 1789–1914 EHESS, Paris

Merchant C 1980 *The Death of Nature: Women, Ecology and the Scientific Revolution* Harper, San Francisco

Nogaret F 1795 *La Terre Est un Animal* Colson, Versailles

Patrin E M 1806 Remarques sur la diminution de la mer *Journal de physique* 60 316

Pomeranz K 2000 *The Great Divergence: China, Europe and the Making of the Modern World Economy* Princeton University Press, Princeton

Robinet J B 1766 *De la Nature* Volume 4 Van Harrevelt, Amsterdam

Schérer R 2001 *L'Écosophie de Charles Fourier* Anthropos, Paris

Sieferle R P 2001 *The Subterranean Forest: Energy Systems and the Industrial Revolution* White Horse Press, Cambridge

Simmons D 2006 Waste not, want not: Excrement and economy in 19th-century France *Representations* 96 73–98

Smil V 2001 *Enriching the Earth* MIT Press, Cambridge Mass.

Staufer C 1987 *Charles Darwin's Natural Selection* Cambridge University Press, Cambridge

Steffen W et al. 2011 The Anthropocene: From global change to planetary stewardship *AMBIO* 40 739–61

Thorsheim P 2006 *Inventing Pollution: Coal, Smoke and Culture in Britain Since 1800* Ohio University Press, Athens, Ohio

Warde P 2011 The invention of sustainability *Modern Intellectual History* 8 153–70

White G 1789 *A Natural History and Antiquities of Selborne* Bensley, London

Williams J 1806 *The Climate of Great Britain* Baldwin, London

Wise N 1990 Work and waste: Political economy and natural philosophy in 19th century Britain *History of Science* 27 221–60

Worster D 1977 *Nature's Economy: A History of Ecological Ideas* Cambridge University Press, Cambridge