Modernity's Frail Climate: A Climate History of Environmental Reflexivity

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The Anthropocene could be said to have started in the latter part of the eighteenth century, when analyses of air trapped in polar ice showed the beginning of growing global concentrations of carbon dioxide and methane. This date also happens to coincide with James Watt's design of the steam engine in 1784.

—Paul Crutzen, "Geology of Mankind"

Paul Crutzen could also have referred to another—more disconcerting—coincidence, namely, the publication of Georges-Louis Leclerc de Buffon's *Epoques de la nature* in 1778. Just as humanity was becoming a geological force, Buffon explained that "the entire face of the Earth now bears the imprint of man's power." And this influence is even being exerted upon the climate as, 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."[1]

So humanity was helping to dictate the climate, which was becoming a highly political subject at the beginning of the nineteenth century. At that time, the issue of deforestation in particular transformed Buffon's demiurgical optimism into climatic angst. In 1821, the French minister for the interior sent out a strange circular to all prefects placed under his authority: "Gentlemen, for the past number of years, France appears to have been increasingly subject to a marked cooling of the atmosphere, abrupt changes in the seasons and hurricanes, partially attributable to deforestation of our mountains and land clearing. . . . But these are not irremediable

1. Georges-Louis Leclerc de Buffon, *Époques de la nature,* in *Histoire naturelle, générale, et particulière*, 5 vols. (Paris, 1778), 5:244.

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problems."[2] The minister ordered his prefects to conduct a survey of climate modification in their *département*.

This concern was actually widespread. After the Tambora volcanic eruption in April 1815 that released an enormous amount of dust in the atmosphere, Europe experienced a series of anomalous seasons and bad harvests.[3] In consequence, learned societies in France, Britain, Switzerland, and the Netherlands fostered research on climate change pointing to the possibility of its anthropogenic origin.

Our surprise when considering these climatic worries today stems from our poor knowledge of the environmental reflexivity of modern societies, that is, their complex, historically determined ways—very different from our own—of conceiving of the consequences of human actions on the environment. Such climatic worries were not a premonition (the feared climate change is not the contemporary global climate change) or especially unusual for the time.

We believe that a historical understanding of past environmental discourses is essential for contemporary social and green theory because the dominant narratives used to reflect upon the contemporary environmental crisis are too simple. There is an assumption shared by most postmodern thinkers today that for about two generations we have been experiencing a complete transformation of our relationship with the environment. After three centuries of frenetic modernism, we entered, at last, an enlightened era of environmental awareness. Landmark writers of social theory have coined new labels to name our epoch and express its radical novelty: risk society (as opposed to industrial society), reflexive modernization, second modernization, or high modernity, while philos-

2. Joseph-Jérôme Siméon, memo, 25 Apr. 1821, box 7M953, Archives départementales de l'Hérault, Montpellier.

3. See *The Year without a Summer? World Climate in 1816*, ed. Charles R. Harrington (Ottawa, 1992).

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ophers have reflected on the recent transformation of the nature of human action.[4]

Using a somewhat simplistic vision of the past so as to emphasize our own excellence and reflexivity is problematic in a number of respects. By virtually denying the environmental awareness of past societies, it depoliticizes the long-term history of environmental deterioration while, by stressing the recent reflexivity as an intrinsic characteristic of our contemporary societies, such narratives tend to treat ecological concerns as a given and disregard the conflicts that have actually driven them.

This essay will argue, on the contrary, that we entered the Anthropocene Age not in a blind modernist geist but saturated with multifaceted reflections and profound worries over human impacts on the climate. So we wish to challenge the theses whereby the contemporary period represents a turning point in a new modernity and, namely, (1) that we display unprecedented reflexivity with regard to the environmental consequences of human action and its boomerang effects and (2) that our ancestors transformed the world in a kind of joyful apocalypse without exercising due care, blinded by their faith in progress and their belief in the regenerative capacity of nature.

We think that a great part of the misunderstanding comes from the historical transformation of categories. To understand the environmental reflexivity of eighteenth- and nineteenth-century societies, we need to shake off our innate/acquired, body/environment, living/inert, or nature/society dichotomy-based classifications to think our way into a now-defunct epistemological realm known as climate theory where technique, political form, environment, and bodies all overlapped. For more than a century, from the mid-eighteenth century to the last thirty years of the nineteenth century, Western societies conceived of their relationship to the environment and their responsibility for the transformation of both nature and their own way of life in terms of the climate.

We propose a genealogy of climate as a category of environmental and political action. Our point is not simply to present early modern societies as environmentally aware. Climate theories were used in a variety of contexts: to promote the transformation of nature for human benefits, to qualify spaces and segregate races, to govern populations, and sometimes to denounce environmental transformation. Even if the climate of 1800

4. See Ulrich Beck, *Risk Society: Towards a New Modernity*, trans. Mark Ritter (London, 1992); Anthony Giddens, *Modernity and Self Identity: Self and Society in the Late Modern Age* (Stanford, Calif., 1991); Niklas Luhmann, *Risk: A Sociological Theory*, trans. Rhodes Barrett (New York, 1993); and Hans Jonas, *The Imperative of Responsibility: In Search of an Ethics for the Technological Age*, trans. Jonas and David Herr (Chicago, 1984).

and of 2000 has a different set of meanings and political implications, that notion evolved continuously in relation to the question of human agency upon nature.

The Malleable Climate of Biopolitics

Ever since Ptolomy's *Geography,* climate was traditionally defined by latitudinal position on the globe. It was both a given and an underlying factor in explaining cultural, racial, and political differences.[5] During the seventeenth century, climate acquired a certain pliability. Although it continued to be partially determined by place on the globe, learned discourse—mainly in meteorology and medicine—began to focus on the innumerable local variations in climate and on the role of human actions in its improvement or deterioration.

In a nutshell, we moved from climate conceived of as a geodetic or geographical position, to climate as seen as a series of dynamic processes that together produce the characteristics of a place: precipitation, pressure, winds, emanations, topography, soil, water, vegetation, light, smoke, and so on. This is an essential shift as human activity could then be conceived of as one of many processes among myriad causes. This notion of climate attributed a history to nature in which man played a role.[6]

This transformation was partly linked to the biopolitical projects of Enlightenment era monarchs. According to Hippocratic doctrine, climate had a determining influence on the health of the population. Consequently, because it could be altered at will, governments intended to use climate to improve both the number and the quality of their populations. In 1770, Abbé Richard explained that his *Histoire naturelle de l'air et des météores* "was not merely a speculative study" but "*useful in the broad scheme of governing men.*"[7] The link between climate and biopolitics was especially clear in France. In 1776, the monarchy established a new academic institution, the Société Royale de Médecine, to study the links among climates, epidemics, and temperaments and to guide its medico-environmental policies.

Rational transformation of climates was also a hot topic during the Consulate and the Empire periods. Diamantinos Coray in his 1800 commentary of the Hypocratic treatises, *Des airs, des eaux, et des lieux*, stressed

5. See Clarence J. Glacken, *Traces on the Rhodian Shore: Nature and Culture in Western Thought from Ancient Times to the End of the Eighteenth Century* (Berkeley, 1967).

6. See Jan Golinski, *British Weather and the Climate of Enlightenment* (Chicago, 2010), pp. 170–202.

7. Abbé Jérôme Richard, *Histoire naturelle de l'air et des météores*, 10 vols. (Paris, 1770), 1:2; our emphasis.

that this work "merited close attention from modern legislators."[8] Eusèbe de Salverte—doctor, revolutionary, and later a deputy who was close to the group known as the Ideologues[9]—went farthest in describing this project of climate and human engineering. In his work *Des rapports de la médecine avec la politique* (1806), he listed the medical benefits of the Napoleonic Empire. Because the territory that needed to be controlled covered a number of climates and peoples, "transmigration" could be used to find the best climatic fit for the different populations. The government's new-found authority could also be used for crossbreeding in order to optimize racial selection. And it could also use major works projects (draining marshes, planting forests, clearing uncultivated land) to improve the "physical constitution of the climate" and—once again—that of populations.[10]

Deterioration of Forests and Climate Change

But the demiurgical optimism borne out by these projects could also be turned inside out. Manmade climates represented a borderline case in attempts to control nature. As climate is composed of a series of heterogeneous interacting processes, transforming the climate is always an uncertain business, and ostensibly benign environmental changes could have dire consequences. For example, according to Abbé Richard, an epidemic in the Dutch Mollucan Islands had been caused by the destruction of clove plants whose aromatic particles purified the putrid air from a volcano.[11] So while man's actions may enhance climates and populations, it can also lead to catastrophe.

This contention was illustrated in the eighteenth-century insular colonial world. From the 1760s on, the environmental consequences of the plantation economy began to become apparent in the French (Mauritius) and British (Saint-Helena, Grenada, Barbados) insular colonies.[12] Drawing upon the theories of Theophrastus of Eresus (Aristotle's successor as head of the Lyceum), in which trees have a significant bearing on precipitation through transpiration and restoring water to the atmosphere through their pores, the colonial elite began to worry about the decline in the rains linked to land clearing. And these concerns were taken up back home; when Pierre Poivre was appointed commissaire-intendant of Mauritius in 1766,

8. Diamantinos Coray, *Traité d'Hippocrate, des airs, des eaux, et des lieux* (Paris, 1800), p. xlv.

9. This group, which included Pierre Cabanis, Jean Volney, and Constantin-François Antoine Destutt de Tracy, wished to promote a general science of ideas underpinned by materialist considerations.

10. Eusèbe de Salverte, *Des rapports de la medicine à la politique* (Paris, 1806), p. 11.

11. See Richard, *Histoire naturelle de l'air et des météores*, 2:412.

12. See Richard Grove, *Green Imperialism: Colonial Expansion, Tropical Islands, Edens, and the Origins of Environmentalism, 1600–1860* (Cambridge, 1995).

his brief included restoring rainfall on the island through forest conservation. In the late eighteenth century, the East India Company voiced similar worries for Saint Helena.

In Europe, the effects of deforestation and agriculture on the climate had long been seen as beneficial. In his *Époques de la nature*, Buffon made a favorable comparison between the European climate—milder thanks to centuries of human presence—and the ruder American climate. In North America, it was hoped that settlement and cultivation were civilizing the climate, turning it into a temperate, European one. Thomas Jefferson even called for a network of weather observers to demonstrate the good effects of deforestation on climate.[13]

Because it was linked with agriculture and deforestation, climate change was a politically laden topic. In England for instance, it could be used to discuss the consequences of the enclosures. In 1806, the horticulturist John Williams explained that the rainy and cold summers that had been prevalent for the last thirty years were the result of an increased evaporating surface of the country that was in turn caused by the replacement of agriculture by more lucrative pasturage and the extensive lattice of hawthorn fences that had been planted for that purpose.[14]

In France, deforestation began to be of climatic concern from the 1790s in tandem with general criticisms of the decline in French forests. In the wake of the revolution, these were undergoing profound changes in both their ownership and usage. The expropriation of the clergy and émigrés, the selling off of national assets, and the carving up of commonly held land resulted in plot division and transfers of wooded surfaces that benefited the bourgeoisie and certain types of farmers. The water and forest jurisdiction, which was a symbol of absolutism, was scrapped, and the exploitation of privately owned forests was deregulated.

This postrevolutionary change turned the climate into an eminently political topic. The peasants of year 2 of the Republic who had supposedly chopped and pillaged the noble timber were blamed for every meteorological incident. During the drought of the summer of 1800, a number of articles describing doomsday scenarios were published in *Moniteur Universel.* Antoine-Alexis Cadet de Vaux, a renowned pharmacist and agronomist explained: "We are plagued by drought and science says, we must not accuse nature but man who, by altering the surface of the earth has

13. See Golinski, *British Weather and the Climate of Enlightenment,* p. 197, and James Rodger Fleming, *Historical Perspectives on Climate Change* (New York, 1998), pp. 21–32.

14. See John Williams, *The Climate of Great Britain* (London, 1806), and Vladimir Jankovic, *Reading the Skies: A Cultural History of the English Weather, 1650–1820* (Chicago, 2000), p. 1.

changed the course of the atmosphere and thence the influence of the seasons."[15]

It must be underlined that the climatic impact of deforestation could be considered on a planetary scale. One development of particular importance in this respect was the work of François-Antoine Rauch, a French civil engineer active in the first quarter of the nineteenth century. His analysis focused on what he called the natural economy of water, that is, the global circulation of water that evaporates from the soil, transforms into clouds, and thereafter supplies oceans or returns to trees as rain. Rauch considered the destruction of forests a catastrophic interference in this natural and providential order. Many phenomena ranging from draughts, floods, and bad seasons in temperate zones to the abnormal growth of polar ice caps were caused by human tinkering with nature. These views were quite popular in France during the Restoration; Rauch wrote several articles, published a book, and even founded a periodical (*Les Annales Européennes*) to denounce the degradation of French and European forests and its impact on climate.[16]

The governments of the Restoration period, for their part, accused the revolution of having snatched the forests away from their traditional, legitimate owners and delivering them into the hands of the bourgeoisie, who were incapable of the long-term vision of land management that was the preserve of the aristocracy. The aforementioned 1821 climate survey took place against this backdrop; in the wake of the frightful winter of 1820–21, the minister of the interior quizzed the prefects on the disturbances to the "meteorological system" linked to deforestation in their *départments*.[17]

The climate debate, which rumbled along to the tune of extreme meteorological events, was again wheeled out when forestry policy was discussed at the Assemblée Nationale. During the period of the July Monarchy, there were skirmishes between proponents and opponents of administrative authorizations for land clearance (a measure taken in 1803 to protect French forests). On 27 February 1836, when a deputy submitted draft legislation proposing to scrap the government authorization, the astronomer François Arago improvised a reply describing the catastrophic consequences of land clearance that included cooling of the atmosphere, hailstones, flooding, and so on. He added, "I do not claim this to be certain, but I do say that it is possible and that a serious examination is war-

15. Antoine-Alexis Cadet de Vaux, "Observation sur la sécheresse actuelle, ses causes, et les moyens de prévenir la progression de ce fléau," *Moniteur Universel,* 26 Aug. 1800, n.p.

16. See François-Antoine Rauch, *Régénération de la nature végétale,* 2 vols. (Paris, 1818) and *Annales européennes de physique végétale et d'économie publique,* 3 vols. (Paris, 1821–22).

17. Siméon, memo.

ranted."[18] A parliamentary commission was set up on Arago's recommendation to enquire into climate change; however two years later before the Assemblée Nationale he had to recognize science's inability to tackle the question.

So, while climate change became a hot political topic in the wake of the revolution, academic science found it very difficult to handle because it was far removed from the experimental and theoretical programs that predominated in the contemporary physical sciences. Scientists like Arago who had been enlisted as climate experts were loath to provide clear answers and pointed to the huge uncertainties involved by this kind of research: How do we define climate change? How can we distinguish epiphenomena from long-term trends? How is it possible to study periods for which no meteorological observations are available? While scientists and experts favored measurement and precision as gauges of objectivity, governments and public opinion were pressuring them into studying an object that was difficult to analyze in such terms.

The first serious advances in historical climatology took place in this specific context. Aiming to answer politically pressing questions about climate change, scientists and erudite scholars tried to use the new science of plant geography that Alexandre von Humboldt and his followers had founded.[19] Knowing the quantitative laws ruling plant distribution as a function of temperature, they worked at reconstituting historical vegetation data and at inferring conclusions concerning the climates of the last two thousand years. Arago was one of the chief initiators of this approach. For the very first time, meteorologists started to collect and use the dates of grape harvests to reconstitute past climates. What will become a scientific discipline per se, historical climatology was born out of concerns over the deterioration of forests and its related climatic impact.

Seen through the prism of forest and climatic deterioration, humanity was perceived as a planetary force and the planet as a fragile being to care about. In 1822, Charles Fourier drafted a text entitled "Détérioration matérielle de la planète."[20] Based on the premise of a disruption to the climate due to land clearance, he concluded that there had been a "decline in the health of the planet" ("DM," p. 404). The root of the problem is social.

18. François Arago, "De l'influence du déboisement sur le climat," *Oeuvres complètes*, 12 vols. (Paris, 1859), 12:432.

19. See Alexandre von Humboldt, *Essai sur la géographie des plantes* (Paris, 1805) and *Fragmens de géologie et de climatologie asiatiques,* 2 vols. (Paris, 1831).

20. See Charles Fourier, "Détérioration matérielle de la planète," *La Phalange* 2 (1847): 401–40, 498–536; hereafter abbreviated "DM." For a vision of the Earth as a living being that man risks killing, see Eugène Huzar, *La Fin du monde par la science* (Paris, 1855).

Economic motives and rampant individualism had led to land clearance: "climatic disorder is a vice inherent to civilized cultures that disrupts everything due to the battle between individual and the collective interest" ("DM," p. 430). In Fourier's view, all attempts to mend contemporary individualist society were doomed to failure, as borne out by successive, inane forestry legislation. The only solution to planetary ills was revolution: "we need to get away from civilization" ("DM," p. 435).

Climatic Colonialism and Orientalism

Aside from the whole forestry question, the idea of climates produced by human enterprises provided Western societies with a means of analyzing two key nineteenth-century historical processes, namely, the Industrial Revolution and colonial expansion. The most encompassing justification of both industrialization and its attendant environmental damage and colonialism was based on a form of climatic orientalism: a comparison between industrial and oriental climates was used to project an image of a relatively clean, wholesome, industrial Europe and a barbarous, dangerous, outside world.

Indeed, colonialism was both conceived of and vaunted as a cleansing, climatic rehabilitation process that would save the European physique from the same sort of deterioration as that being suffered by indigenous peoples. European racial superiority was indirectly bound up with climate theories; Europeans had distinguished themselves by their ability to manage their environments and climates effectively, thus preserving or even producing their physical qualities.

After the capture of Algiers in 1830 concerns about the potentially deleterious effects of oriental climates on colonialists increased dramatically. In the view of hygienists specialized in medical geography, the overriding risk was that Europeans who settled in Africa or Asia would go native. Mortality statistics for the colonial armies were none too encouraging. They tended to prove that man was not cosmopolitan in nature and could not really adapt to climates that were too different from his place of racial origin unless, in the words of the hygienist Jean-Christian Boudin, he turned "Hottentot in Southern Africa and Eskimo in Antartica." "But," he added, "if this is what acclimatization entails, the price is a little too high."[21]

Luckily, insalubrity was not inherent to North African climates but was deemed to be a historical artefact and the unfortunate legacy of the oriental barbary and Islamic fatalism that had never been capable of managing environments effectively. The problem with the "oriental" was that he had

21. Jean-Christian Boudin, "Recherches sur l'acclimatement des races humaines sur divers points du globe," *Annales d'hygiène publique et de médecine légale* 13, ser. 2 (1860): 310.

supposedly contributed to his own degeneration by his incapacity to control nature. The Egyptians under Mamluk domination were cited as a classic example in medical literature. In 1826, in his inaugural lecture as professor of hygiene at the medicine faculty of Montpellier, Jean-Baptiste Bérard explained: "Egypt was formerly one of the cleanest, most fertile and densely populated regions of antiquity. But having being subjected to the ignorance and barbarism of Islam, it became one of the most insalubrious places in the modern world. Through Turkish negligence, the Nile became a source of plague that infects or threatens the rest of the world."[22] The colonialist has a duty to amend these deleterious climates through his agricultural labor as well as by draining marshes and reforestation.[23] As another hygienist put it "colonizing is sanitizing."[24]

Because Algeria was a settlement colony, it hosted the greatest number of climate correction projects. In 1864, the Société Climatologique d'Alger was established and tasked with demonstrating that the North African climate was basically healthy and that a number of extremely harmful (marshy) localities could be improved. The secretary of the society, Émile Bertherand, launched a campaign to replant entire plains and lauded the virtues of the eucalyptus tree in particular in banishing miasma. On his advice, a farmer from the Mitidja area planted twenty thousand trees in clusters "so as to form a veritable barrier against emanations coming up from the plain," and in 1876 Bertherand estimated that over two million eucalyptus trees had been planted in Algeria in just ten years.[25]

In 1874, in a similar climate-engineering vein, the military officer and colonialist François Élie Roudaire proposed flooding the *chotts* of the Sahara by digging a canal to the Mediterranean. The objective was to boost agriculture. Roudaire, who put forward the climatic change noticed after the Suez Canal, envisioned for the whole of Algeria a more temperate climate and regular precipitations. The project was part of the larger colonial "regeneration mission" as an Algerian inland sea was supposed to exist during antiquity.[26]

22. Jean-Baptiste Bérard, *Discours sur les améliorations progressives de la santé publique, par l'influence de la civilisation* (Paris, 1826), p. 24.

23. Concerning the forestation of territories never previously planted, see Diana K. Davis, *Resurrecting the Granary of Rome: Environmental History and French Colonial Expansion in North Africa* (Athens, Ohio, 2007).

24. Jean-Noël Perier, "De l'acclimatement en Algérie," *Annales d'Hygiène Publique et de Médecine Légale* 33 (1845): 40–41.

25. Émile Bertherand, *L'Eucalyptus du point de vue de l'hygiène en Algérie* (Algiers, 1876), p. 17.

26. See *Travaux de la commission supérieure pour l'examen de projet de mer intérieure dans le sud de l'Algérie et de la Tunisie* (Paris, 1882), p. 418, and François Élie Roudaire, "Une Mer intérieure en Algérie," *Revue des Deux Mondes* 3 (May–June 1874): 323–50.

Industrial Climates

At the same time, artificial modification of the climate was playing a key role in interpreting the effects of the Industrial Revolution. Workshop and factory environments interested doctors from a very early stage; in the climatic medicine paradigm, craftsmen were much-coveted research objects because the vapors that constantly surrounded them produced the artificial microclimates that explained their bodily transformations. Bernardino Ramazzini's treatise *De morbus artificium* (1699), often somewhat anachronistically presented as the founding act of professional medicine, was primarily an attempt to conceive of workshops as medical microclimates. The (supposed) resistance of certain craftsmen to epidemics also provided case studies for analyzing phenomena of contagion. In a query sent to its correspondents in 1776, the Société Royale de Médecine asked whether craftsmen's practices "have had any influence on current epidemics."[27]

In the following century, questions over the declining health of industrial and urban populations became more widespread. The problem of the industrial environment was couched in terms of the production of human races. In 1857, the French hygienist Bénédict Augustin Morel developed a grand theory of degeneracy. He drew on Buffon and applied the idea of gradual climate-based transformations of the human species to the new climate created by the industrial society. "The whole planet has become man's domain," he wrote. But he wondered if "this action on natural elements does not transform humankind in return." In order to overcome the dangers inherent in nature, man has had to create an even more dangerous "artificial nature" that subjects the body to new sources of degeneration.[28]

On the other hand, viewing the factory in terms of climate also made it possible to euphemize workers' ailments as a sort of acclimatization process. In mid-nineteenth-century hygienist research, workshops were conceived of as a colonial microclimate encysted within the metropolitan climate. In a report on tobacco factories, François Mêlier considered the worker as analogous to the colonialist insofar as "the position of a worker entering a workshop for the first time has something in common with the traveler transported to new and different horizons. Like the traveler he must contend with other elements and withstand all of the challenges and modifications of a kind of acclimatization."[29] When discussing phospho-

27. Session of 17 December 1776; cited in *Journal de Paris*, 22 Oct. 1778.

28. Bénédict Augustin Morel, *Traité des dégénérescences physiques, intellectuelles, et morales de l'espèce humaine* (Paris, 1857), p. 50.

29. François Mêlier, "De la santé des ouvriers employés dans les manufactures de tabac, rapport lu à l'Académie Royale de Médecine, 22 avril 1845," *Annales d'hygiène publique et de médecine légale* 34 (1845): 242.

rous factories (among the most harmful of all), the hygienist Alphonse Dupasquier explained that in spite of a horrible first impression, "workers quickly get used to them, become *acclimatised* and work in the midst of all these emanations without being unduly worried, as if they were working in the purest of atmospheres."[30]

As well as advancing these reassuring theories about acclimatization, hygienists highlighted the contrast between the relatively benign European climates (even factory-type microclimates) and the deleterious climates of Africa and the Orient. Through the production of vital statistics (mortality or sickness rates) on both metropolitan and colonial spaces, hygienists placed oriental, European, and industrial climates in the same statistical realm, thus helping to attenuate the relative harmfulness of the two latter ones. The vision of the Earth as an isomorphic medical space transformed by contrasting environmental management approaches made it possible to develop a reassuring narrative in relation to metropolises.

However, hygienism ultimately helped to undermine the climatic paradigm. In order to refute middle-class complaints about noxious factories (that drew on climate-based medicine), hygienists used risk comparisons to recast medical etiologies. Social conditions rather than climate became determinants of health. Hygienist social surveys gradually replaced medical topographies.[31] This shift from environmental to social etiologies helped forge a link between industrialization and progress in the field of health; in spite of their inconveniences, factories would bring about a prosperous, healthier population. A strong, vigorous population was now dependent on industrial prosperity rather than a healthy climate, and political economy gradually supplanted climate as the basis of biopolitics.

The Collapse of the Climatic Paradigm

The climatic paradigm began to lose ground in the second half of the nineteenth century. The Pasteur revolution, the root-and-branch renewal of heredity theory, changes in climatological knowledge, and the emergence of both the social sciences and marginalist economics all helped to undermine cause-and-effect relationships and produce new determinisms.

First, the Pasteur revolution invalidated climate-based etiologies. Doctors could now point to well-defined, microscopic culprits to explain dis-

30. Alphonse Dupasquier, "Mémoire relatif aux effets des émanations phosphorées sur les ouvriers employés dans les fabriques de phosphore," *Annales d'hygiène publique et de médecine légale* 36 (1846): 346; our emphasis.

31. See Fressoz, "Circonvenir les circumfusa : La Chimie, l'hygiénisme, et la libéralisation des choses environnantes," *Revue d'Histoire Moderne et Contemporaine* 56, no. 4 (2009): 39–78.

eases and no longer needed to resort to factors in the general environment. Health programs now focused on targeted disinfection and sterilization techniques and on prophylactic measures rooted in a careful analysis of social relations between humans and microorganisms.[32]

Second, heredity theory was totally recast. The Darwinian theory of the species, just like Lamarckian and neo-Lamarckian transformism, conceived of living matter as a universe in a perpetual state of change driven by the environment and the maintenance of acquired characteristics. Climate was allotted an important role among the environmental factors. Within the maze of nineteenth-century evolutionary theories, the theses of the French naturalist Isidore Geoffroy Saint-Hilaire focused most clearly on climate as a vector for redefining biological identities, and they provided the theoretical grounding sought after by the acclimatationist movement promoted by the French colonial elite from the 1840s on.[33] The purpose of transporting animals or plants from their natural milieux to the four corners of the empire was to create new living beings that would be fashioned by the soil and climate of their adopted country and to help exploit its potential.

However, beginning in the 1880s with the progressive focus of agronomics on the inventory and the production of so-called stable or pure lines of crops and with the rise in Mendelian genetics, the conception of biological identity became more rigid and shed its interactional component. This identity retreated into the heart of the cell before subsequently crystallizing, after World War II, around the DNA molecule metaphorized as the organism's code or map.[34] Climate was no longer the infinite fabric of life that had so fascinated the colonialists who attempted to harness it for their own ends.

The third blow to the climatic paradigm came in the form of developments in earth sciences. The late nineteenth and early twentieth centuries witnessed an unprecedented boom in scientific exploration in Alpine regions where the presence of gigantic, isolated rock masses—or erratic blocks—bewildered scientists.[35] In the early 1830s, a Swiss engineer named

32. See the use of "social relations" in Bruno Latour, *The Pasteurization of France,* trans. Alan Sheridan (Cambridge, Mass., 1988).

33. See Michael A. Osborne, "Acclimatizing the World: A History of the Paradigmatic Colonial Science," *Osiris* 15 (2000): 135–51.

34. See Phillip Thurtle, *The Emergence of Genetic Rationality: Space, Time, and Information in American Biological Science, 1870–1920* (Seattle, 2007), and Christophe Bonneuil, "Producing Identity, Industrializing Purity: Elements for a Cultural History of Genetics," in *Heredity in the Century of the Gene*, vol. 4 of *A Cultural History of Heredity,* ed. Staffan Müller-Wille and Hans-Jörg Rheinberger (Berlin, 2008), pp. 81–110.

35. See John Imbrie and Katherine Palmer Imbrie, *Ice Ages: Solving the Mystery* (Short

Ignace Venetz sought to explain this phenomenon through the existence of massive glaciers that had covered the alpine regions in the distant past.

The emergence of the glaciations theory is a context worth mentioning. As in the case of historical climatology, it was climate change that fostered Venetz's pathbreaking study.[36] In 1816 and 1817, as has been said, Europe experienced a series of bad seasons, including severe summer climate abnormalities in 1816, that caused subsistence crisis in Germany, Wales, Ireland, and Switzerland. In Switzerland, the 1816–17 famine led to one of the largest emigration waves in its history. Following these dramatic events, the Helvetian Society of Natural Sciences (Société Helvétique des Sciences Naturelles) issued an essay competition on a burning question: "Is it true that the High Alps of Switzerland have become harsher and colder for a series of years?"[37] If Ventez published his theory in 1833 only, the original memoir actually dates back to 1821 and had been penned for this prize.

The Venetz hypothesis gradually gained credence in the second half of the nineteenth century as geologists, physicians, and astronomers became interested in the ice ages that had turned Europe and North America into frozen deserts in the dim geological past. A new history of humanity also emerged as geological and paleontological chronologies began to be reevaluated; after suffering the hardships of intense cold, man had made the most of a thaw in the glacial offensive to lay out his fields and build his cities and empires. And we are still living in this interlude that the world's geologists christened the Holocene at a conference organized in 1885. Man now appeared to be trapped in immense cycles of geological time and caught up in climatic mechanisms so vast that they defeat any attempt to change this most basic element of man's environment.

The second half of the nineteenth century also witnessed the organization of descriptive climatology as a scientific discipline structured around the production and processing of reams of data that was mapped onto virtually immutable climatic regions with fixed contours and properties. The idea of man-made climatic change lost currency while there was a shift in the very notion of climate that came to have a more restrictive meaning

Hills, N.J., 1979), and Martin J. S. Rudwick, *Worlds before Adam: The Reconstruction of Geohistory in the Age of Reform* (Chicago, 2008).

36. See Ignace Venetz, "Mémoire sur les variations de la température dans les Alpes de la Suisse," *Mémoires de la Société Helvétique des Sciences Naturelles* 1, no. 2 (1833): 1–38.

37. Quoted in Jean Picot, *Statistique de la Suisse* (Geneva, 1819), p. 51.

and depict a certain regularity in mean atmospheric variables (temperature, hygrometry, and so on).[38]

Historians and geographers also took these conceptions on board; climate was no longer presented as an adaptable matrix of both human and natural changes but as a set framework that lays down the conditions for practicing agriculture or for maritime transport or housing. And this was exactly the role ascribed to it by the first two generations of the Annales school (that is, the generation of Lucien Febvre and Marc Bloch, followed by Ernest Labrousse and Fernand Braudel). Certainly, Braudel differed in his wish to take account of the historicity of environmental factors, but he also talks about the "almost timeless" character of these factors that limit society's development to a restricted set of historical possibilities.[39] Braudel's climate perspective does evolve but at the virtually undetectable pace of geological evolution studied on a historical scale, without human action having any impact whatsoever.[40]

The fourth nail in the climatic paradigm coffin was the birth of sociology and the marginalist revolution in economics. Temperament, constitution, character: the theoretical grammar of climate characterized spaces and those who lived there without distinction. It analyzed the natural and political aspects of places in the same way and treated social organizations as a continuation (and complexification) of plant and animal societies. In eighteenth-century philosophical and historical literature, climate was used to point out specific characteristics of political regimes and morals in accordance with their natural context.[41]

In the early nineteenth century, the climatic paradigm was still very influential for the emergence of social statistics. Adolphe Quetelet is an interesting transitional figure. If he is best remembered as a founder of social statistics (the average man, the Brussels international conferences of statistics), he actually endeavored to accumulate data for the physical and social sphere as a whole, and he was also a major driving force behind transnational networks for producing and collecting meteorological, geomagnetic, and seismic data.[42] For him, natural forces—and especially the climate—played a decisive role in the rates of births, deaths, murders, and

38. See Locher, *Le Savant et la tempête: Étudier l'atmosphère et prévoir le temps au XIX^e siècle* (Rennes, 2008).

39. Dipesh Chakrabarty, "The Climate of History: Four Theses," *Critical Inquiry* 35 (Winter 2009): 204.

40. Braudel wrote that "in climatic variations, a will *exogenous to man* asserts its role as well as its part in our habitual explanations" (Fernand Braudel, *La Méditerranée et le monde méditerranéen à l'époque de Philippe II*, 2 vols. [Paris, 1986], 1:24; our emphasis).

41. Naturally, we need to mention Charles Montesquieu, *De l'esprit des lois* (Geneva, 1748).

42. See Locher, "The Observatory, the Land-Based Ship, and the Crusades: Earth Sciences

suicides, alongside "disturbing forces" (he borrowed the words from astronomy) due to human conduct, history, and institutions.[43]

For Auguste Comte, on the contrary, climate needed to be dismissed. In his *Course in Positive Philosophy*, he coined the term *sociology* to distinguish his "social physics" from Montesquieu's climate theory and to stress the primacy of the law of the three estates over the influence of the climate.[44] Fifty years later, when using the question of suicide to construct an applicable model for his *Rules of the Sociological Method,* Émile Durkheim emphasized the break with the past by dismissing any possible "cosmic influences."[45] He also opposed the views of Quetelet and the proponents of the Italian school of criminology (Cesare Lombroso, Enrico Ferri, Enrico Morselli) that held that climate played a powerful role in activating the individual predispositions to violence. Durkheim's argument exemplifies the theoretical basis that seeks to replace climatic determinism with social mechanisms. According to him, more suicides do not occur during hot weather because the weather is finer but because the days are longer and social interaction more intense. Sociology emerged as a bulwark against climate, and the social sciences contributed in their manner to bringing down the climatic paradigm.

Beginning in the late nineteenth century, economics had a similarly destabilizing effect. Until the 1870s, the study of business cycles involved analyzing the price of a good in relation to a noneconomic factor. Climate played a key role in this process as the cyclicality of business cycles seemed to be tied to meteorological events, which were being forecast and analyzed with increasing precision all over the globe.[46] But three historical processes radically transformed economics and broke the climate link.

First, as demonstrated by Alex Preda, automatic pricing and price communication mechanisms accelerated the flow of financial information (the stock ticker first appeared in the New York Stock Exchange in 1867). Whereas price-fixing mechanisms previously led to monthly variations tied to political events, harvests, or the weather, prices now varied from hour to hour and they were soon to change by the minute. The major

in European Context, 1830–50," *British Journal for the History of Science* 40 (Dec. 2007): 491–504.

43. See Adolphe Quetelet, *Sur l'homme et le développement de ses facultés, ou Essai de physique sociale,* 2 vols. (Paris, 1835), esp. 1:16–21.

44. Auguste Comte, *Cours de philosophie positive*, 6 vols. (Paris, 1839), 4:252–53.

45. See Émile Durkheim, "Le Suicide et les facteurs cosmiques," *Le Suicide* (Paris, 1897).

46. See Thomas Tooke, *A History of Prices and of the State of the Circulation from 1793 to 1837* (London, 1838).

consequence of this transformation was that prices of commodities and equities now became temporal continuums that appeared to change autonomously, with no link to anything except themselves.[47]

Secondly, marginalist theories tended to separate the value of commodities from the circumstances of their production. Labor, capital, and soil productivity were no longer as important as the agencies of consumers and producers seeking to maximize their individual utility. This change allowed economic subjects to be treated separately from the circumstances that determined the productivity of natural and social systems. In the 1890s, the American economists Irving Fisher and Wesley Mitchell made a key contribution to this process by analyzing not only price changes in response to exogenous factors (the weather, sunspots, and so on) but the symmetrical relations between different prices, thus modeling the economy as a closed space.[48] External factors now merely interfere with and complicate systemic trends. Econometric tools developed from the 1920s modeled economics as an interdependent system of economic variables and the economy became an autonomous entity that could be monitored by scientific means.[49]

The last stage corresponded to the 1930s overproduction crisis and Keynesianism. Before Keynes, the notion of growth was linked to a material process of expansion, for example, boosting production of a commodity or opening up the economy to new resources or new territories. However, in the wake of the overproduction crisis, growth was reanalyzed not in material terms but as the intensification of all relationships that define the economy as an object. Ditching the gold standard in the 1930s (thus ending the idea that banknotes were equivalent to gold) and the invention of gross domestic product (GDP) for national accounting purposes completed the process of dematerializing economic thought.

These three processes helped give rise to a new notion: the economy, understood as all economic-type relations and nearly independent from politics, natural constraints, and climate. This autonomous object could thenceforth be construed as having indefinite growth potential, divorced from natural deterministic factors or physical limits.[50]

47. See Alex Preda, "Socio-Technical Agency in Financial Markets: The Case of the Stock Ticker," *Social Studies of Science* 36 (Oct. 2006): 753–82.

48. As Philip Mirowsky has demonstrated, this conceptual closure is based on a physics analogy, with the conceptualization of the economy as an oscillating mechanical system. See Philip Mirowsky, *More Heat Than Light: Economics as Social Physics, Physics as Nature's Economics* (Cambridge, 1989).

49. Daniel Breslau, "Economics Invents the Economy: Mathematics, Statistics, and Models in the Work of Irving Fisher and Wesley Mitchell," *Theory and Society* 32 (June 2003): 379–411.

50. See Timothy Mitchell, "Fixing the Economy," *Cultural Studies* 12, no. 1 (1998): 82–101.

Ice Ages, Cold War, and Global Warming

What historical process has paved the way for the reemergence of climate as a political issue over the past few decades? Of course, this reemergence is the product of heightened awareness that our way of life—underpinned by the massive use of fossil fuels—has a major impact on the world's climate through the discharge of enormous quantities of greenhouse gases into the atmosphere. This now-incontestable prognosis is substantiated by a theoretical and empirical corpus accumulated since the mid-nineteenth century.

From the 1850s to the Second World War, climate specialists were preoccupied primarily by ice ages. The underlying theses were numerous, but they all highlighted causes exogenous to human action: intermittent weakening of the sun's rays, the earth's passage through cold interstellar regions, a change in the earth's axis following major geological upheavals, and so on. Two theories in particular were much discussed: an *astronomical* theory attributing ice ages to plurimillennial changes in the earth's trajectory and an *atmospheric* theory pointing up natural changes in the earth's gaseous layers and their impact on temperatures.

Contemporary historians focusing on global climate change have often written a history of the precursors, in other words, those nineteenth-century scientists whose work has made it possible to document the greenhouse gas phenomenon and the role of carbon dioxide (CO_2). However John Tyndall, Svante Arrhenius, and Thomas Chamberlin had one sole objective in mind: to substantiate and illustrate the atmospheric theory of ice ages. In an oft-cited article, Arrhenius estimated that a doubling in concentration of CO_2 would push the earth's average temperature up by 5°C.[51] But he was not worried about the impact of man's actions on the climate. Rather, he was looking to understand the hot climates of the Tertiary period when elephants and rhinoceroses roamed as far as the poles.[52]

The basic knowledge that would underpin climate change theory can be found in the interstices of research into the ice ages carried out in the years

51. See John Tyndall, "On the Absorption and Radiation of Heat by Gases and Vapours, and on the Physical Connection of Radiation, Absorption, and Conduction," *Philosophical Transactions of the Royal Society of London* 151 (1861): 169–94 and 273–85; Svante Arrhenius, "On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground," *Philosophical Magazine* 41 (Apr. 1896): 237–76; and T. C. Chamberlin, "A Group of Hypotheses Bearing on Climatic Changes," *Journal of Geology* 5 (Oct.–Nov. 1897): 653–83.

52. See Arrhenius, "On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground," pp. 268–69. Contrary to what is often claimed, Arrhenius does not deal with the effects of human-induced CO_2 emissions in this article. He does mention them and the warming they could cause in Arrhenius, *Worlds in the Making: The Evolution of the Universe* (New York, 1908), p. 63.

before the Second World War. What first emerged as a working theory gradually gained currency in the 1950s, 1960s, and 1970s through a synergy of glacial climatology theories, advances in researching the processes of metabolization of CO_2 by the oceans, and early digital simulations of atmospheric circulation.[53] Much of this research was rooted in the efforts of the United States, which was in the midst of the cold war and had decided to elevate knowledge of the earth's physical environment (globe, oceans, and atmosphere) to a strategic objective. The planet needed to be mapped, sounded out, modeled, and controlled for the deployment of ballistic missiles and nuclear submarines, and climate change was taken particularly seriously due to its potential impact on the North Pole ice cap, the future battleground of World War Three. Scientists commissioned to predict the climate impact of a global nuclear conflict (the famous nuclear winter) also gained new knowledge of atmospheric mechanisms as well as a much better idea of the potential climatic effects of human actions.[54]

If the first warnings of climate change addressed to the US government were issued as early as 1947,[55] the question was not widely discussed until the last quarter of the century, when a consensus gradually developed in the scientific community concerning the human-induced component of climate change.[56] The issue barged its way into both the political and media arena as one of the main challenges facing humanity. After a long period out in the cold, climate was once again the focus of environmental reflexivity, albeit in a very different form.

Us and Them: Environmental Reflexivity and Modernity

Over the past few years, climate has once again become an object of philosophical inquiry. According to Peter Sloterdijk, as climate change fleshes out our conditions of existence, it is emblematic of a modernity in which what was previously in the background is made explicit.[57] Climate change also stresses the necessity for overtaking major features of the cultural mindsets of modernity, as the division between natural and human history.[58] For Bruno Latour, the entry of climate into the political arena is

53. See Spencer R. Weart, *The Discovery of Global Warming* (Cambridge, Mass., 2003).

54. See James Rodger Fleming, *Fixing the Sky: The Checkered History of Weather and Climate Control* (New York, 2010).

55. See Ronald E. Doel, "Constituting the Postwar Earth Sciences: The Military's Influence on the Environmental Sciences in the USA after 1945," *Social Studies of Science* 33 (Oct. 2003): 635–66.

56. See Naomi Oreskes, "Beyond the Ivory Tower: The Scientific Consensus on Climate Change," *Science,* 3 Dec. 2004, p. 1686 and "Erratum," *Science*, 21 Jan. 2005, p. 1.

57. See Peter Sloterdijk, *Sphären III – Schäume, Plurale Sphärologie* (Frankfurt, 2004).

58. See Chakrabarty, "The Climate of History."

the recognition that the "nonmoderns" have mingled nature and culture on a global scale and provides an opportunity for recalling modernity, defined as the great divide between nature and society or science and politics.[59]

Surprisingly, all these grand philosophical narratives seem to take for granted that the climatic question is entering our political and cultural arenas for the first time. However, throughout the eighteenth and nineteenth centuries, the climate topic provided a matrix for environmental reflexivity and was used to reflect upon people, objects, and processes—without subjecting them to the nature/society distinction—within a perspective that was attentive to their common future.

We need to bear in mind that deforestation was always seen as a break in the organic link between the tree and human society, that eighteenth- and nineteenth-century medical etiologies struck a balance between social and environmental events, and that organicist thought that conceives of the Earth as a living being persisted well into the nineteenth century. This history shows how environments and civil societies are intertwined in the cosmologies of modernity in an ongoing jumble of political and natural orders. This should warrant a revision of the vision of modernity underpinning contemporary discourse about global warming and its civilizational impacts.

Finally, we need to take on board the strange and disturbing fact that the modern destruction of environments has occurred not as if nature counted for nothing but, on the contrary, has occurred in a world of long-standing climatic theories that have earmarked environmental objects as the very things that produce humankind. Modern man, oblivious of the impact of his actions and blinded by his faith in progress and polarized vision of the world? Our postmodernity also has its own mythologies.

59. See Latour, *We Have Never Been Modern* (Cambridge, Mass., 1993) and "The Recall of Modernity: Anthropological Approaches," *Cultural Studies Review* 13 (Mar. 2007): 11–30.